

Integrating Personality Psychology into Economics

James Heckman
University of Chicago
American Bar Foundation
University College Dublin
Cowles Foundation, Yale University

with

Mathilde Almlund Tim Kautz
University of Chicago University of Chicago

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Major Question

What can economists take from and contribute to personality psychology?

What do we learn from personality psychology?

- 1 Personality traits predict many behaviors sometimes with the same strength as conventional cognitive traits.
- 2 Personality psychology considers a wider array of actions than are considered by economists—enlarges the economist's way to describe and model the world.
- 3 Cognition is one aspect of personality broadly defined.
- 4 Personality traits are not set in stone. They change over the life cycle. They are a possible avenue for intervention and policy.

How Economists Can Contribute to Personality Psychology

- 1 Personality psychologists lack precise models. Economics provides a clearer framework for recasting the field.
- 2 Economics now plays an important role in clarifying the concepts and empirical content of psychology.
- 3 More precise models reveal basic identification problems that plague measurement in psychology. This analysis shows that, at an empirical level, “cognitive” and “noncognitive” traits are not easily separated.
- 4 Personality psychologists typically present correlations not causal relationships.
- 5 Many contemporaneously measured relationships suffer from the problem of reverse causality.

- ⑥ Economists can apply their tools to define and estimate causal mechanisms and to understand the causes of effects.
- ⑦ Psychological measures have substantial measurement error.
- ⑧ Econometric tools account for measurement error, and doing so makes a difference.
- ⑨ Economists formulate and estimate mechanisms of investment—how traits can be changed for the better.

Challenges

- 1 Linking the traits of psychology with the preferences, constraints and expectation mechanisms of economics.
- 2 Developing rigorous methods for analyzing causal relationships in both fields.
- 3 Developing a common language and framework to promote interdisciplinary exchange.
- 4 Danger in assuming that basic questions of content and identification have been answered by psychologists at the level required for rigorous economic analysis.
- 5 In explaining outcomes, how important is the person? How important is the situation? How important is their interaction?

We draw on

“Personality Psychology and Economics.”

Mathilde Almlund, Angela Duckworth, James Heckman and Tim Kautz.

Forthcoming, *Handbook of the Economics of Education*,

E. Hanushek, S. Machin and L. Wössman (eds.).

Amsterdam: Elsevier, 2011.

- Denoted: ADHK
- Posted at the website for the conference.

A Brief History of Personality Psychology

- Alfred Binet, architect of the first modern intelligence test that became the Stanford-Binet IQ test, noted that performance in school

Binet [1916, p. 254]

"...admits of other things than intelligence; to succeed in his studies, one must have qualities which depend on attention, will, and character; for example a certain docility, a regularity of habits, and especially continuity of effort. A child, even if intelligent, will learn little in class if he never listens, if he spends his time in playing tricks, in giggling, is playing truant."

- Arthur Jensen, proponent of g , writes:

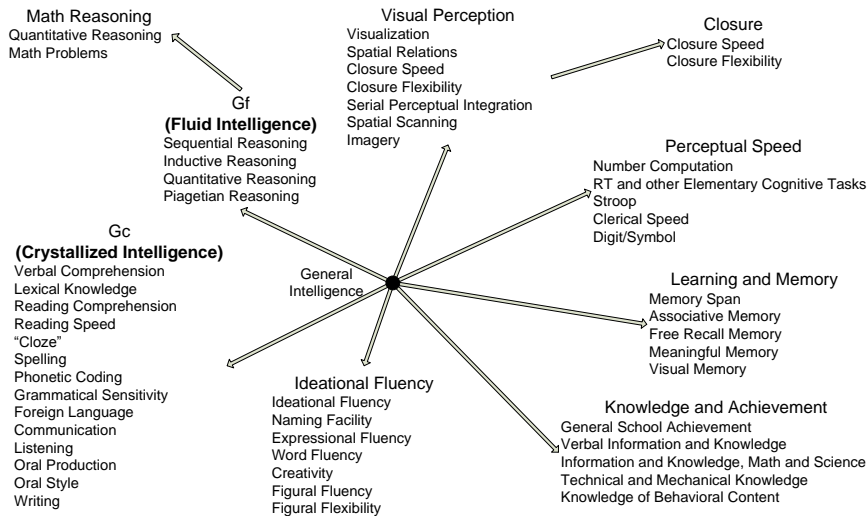
Jensen [1998, p. 575]

“What are the chief personality traits which, interacting with g , relate to individual differences in achievement and vocational success? The most universal personality trait is conscientiousness, that is, being responsible, dependable, caring, organized and persistent.”

Cognition: “g”

- “g” is a product of early Twentieth Century psychology.
- Validation is done using grades and other test scores.
- Rarely look at workplace productivity.
- Exceptions
 - a Personnel psychology
 - b AFQT and studies of achievement tests in economics
- Concept of “g” has been broadened even beyond subcomponents of “fluid” and “crystallized” intelligence.
- But still is at the center of a hierarchy of correlated traits.

Figure 1: An Hierarchical Scheme of General Intelligence and Its Components



Source: Recreated from Ackerman and Heggstad [1997], based on Carroll [1993].

Personality Traits

- Early pioneers used a lexical approach to define personality.
- Classify words that are used to describe people.
- Culminated in the “Big Five” based on factor analysis of measurements of personality.
- Extracted from a variety of measures—
 - a Observer reports
 - b Tests
 - c Measured productivity on the job
- No single “ g_p ” explains all traits.
- Correlations within clusters but not across clusters.

Table 1: The Big Five domains and Their Facets

Big Five Personality Factor	American Psychology Association Dictionary description	Facets (and correlated trait adjective)	Related Traits	Childhood Temperament Traits
Openness to Experience	“the tendency to be open to new aesthetic, cultural, or intellectual experiences”	Fantasy (imaginative) Aesthetic (artistic) Feelings (excitable) Actions (wide interests) Ideas (curious) Values (unconventional)	—	Sensory sensitivity Pleasure in low-intensity activities Curiosity
Conscientiousness	“the tendency to be organized, responsible, and hardworking”	Competence (efficient) Order (organized) Dutifulness (not careless) Achievement striving (ambitious) Self-discipline (not lazy) Deliberation (not impulsive)	Grit Perseverance Delay of gratification Impulse control Achievement striving Ambition Work ethic	Attention/(lack of) distractibility Effortful control Impulse control/delay of gratification Persistence Activity*

Table 1: The Big Five domains and Their Facets

Big Five Personality Factor	American Psychology Association Dictionary description	Facets (and correlated trait adjective)	Related Traits	Childhood Temperament Traits
Extraversion	“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”	Warmth (friendly) Gregariousness (sociable) Assertiveness (self-confident) Activity (energetic) Excitement seeking (adventurous) Positive emotions (enthusiastic)	—	Surgency Social dominance Social vitality Sensation seeking Shyness* Activity* Positive emotionality Sociability/affiliation
Agreeableness	“the tendency to act in a cooperative, unselfish manner”	Trust (forgiving) Straight-forwardness (not demanding) Altruism (warm) Compliance (not stubborn) Modesty (not show-off) Tender-mindedness (sympathetic)	Empathy Perspective taking Cooperation Competitiveness	Irritability* Aggressiveness Willfulness

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Big Five Personality Factor	American Psychology Association Dictionary description	Facets (and correlated trait adjective)	Related Traits	Childhood Temperament Traits
Neuroticism/ Emotional Stability	Emotional stability is “predictability and consistency in emotional reactions, with absence of rapid mood changes.” Neuroticism is “a chronic level of emotional instability and proneness to psychological distress.”	Anxiety (worrying) Hostility (irritable) Depression (not contented) Self-consciousness (shy) Impulsiveness (moody) Vulnerability to stress (not self-confident)	<div>Internal vs. External Locus of control Core self-evaluation</div> Self-esteem Self-efficacy Optimism Axis I psychopathologies (mental disorders) including depression and anxiety disorders	Fearfulness/behavioral inhibition Shyness* Irritability* Frustration (Lack of) soothability Sadness

Notes: Facets specified by the NEO-PI-R personality inventory (Costa and McCrae [1992b]). Trait adjectives in parentheses from the Adjective Check List (Gough and Heilbrun [1983]). * These temperament traits may be related to two Big Five factors. Source: Table adapted from John and Srivastava [1999].

- They are predictive of many outcomes.
- The Big Five are defined without reference to any context (i.e., situation).
- This practice gives rise to an identification problem.

The Person-Situation Debate

- Is variation across people in behavior a consequence of personal traits or of situations?
- Walter Mischel, *Personality and Assessment*

Mischel [1968, p. 146]

“... with the possible exception of intelligence, highly generalized behavioral consistencies have not been demonstrated, and the concept of personality traits as broad dispositions is thus untenable”

Ross and Nisbett [1991]

"Manipulations of the immediate social situation can overwhelm in importance the type of individual differences in personal traits or dispositions that people normally think of as being determinative of social behavior."

- Many behavioral economists hold a similar view and appeal to Mischel as a guiding influence.

Thaler [2008]

“The great contribution to psychology by Walter Mischel [...] is to show that there is no such thing as a stable personality trait.”

Personality Psychology After the Person-Situation Debate

- A rich body of correlational evidence shows that for many outcomes, measured personality traits are as predictive, and are sometimes more predictive, than standard measures of cognition, that traits are stable across situations, but situations also matter.
- Mounting evidence that behavior has a biological basis suggests that personality is an important determinant of behavior.
- The evidence from behavioral genetics shows that measured personality traits are as heritable as cognitive traits.
- Alterations in brain structure and function through accidents, disease and by experiments affect measured personality.

The Predictive Power of Personality Traits

- A growing body of evidence suggests that personality measures—especially those related to Conscientiousness, and, to a lesser extent, Neuroticism—predict a wide range of outcomes.
- The predictive power of any particular personality measure tends to be less than the predictive power of IQ but in some cases rivals it.

Difficulties in Synthesizing Studies of the Effects of Personality

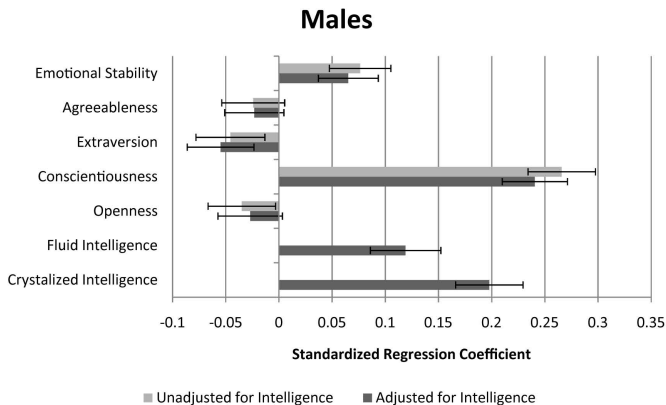
- ① Measures of personality and cognition differ among studies.
 - ② Different studies use different measures of predictive power.
 - ③ Many studies do not address the question of causality, i.e., does the measured trait cause (rather than just predict) the outcome?
- Few economists or psychologists working on the relationship between personality and outcomes address the issue of causality, and when they do so, it is usually by employing early measures of cognition and personality to predict later outcomes.
 - This practice trades an endogeneity problem with an errors in variables problem.

Main Findings from Predictive Analyses

- **Conscientiousness is the most predictive Big Five trait across many outcomes.**
 - Educational attainment, grades
 - Job performance across a range of occupational categories (predictive power of “g” decreases with job complexity)
 - Longevity
 - Criminality
- Neuroticism (and related *locus of control*)
 - Predicts schooling outcomes
 - Labor market search
- Other traits play roles at finer levels.

Educational Attainment and Achievement

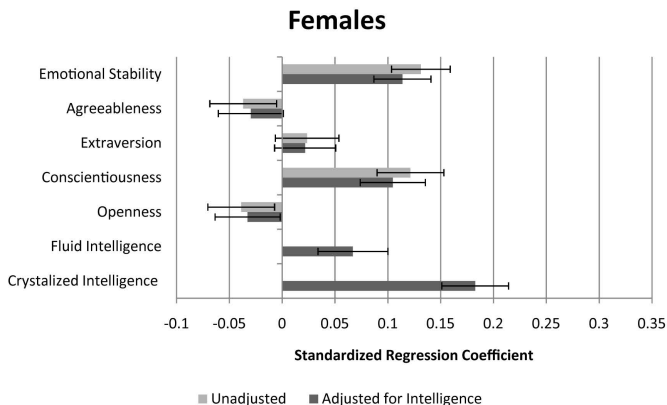
Figure 2: Association of the Big Five and Intelligence with Years of Schooling in GSOEP



Note: The figure displays standardized regression coefficients from multivariate of years of school attended on the Big Five and intelligence, controlling for age and age-squared. The bars represent standard errors. The Big Five coefficients are corrected for attenuation bias. The Big Five were measured in 2005. Years of schooling were measured in 2008. Intelligence was measured in 2006. The measures of intelligence were based on components of the Wechsler Adult Intelligence Scale (WAIS). The data is a representative sample of German adults between the ages of 21 and 94.

Source: German Socio-Economic Panel (GSOEP), waves 2004–2008, own calculations.

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GEDs

Figure 3: Distribution of Cognitive and Non-Cognitive Skills by Education Group

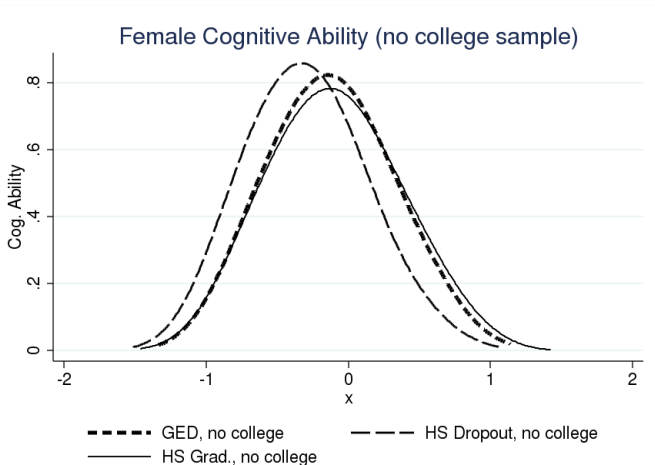
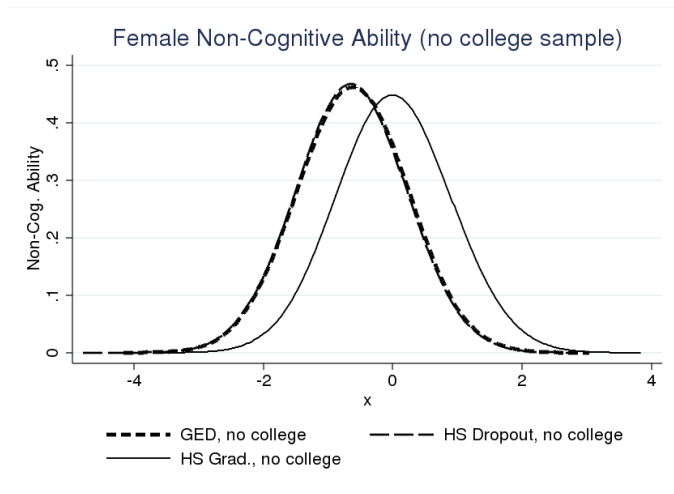
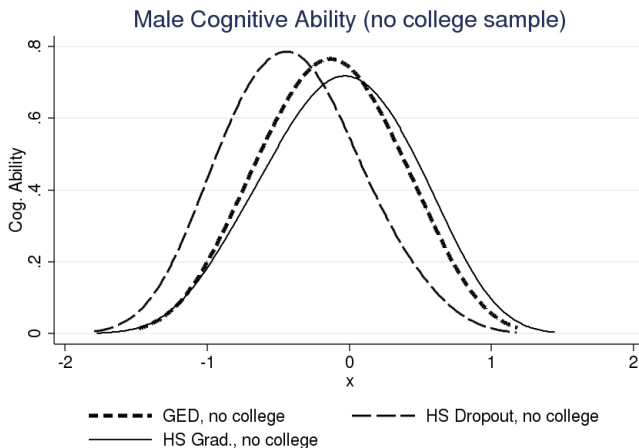


Figure 3: Distribution of Cognitive and Non-Cognitive Skills by Education Group



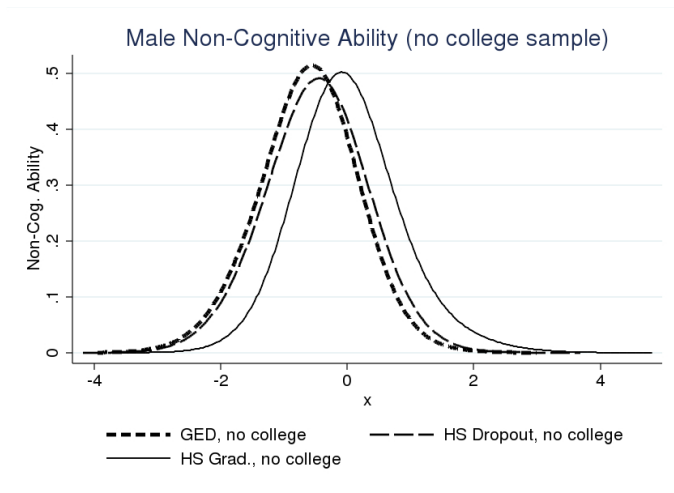
Source: Heckman, Humphries, Veramendi, and Urzua (2010).

Figure 3: Distribution of Cognitive and Non-Cognitive Skills by Education Group



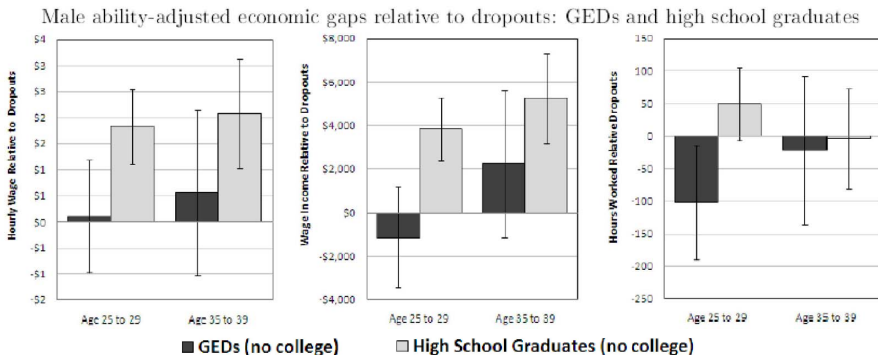
Source: Heckman, Humphries, Veramendi, and Urzua (2010).

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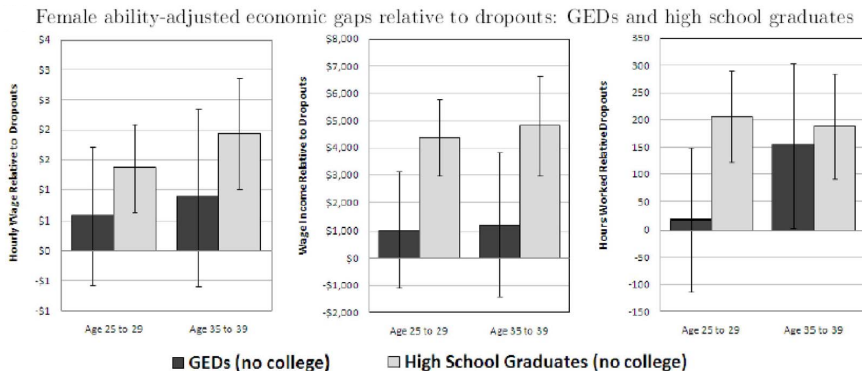
Source: Heckman, Humphries, Veramendi, and Urzua (2010).

Figure 4: Ability-Adjusted Economic Gaps Relative to Dropouts: GEDs and High School Graduates for Males



Source: Heckman, Humphries, and Mader (2010).

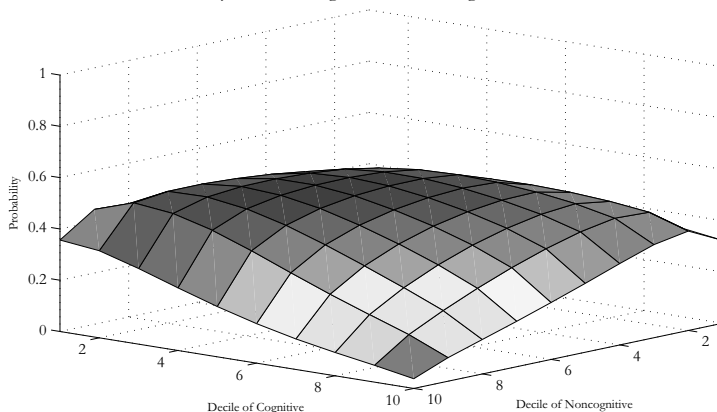
Figure 4: Ability-Adjusted Economic Gaps Relative to Dropouts: GEDs and High School Graduates for Females



Source: Heckman, Humphries, and Mader (2010).

Figure 5: Probability of Being a High School Graduate at Age 30 and Not Going on to Further Education, Males

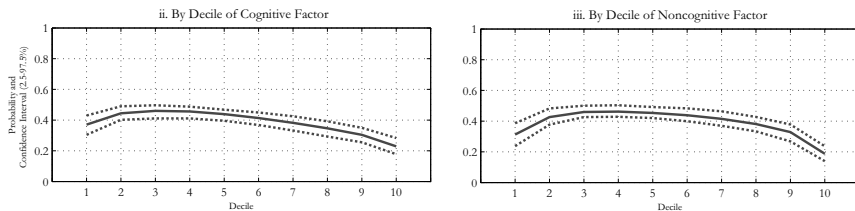
i. By Decile of Cognitive and Noncognitive Factors



Notes: The data are simulated from the estimates of the model and the NLSY79 sample. Higher deciles are associated with higher values of the variable. The confidence intervals are computed using bootstrapping (200 draws). Solid lines depict probability, and dashed lines, 2.5%-97.5% confidence intervals. The upper curve is the joint density. The two marginal curves (ii) and (iii) are evaluated at the mean of the trait not being varied.

Source: Heckman, Stixrud and Urzua [2006, Figure 19].

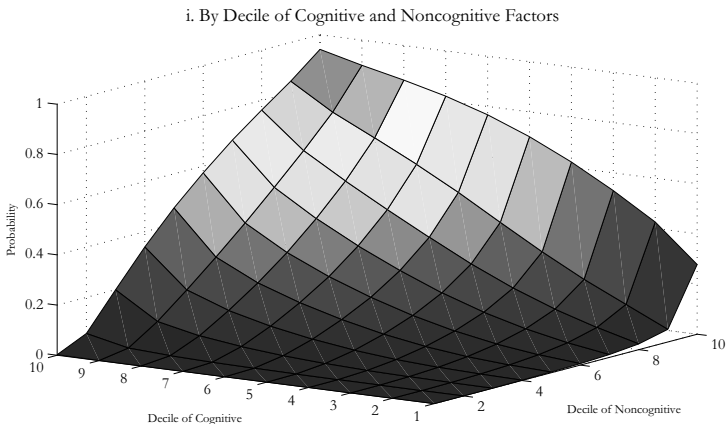
Figure 5: Probability of Being a High School Graduate at Age 30 and Not Going on to Further Education, Males



Notes: The data are simulated from the estimates of the model and the NLSY79 sample. Higher deciles are associated with higher values of the variable. The confidence intervals are computed using bootstrapping (200 draws). Solid lines depict probability, and dashed lines, 2.5%-97.5% confidence intervals. The upper curve is the joint density. The two marginal curves (ii) and (iii) are evaluated at the mean of the trait not being varied.

Source: Heckman, Stixrud and Urzua [2006, Figure 19].

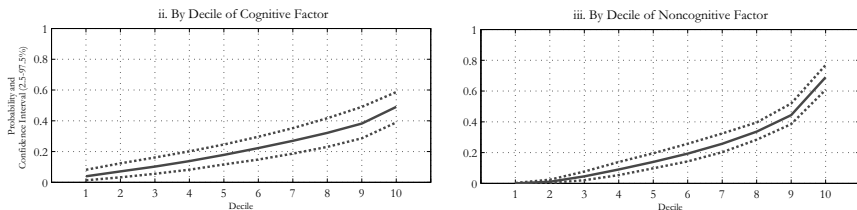
Figure 6: Probability of Being a 4-year-college Graduate or Higher at Age 30, Males



Notes: The data are simulated from the estimates of the model and the NLSY79 sample. Higher deciles are associated with higher values of the variable. The confidence intervals are computed using bootstrapping (200 draws). Solid lines depict probability, and dashed lines, 2.5%-97.5% confidence intervals. The upper curve is the joint density. The two marginal curves (ii) and (iii) are evaluated at the mean of the trait not being varied.

Source: Heckman, Stixrud and Urzua [2006, Figure 21].

Figure 6: Probability of Being a 4-year-college Graduate or Higher at Age 30, Males

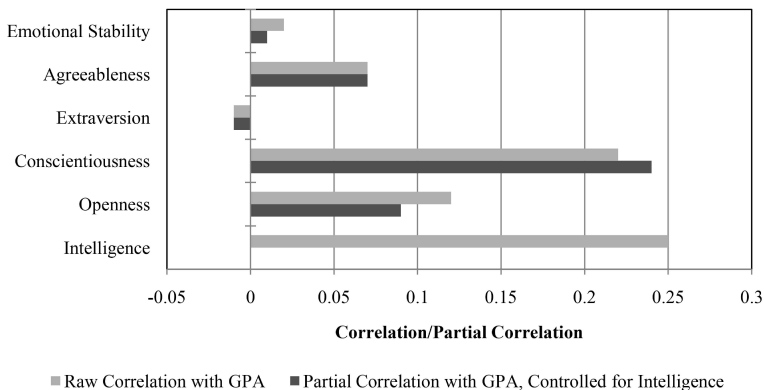


Notes: The data are simulated from the estimates of the model and the NLSY79 sample. Higher deciles are associated with higher values of the variable. The confidence intervals are computed using bootstrapping (200 draws). Solid lines depict probability, and dashed lines, 2.5%-97.5% confidence intervals. The upper curve is the joint density. The two marginal curves (ii) and (iii) are evaluated at the mean of the trait not being varied.

Source: Heckman, Stixrud and Urzua [2006, Figure 21].

Course Grades

Figure 7: Correlations of the Big Five and Intelligence with Course Grades

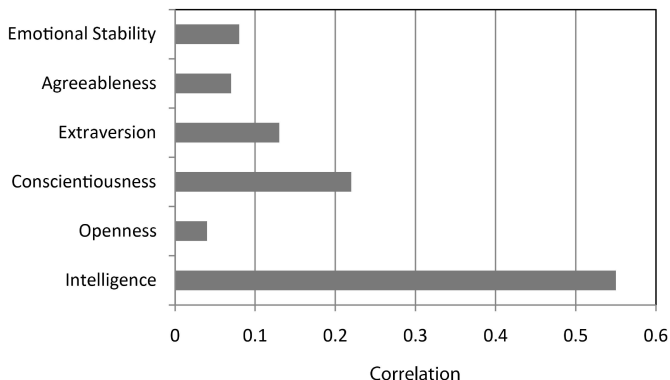


Notes: All correlations are significant at the 1% level. The correlations are corrected for scale reliability and come from a meta analysis representing a collection of studies representing samples of between $N=31,955$ to $N=70,926$, depending on the trait. The meta-analysis did not clearly specify when personality was measured relative to course grades.

Source: Poropat [2009].

Labor Market Outcomes

Figure 8: Associations with Job Performance

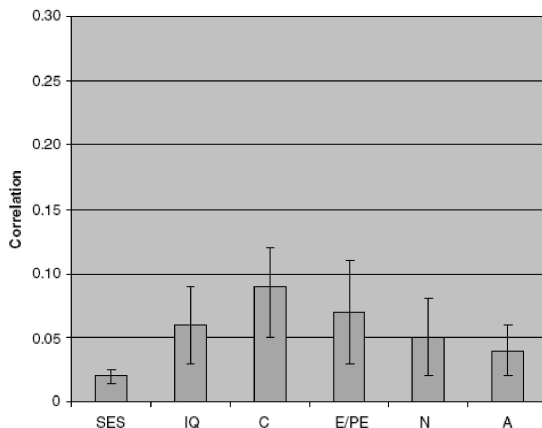


Notes: The values for personality are correlations that were corrected for sampling error, censoring, and measurement error. Job performance was based on performance ratings, productivity data and training proficiency. The authors do report the timing of the measurements of personality relative to job performance. Of the Big Five, the coefficient on Conscientiousness is the only one that is statistically significant with a lower bound on the 90% credibility value of 0.10. The value for IQ is a raw correlation.

Sources: The correlations reported for personality traits come from a meta-analysis conducted by Barrick and Mount [1991]. The correlation reported for IQ and job performance come from Schmidt and Hunter [2004].

Personality and Health

Figure 9: Correlations of Mortality with Personality, IQ, and Socioeconomic Status (SES)

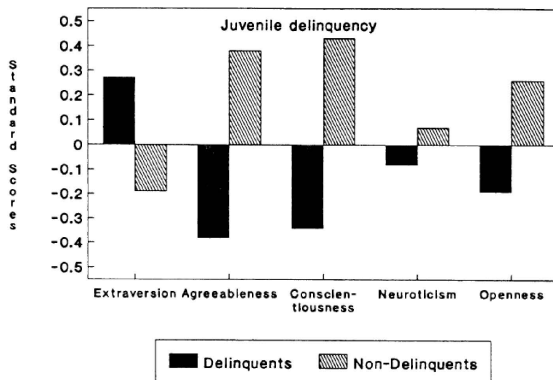


Notes: The figure represents results from a meta-analysis of 34 studies. Average effects (in the correlation metric) of low socioeconomic status (SES), low IQ, low Conscientiousness (C), low Extraversion/Positive Emotion (E/PE), Neuroticism (N), and low Agreeableness (A) on mortality. Error bars represent standard error. The lengths of the studies represented vary from 1 year to 71 years.

Source: Roberts, Kuncel, Shiner et al. [2007]

Personality and Crime

Figure 10: Juvenile Delinquency and the Big Five



Notes: Delinquents are those who have committed at least one of the following: breaking and entering, strongarming, or selling drugs. Non-delinquents have committed at most one of the following stealing at home, vandalism at home, or theft of something less than \$5. The y-axis reports mean differences in standardized scores of the Big Five measures based on mother's reports. The measures were taken at ages 12-13 and reflect cumulative delinquent behavior.

Source: John, Caspi, Robins et al. [1994].

How to Conceptualize These Correlations and Establish a Causal Basis for Them?

An Economic Model of Personality and Its Implications for Measurement of Personality and Preference

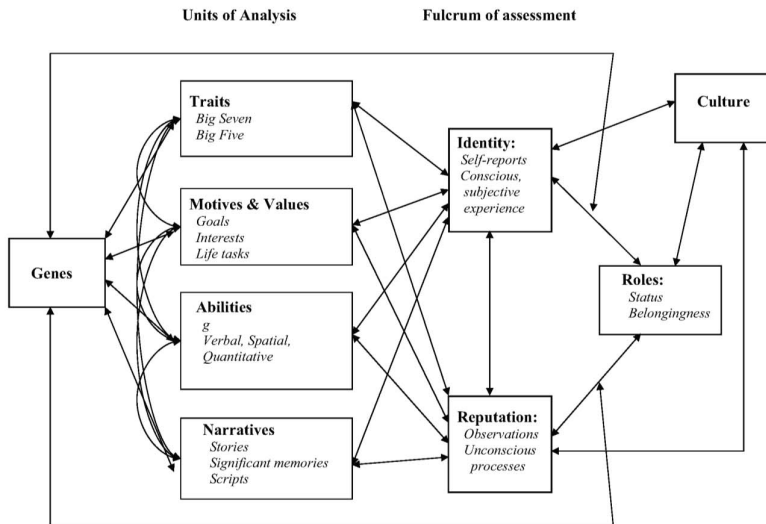
- a Place the concept of personality within economic model(s).
- b Define personality as an emergent property of a system.
- c Use the economic model(s) to frame and solve a central identification problem in empirical psychology (cognitive and noncognitive).
- d How to go from measurements of personality to personality traits.

- Distinguish **personality traits** from **measured personality**.
- Definition of personality by a leading **psychologist**:

Roberts [2009, p. 140]

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

Figure 11: Roberts's Model of Personality Psychology



Source: Roberts [2006].

An Economic Framework for Conceptualizing and Measuring Personality and Personality Traits

How to interpret personality measurements within economic models?

Through

- Preferences? (Standard Approach)
or
- Constraints? (Borghans, Duckworth, Heckman and ter Weel)
or
- Expectations? (Several Recent Papers)
or
- All three?

Personality Affects Comparative Advantage

- Generalized Roy Framework (Heckman, Urzua and Stixrud, 2006).
- Agents can perform one of J tasks with productivity $P_j, j \in \{1, \dots, J\}$.
- “Productivity” can be very general—performance on tests, in workplace, observer reports.
- All measurement systems in psychology are based on performance on these tasks gauged in various ways.

- The productivity in task j depends on the traits of agents represented by θ , and the “effort” they expend on the task, e_j :

$$P_j = \phi_j(\theta, e_j), \quad j \in \mathcal{J} = \{1, \dots, J\}, e_j \in \mathcal{E}, \theta \in \Theta. \quad (1)$$

- Traits are endowments.
- θ : public good.
- Effort e_j : divisible and fixed in supply.
- $\sum_{j=1}^J e_j = \bar{e}$, where \bar{e} is the endowment of total effort.

- Effort and traits are often assumed to be measured so that over the relevant range

$$\frac{\partial \phi_j}{\partial e_j} \geq 0 \quad \text{and} \quad \frac{\partial \phi_j}{\partial \theta} \geq 0.$$

- Neither condition is strictly required.

- Effort may complement capability

$$\left(\frac{\partial^2 \phi_j}{\partial e_j \partial \theta'} > 0 \right).$$

- Or may substitute for it

$$\left(\frac{\partial^2 \phi_j}{\partial e_j \partial \theta'} < 0 \right).$$

- Or there may be different complementarity/substitution relationships for different pairs.
- Effort can be a vector (time, mental energy, attention), and it is assumed to be a divisible private good with the feature that the more that is applied to task j , the less is available for all other tasks at any point in time.

- R_j : reward per unit productivity in task j .
- Possible to productively engage in only one of the J tasks at any time.
- Pick \hat{j} :

$$\hat{j} = \operatorname{argmax}_{j \in \{1, \dots, J\}} \{R_j \phi_j(\theta, \bar{e})\}. \quad (2)$$

- θ and \bar{e} play the same role in this model.

- People with different effort and capability endowments will sort into different occupations and levels of schooling.
- People low in certain traits may have better endowments of effort and may compensate by exerting effort.
- For certain tasks (e.g., creating new branches of mathematics), there may be threshold levels of θ such that for $\theta < \bar{\theta}_j$, $\phi_j(\theta, \bar{e}) = 0$ for all $e_j < \bar{e}$.
- $R_j \uparrow \Pr(j \text{ is selected}) \uparrow$

Multiple Tasking

- $\phi_j(\theta, e_j)$ concave and increasing in e_j .
- The agent maximizes

$$\sum_{j=1}^J R_j \phi_j(\theta, e_j) \quad (3)$$

subject to

$$\sum_{j=1}^J e_j = \bar{e}.$$

- $R_j \uparrow e_j \uparrow$
- Agent might still specialize if there are increasing returns.

Identifying Personality Traits From Measured Performance on Tasks

- What are the psychological traits captured by θ ?
- Some tasks may require only a single trait or only a subset of all of the traits.
- Divide θ into “mental” (μ) and “personality” (π) traits.
- θ_μ and θ_π , each of which may be a vector.

- To use performance on a task (or on multiple measures of the task) to identify a trait requires that performance on certain tasks (performance on a test, performance in an interpersonal situation, etc.) depends exclusively on one component of θ , say $\theta_{1,j}$.

- Thus it assumes task j output is

$$P_j = \phi_j(\theta_{1,j}, e_j).$$

- One must standardize for the effort at a benchmark level, say e^* , to use P_j to identify a measure of the trait $\theta_{1,j}$.

- The activity of picking a task (or a collection of tasks) that measure a particular trait ($\theta_{1,j}$ in our example) is called **operationalization** in psychology.
- Demonstrating that a measure successfully operationalizes a trait is called **construct validity**.
- Need to standardize for effort to measure the trait.
- Otherwise produces variation in the measured trait across situations with different incentives.

A Fundamental Identification Problem

- Operationalization and construct validation require heroic assumptions.
- Even if one adjusts for effort in a task, productivity in a task may depend on multiple traits.
- Thus two components of θ (say $\theta_{1,\mu}$, $\theta_{1,\pi}$) may determine productivity in j .
- Without further information, one cannot infer which of the two traits produces the productivity in j .
- In general, even having two (or more) measures of productivity that depend on $(\theta_{1,\mu}, \theta_{1,\pi})$ is not enough to identify the separate components.

- Ignore measurement error for now.
- Consider the following case of two productivity measures for the two tasks j and j' :

$$\begin{aligned}P_j &= \phi_j(\theta_{1,\mu}, \theta_{1,\pi}, e_j) \\P_{j'} &= \phi_{j'}(\theta_{1,\mu}, \theta_{1,\pi}, e_{j'}), \quad j \neq j'.\end{aligned}$$

- Standardize measurements at a common level of effort $e_j = e_{j'} = e^*$.
- Note that if the support of e_j and $e_{j'}$ is disjoint, no $(\theta_{1,\mu}, \theta_{1,\pi})$ exists.
- If the system of equations satisfies a local rank condition, then one can solve for the pair $(\theta_{1,\mu}, \theta_{1,\pi})$ at e^* .

- Note, however, that **only the pair is identified**.
- One cannot (without further information) determine which component of the pair is $\theta_{1,\mu}$ or $\theta_{1,\pi}$.
- In the absence of **dedicated constructs** (constructs that are generated by only one component of θ), there is an intrinsic identification problem that arises in using measures of productivity in tasks to infer traits.
- Analysts have to make one normalization in order to identify the traits.
- Need only one such construct joined with patterned structures on how θ enters other task to identify the vector θ (e.g. one example is a recursive, triangular structure).

Examples of Nonidentification Problems

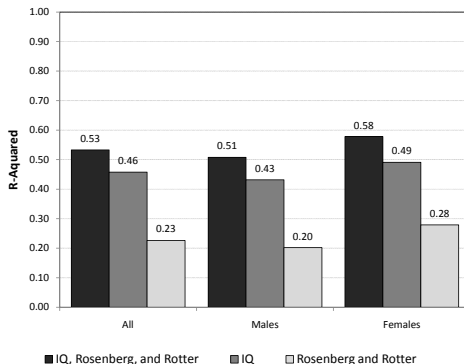
IQ and Achievement Test Scores Reflect Incentives and Efforts, and Capture Both Cognitive and Personality Traits

Table 2: Incentives and Performance on Intelligence Tests

Study	Sample and Study Design	Experimental Group	Effect size of incentive (in standard deviations)	Summary
Edlund [1972]	Between subjects study. 11 matched pairs of low SES children; children were about one standard deviation below average in IQ at baseline	M&M candies given for each right answer	Experimental group scored <u>12 points</u> higher than control group during a second testing on an alternative form of the Stanford Binet (about 0.8 standard deviations)	"...a carefully chosen consequence, candy, given contingent on each occurrence of correct responses to an IQ test, can result in a significantly higher IQ score."(p. 319)
Breuning and Zella [1978]	Within and between subjects study of 485 <i>special education</i> high school students all took IQ tests, then were randomly assigned to control or incentive groups to retake tests. Subjects were below-average in IQ.	Incentives such as record albums, radios (<\$25) given for improvement in test performance	Scores increased by about 17 points. Results were consistent across the Otis-Lennon, WISC-R, and Lorge-Thorndike tests.	"In summary, the promise of individualized incentives contingent on an increase in IQ test performance (as compared with pretest performance) resulted in an approximate 17-point increase in IQ test scores. These increases were equally spread across subtests... The incentive condition effects were much less pronounced for students having pretest IQs between 98 and 120 and did not occur for students having pretest IQs between 121 and 140." (p. 225)

- Many other studies (see ADHK).

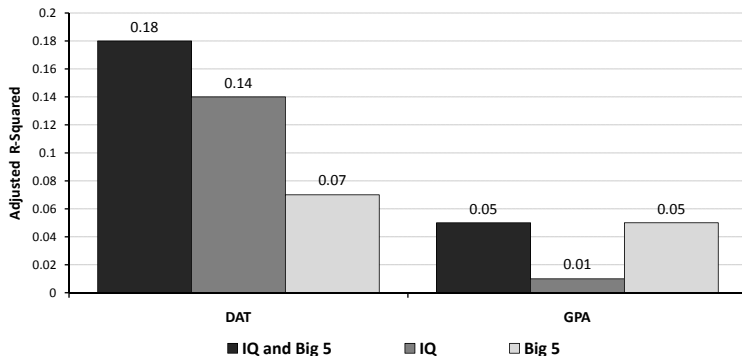
Figure 12: AFQT Score Decomposed by IQ, Rosenberg, and Rotter



Notes: The data come from the NLSY. Rosenberg, and Rotter were administered in 1979. The ASVAB was administered in 1980. To account for varying levels of schooling at the time of the test, scores have been adjusted for schooling at the time of the test conditional on final schooling using the method developed in Hansen, Heckman and Mullen [2004]. AFQT is constructed from the Arithmetic Reasoning, Word Knowledge, Numeric Operations, and Paragraph Comprehension ASVAB subtests. DAT and DAT percentile, IQ, and GPA are from high school transcript data. IQ is pooled across several IQ tests using IQ percentiles. GPA is the individual's core-subject GPA from each year of school. Sample excludes the military over-sample. Background variables include mother's highest grade completed, father's highest grade completed, southern residence at age 14, urban residence at age 14, living in a broken home at age 14, receiving newspapers in the household at age 14, receiving magazines in the household at age 14, and the household having a library card at age 14.

Source: Borghans, Golsteyn, Heckman et al. [2010].

Figure 13: DAT scores and GPA decomposed by IQ and Personality



Notes: Data is from Stella Maris, a high school in the Netherlands. Students were administered part of a Raven's IQ test and personality questions based on the Big 5. DAT and GPA are from high school records.

Source: Borghans, Golsteyn, Heckman et al. [2010].

Digression: The Mechanics of Measuring Personality Using Linear Factor Analysis

- $T_{n,l}$: trait l for person n .
- Use multiple measures on the same traits to control for measurement error.
- $P_{n,l}^q$: q th measurement on trait l for person n .
- The q th measurement of factor l for person n is

$$P_{n,l}^q = \mu_l^q + \lambda_l^q T_{n,l} + \epsilon_{n,l}^q, \quad (4)$$
$$q = 1, \dots, Q_l, n = 1, \dots, N, l = 1, \dots, L$$

- More general case:

$$P_{n,l}^q = \mu_l^q + (\lambda^q)' T_n + \epsilon_{n,l}^q, \quad q = 1, \dots, Q_l. \quad (5)$$

- λ^q is a vector with possibly as many as L nonzero components.
- The $\epsilon_{n,l}^q$ are assumed to be independent of T_n and mutually independent within and across constructs (l and l' are two constructs).
- Cunha, Heckman and Schennach [2010] develop nonlinear factor models (nonlinear and nonparameteric).

- Conventional psychometric validity of a collection of items or test scores for different constructs has three aspects.

Discriminant Validity

- (a) Factor T_I for construct I is statistically independent of factor $T_{I'}$ for construct $I' \neq I$.

Convergent Validity

- (b) A factor T_I is assumed to account for the intercorrelations among the items or tests within a construct I .
- (c) Item-specific and random error variance are low (intercorrelations among items are high within a cluster).

Predictive Validity

- An alternative criterion for validating measurement systems is based on the predictive power of the tests for real world outcomes, that is, on behaviors measured outside of the exam room or observer system.

Problems with Predictive Validity

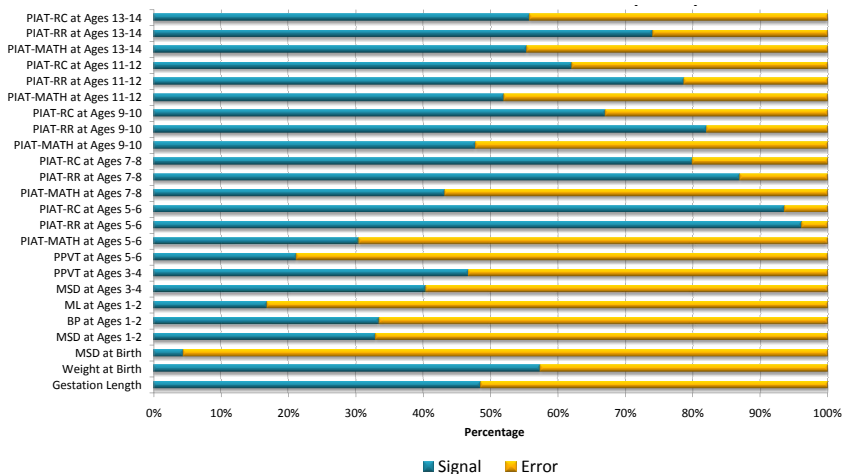
- 1 All measurements of factor $T_{n,l}$ can claim incremental predictive validity as long as each measurement is subject to error ($\epsilon_{n,l}^q \neq 0$).
- 2 *Reverse causality.*
- 3 Especially problematic when interpreting contemporary correlations between personality measurements and outcomes.

- The problem of reverse causality is sometimes addressed by using early measures of traits determined well before the outcomes are measured to predict later outcomes.
- This approach is problematic if the traits the analyst seeks to identify evolve over time and the contemporary values of traits drive behavior.
- Trades a reverse causality problem with a version of an errors in variables problem.
- Early measures of the traits may be poor proxies for the traits that drive current measured behavior.

The Quantitative Importance of Measurement Error

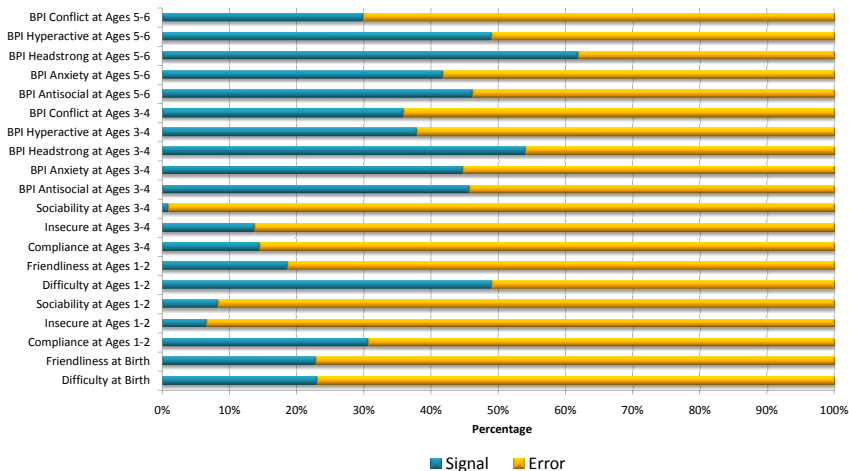
- The share of error variance for proxies of cognition, personality and investment ranges from 1%–90%.
- Not accounting for measurement error produces downward-biased estimates of self-productivity effects and perverse estimates of investment effects.

Table 3: Share of Residual Variance in Measurements of Cognitive Skills Due to the Variance of Cognitive Factor (Signal) and Due to the Variance of Measurement Error (Noise)



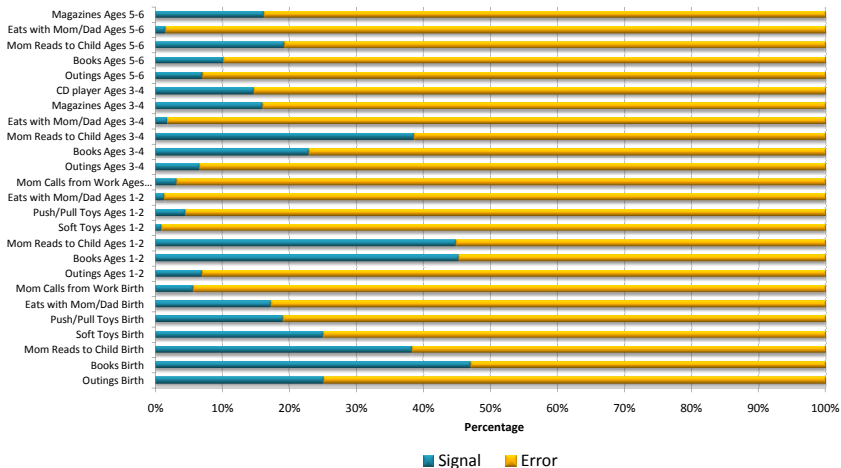
Source: Cunha, Heckman and Schennach [2010].

Table 4: Share of Residual Variance in Measurements of Socioemotional Skills Due to the Variance of Socioemotional Factor (Signal) and Due to the Variance of Measurement Error (Noise)



Source: Cunha, Heckman and Schennach [2010].

Table 5: Share of Residual Variance in Measurements of Investments Due to the Variance of Investment Factor (Signal) and Due to the Variance of Measurement Error (Noise)



Source: Cunha, Heckman and Schennach [2010].

Faking

- “Faking” may corrupt measurements designed to proxy latent factors.
- There are at least two types of false responses:
 - (a) those arising from impression management and
 - (b) those arising from self-deception (Paulhus [1984]).
- These have been shown to be empirically unimportant (see ADHK).

End of Digression.

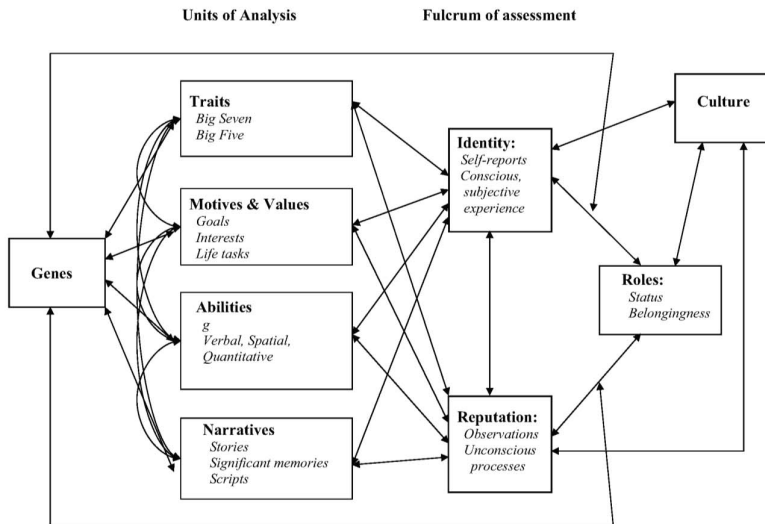
Extensions of Model Leading Up to a Definition of Personality

- Task-specific costs.
- Clusters of tasks, hierarchical structure (Roy within clusters; multi-tasking across clusters).

Adding Preferences and Goals

- Preferences and goals (see Figure 11) may also shape effort.
- These are central features of “social-cognitive” theories of personality: Bandura and Mischel.
- Consider a model with multitasking.

Figure 11: Roberts's Model of Personality Psychology



Source: Roberts [2006].

- Array the effort across tasks in vector $e = (e_1, \dots, e_J)$.
- Direct value might be attached to the productivity in tasks arrayed in vector $P = (P_1, \dots, P_J)$ with reward R_j .
- Output produces income

$$\sum_{j=1}^J R_j P_j$$

which can be spent on goods X with associated prices W .

- A utility function over X , P , and e with preference parameter vector $\psi \in \Psi$.
- Preferences capture the psychologists' "goals."
- Utility need not be associated with "happiness."
- ψ associated with choices and choice behavior, not mental states.

- Preferences:

$$U(X, P, e \mid \psi), \quad (6)$$

- Agent maximizes (6) with respect

$$Y + R'P = W'X, \quad (7)$$

- Y is a flow of unearned income available

$$\sum_{j=1}^J e_j = \bar{e}. \quad (8)$$

- Preference specification (6) captures the notions that
 - (a) agents have preferences over goods,
 - (b) agents may value the output of tasks in their own right, and
 - (c) agents may value the effort devoted to tasks.

Adding Uncertainty

- \mathcal{I} is information possessed by the agent.
- “ E ” denotes the expectation operator.
- The agent can be interpreted as making decisions based on

$$E[U(X, P, e \mid \psi) \mid \mathcal{I}]. \quad (9)$$

- In a general specification, agents can be uncertain about their preferences (ψ), their traits (θ), the prices they face (W), the rewards to productivity (R), the outcomes of purchase decisions (X), and their endowments of effort (\bar{e}).
- A Freudian version: Agents may not act on what they know but rather on what subconscious motives drive them.

An Economic Definition of Personality

- **Personality traits** are components of e , θ and ψ that affect behavior.
- We observe **measured personality**—behaviors generated by incentives, goals, and traits.

- One might define measured personality as the performance (the P_j) and effort (the e_j) that arise from solutions to the optimization problems previously stated.
- This approach does not capture the full range of behaviors considered by personality psychologists that constitute aspects of personality.
- The actions considered by psychologists include a variety of activities that economists normally do not study, e.g., cajoling, beguiling, bewitching, charming, etc.
- To capture these more general notions, we introduce a set of “actions” broader than what is captured by e .

- Actions are styles of behavior that affect how tasks are accomplished.
- They include aspects of behavior that go beyond effort as we have defined it.
- Tasks can be accomplished by taking actions.
- The i^{th} possible action to perform task j : $a_{i,j}$, $i \in \{1, \dots, K_j\}$.
- Array actions in a vector $a_j = (a_{1,j}, \dots, a_{K_j,j}) \in \mathcal{A}$.
- The actions may be the same or different across the tasks.

- The productivity of the agent in task j depends on the actions taken in that task:

$$P_j = \tau_j (a_{1,j}, a_{2,j}, \dots, a_{K_j,j}). \quad (10)$$

- The actions themselves depend on traits θ and “effort” $e_{i,j}$:

$$a_{i,j} = \nu_{i,j}(\theta, e_{i,j}) \quad (11)$$

where

$$\sum_{i=1}^{K_j} e_{i,j} = e_j \text{ and } \sum_{j=1}^J e_j = \bar{e}.$$

- Actions generalize the notion of effort to a broader class of behavior.

- Agents may have utility over actions beyond the utility they get from consuming the outputs of tasks.
- Define utility over actions.
- Let a denote the choice of actions applied to all tasks:
($a = (a_1, \dots, a_J)$).
- \mathcal{M} : the set of actions, including actions that do not directly contribute to productivity.
-

$$a_{i,m} = \nu_{i,m}(\theta, e_{i,m}), \quad m \in \mathcal{M}$$
$$\mathcal{A} \subseteq \mathcal{M}.$$

- The agent solves

$$\max E[U(a, X, P, e \mid \psi) \mid \mathcal{I}]$$

with respect to X and e given the stated constraints.

Introducing Situations

- Situations indexed by $h \in \mathcal{H}$.
- For a person with traits θ and effort vector e_j with action $a_{i,j}$, using the specification (11), the action function can be expanded to be dependent on situation h :

$$a_{i,j,h} = \nu_{i,j}(\theta, e_{i,j,h}, h), \quad (12)$$

productivity on a task

$$P_{j,h} = \tau_j(a_{1,j,h}, \dots, a_{K_j,j,h}) \quad (13)$$

or more generally

$$P_{j,h} = \tau_j(\theta, a_{1,j,h}, \dots, a_{K_j,j,h}, h). \quad (14)$$

- Equations (12)-(14) capture the “if-then” notion of Mischel and Shoda [1995] used to resolve the person-situation debate.
- Failure to control for situation h , just like failure to control for effort, contaminates identification of traits using measures of actions or productivities.
- Let $T \in \mathcal{T}$ be the vector of traits (θ, ψ, \bar{e}) .
- The solution to the general constrained maximization problem is to pick goods X , situation h , action a_{ij} , and effort e_j , $j \in \{1, \dots, J\}$ subject to the constraints.
- h is fixed if the situation is forced on the agent.
- For simplicity, we analyze this case.

Personality is a response function.

$$\text{Personality} \left\{ \begin{array}{ll} X = X(R, W, T, h, Y, \mathcal{I}) & (13) \\ e = e(R, W, T, h, Y, \mathcal{I}) & (14) \\ a = a(R, W, T, h, Y, \mathcal{I}) & (15) \end{array} \right.$$

- The behaviors that constitute personality are defined as a pattern of actions in response to the constraints, endowments, and incentives facing agents given their goals and preferences.
- Personality emerges from this system.

- People may have different personalities depending on their trait endowments, constraints, and situations.
- The actions—not the traits—constitute the data used to identify the traits.
- Personality psychologists use actions (e.g., “dispositions”) to infer traits.
- The same identification issues previously discussed apply to a broader set of measurements of behaviors.

- Many personality psychologists define personality as

*“enduring patterns of thoughts, feelings
and behaviors”*

that reflect tendencies of persons to respond in certain ways
under certain circumstances.

- What are enduring patterns of actions?
- “**Enduring actions**”—average of the a functions for a person with a given trait vector $T = t$ over situations and efforts.

- For task j and trait vector t , the average action for information set \mathcal{I} can be defined as

$$\bar{a}_{T,j,\mathcal{I}} = \int_{\mathcal{S}_{T,\mathcal{I}}(h, e_{i,j})} \nu_{i,j}(\theta, e_{i,j}, h) g(h, e_{i,j} \mid T = (\theta, \psi, \bar{e}), \mathcal{I}) dh de_{i,j}.$$

- $\mathcal{S}_{T,\mathcal{I}}(h, e_{i,j})$ is the support of $(h, e_{i,j})$ given T and \mathcal{I} .

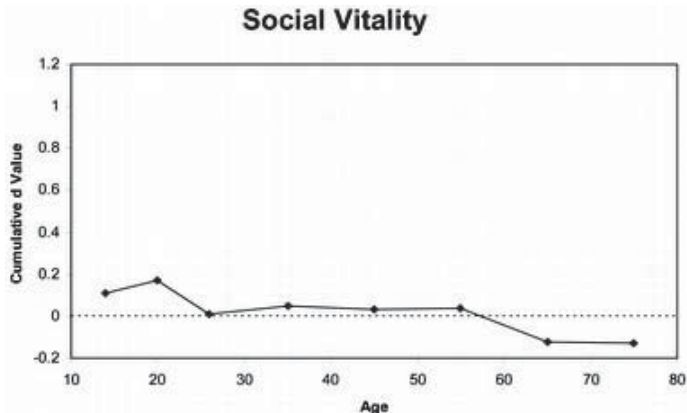
- $g(h, e_{i,j} \mid T = (\theta, \psi, \bar{e}), \mathcal{I})$ is the density of $(h, e_{i,j})$ given $T = (\theta, \psi, \bar{e})$ and information set \mathcal{I} .
- $\bar{a}_{T,j,\mathcal{I}}$ is the “enduring action” of agents across situations in task j with information \mathcal{I} , i.e., the average personality.
- If $\nu_{i,j}$ is separable in T , the marginal effect of personality trait vector θ is the same in all situations.

- One can define the “enduring traits” in a variety of ways, say by averaging over tasks, j , situations, h , or both.
- Only under separability in T will one obtain the same marginal effect of θ .
- Epstein [1979] and a subsequent literature present evidence against nonseparability and in favor of an “enduring trait” that is common across situations.

Stability and Change in Personality Traits and Preferences

- Traits change over the life cycle.

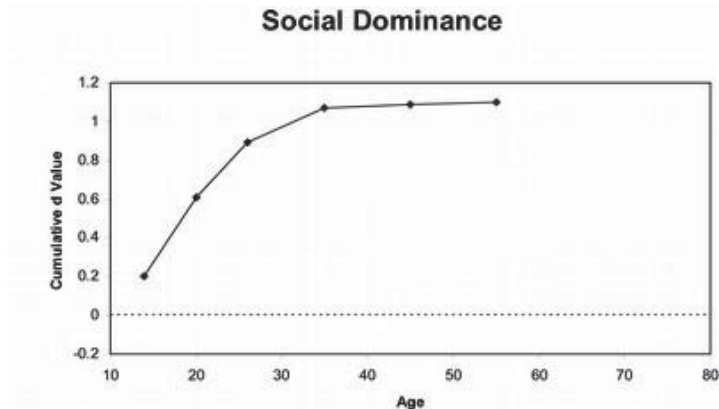
Figure 14: Cumulative Mean-Level Changes in Personality Across the Life Cycle



Note: Social vitality and social dominance are aspects of Big Five Extraversion. Cumulative d values represent total lifetime change in units of standard deviations ("effect sizes").

Source: Figure taken from Roberts, Walton and Viechtbauer [2006] and Roberts and Mroczek [2008]. Reprinted with permission of the authors.

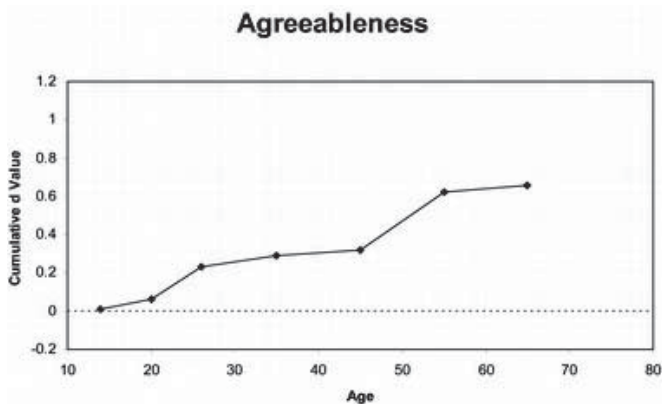
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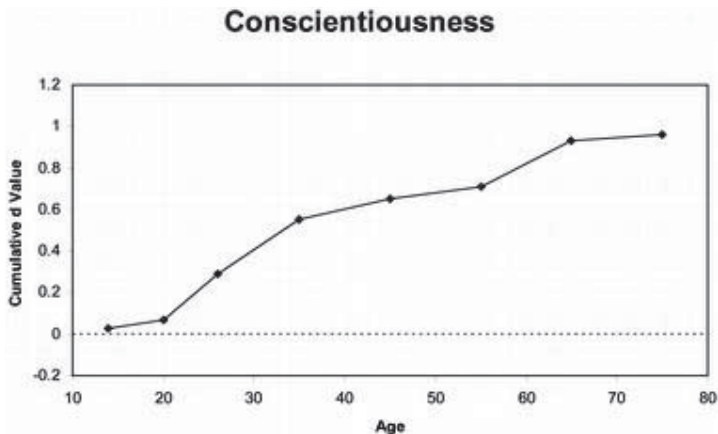
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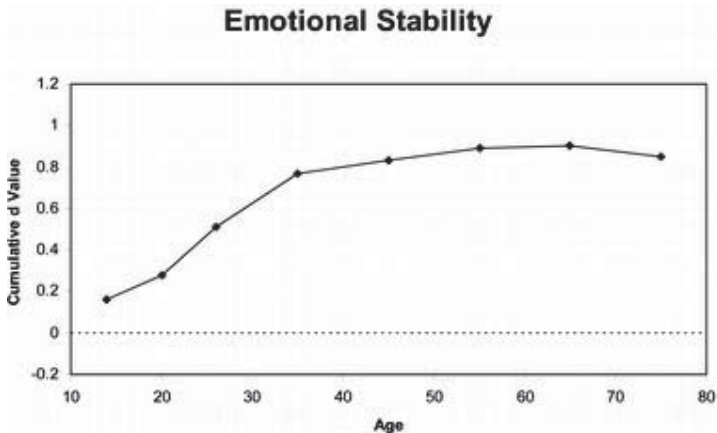
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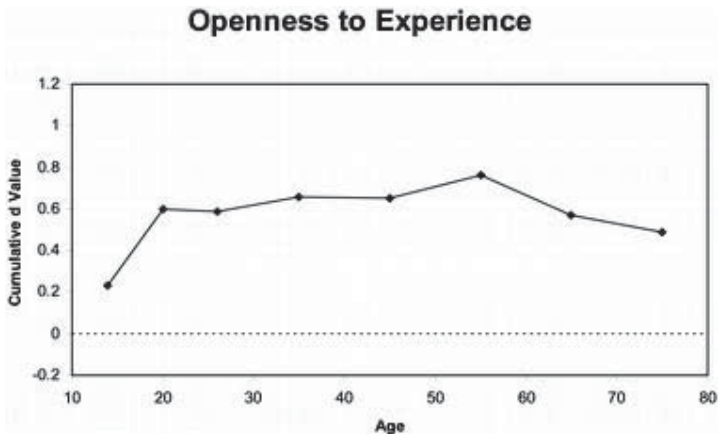
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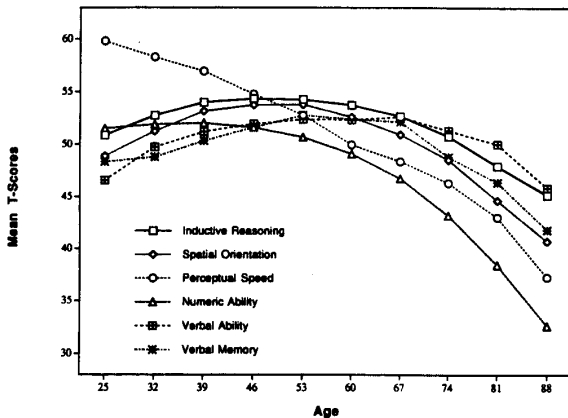
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Source: Figure taken from Roberts, Walton and Viechtbauer [2006] and Roberts and Mroczek [2008]. Reprinted with permission of the authors.

Figure 15: Longitudinal Analysis of Cognitive Skills



Notes: T-scores on the y-axis are standardized scores with a mean of 50 and a standard deviation of ten.

Source: Figures taken from Schaie [1994]. Used with permission of the publisher.

Three Processes of Development Discussed in the Literature

- Ontogeny (programmed developmental processes common to all persons) and sociogeny (shared socialization processes).
- Personality changes through external forces above and beyond common ontogenic and sociogenic processes that operate through alterations in normal biology, such as brain lesions and chemical interventions.
- Investment: educational interventions and parental investment can affect personality throughout the lifecycle.

Life Cycle Dynamics of the Model

- T^v : traits at age v , $v \in \{1, \dots, V\} \in \mathcal{V}$.
- Information \mathcal{I}^v may be updated through various channels of learning.
- The technology of skill formation (Cunha and Heckman [2007; 2009]):

$$T^{v+1} = \eta^v \left(\underbrace{T^v}_{\text{self-productivity}}, \underbrace{IN^v}_{\text{investment}}, h^v \right), v = 0, \dots, V-1 \quad (16)$$

- Functions can be nonautonomous (v -dependent).

- Situations may change over time as a function of past actions, past situations, investment, information, and the like:

$$h^{v+1} = \chi^v(h^v, IN^v, a^v). \quad (17)$$

- Information \mathcal{I}^v may also change over the life cycle through experimentation and learning:

$$\mathcal{I}^{v+1} = \rho^v(\mathcal{I}^v, a^v, T^v, IN^v, h^v). \quad (18)$$

The Evidence on the Causal Effects of Parental Investment, Education, and Interventions

- The empirical literature has not estimated investment model (16) in its full generality.
- Focuses on estimating productivity functions (1) specified in terms of traits θ not general T .
- Keep h implicit.

- Productivity of traits at age v : θ^v .
- Performance on task j at age v :

$$P_j^v = \phi_j^v (\theta^v, e_j^v), \quad j \in \{1, \dots, J\}, \quad v \in \mathcal{V}. \quad (19)$$

- e_j^v : effort devoted to task j at time v .
- Break θ^v into cognitive (μ) and personality (π) components:
 $\theta^v = (\theta_\mu^v, \theta_\pi^v)$.

- In this notation:

$$\theta^{v+1} = \eta^v(\theta^v, IN^v, h^v), \quad v = 1, \dots, V. \quad (20)$$

- IN^v includes investment by parents, schools, work experience and interventions.
- θ^0 : the vector of initial endowments.
- Some components of effort may be included in investment.

- Productivity of investment can depend on the age at which it is made.
- A crucial feature of the technology that helps to explain many findings in the literature on skill formation (see Cunha and Heckman [2007; 2009]) is complementarity of traits with investment:

$$\frac{\partial^2 \eta^v(\theta^v, IN^v, h^v)}{\partial \theta^v \partial (IN^v)'} \geq 0. \quad (21)$$

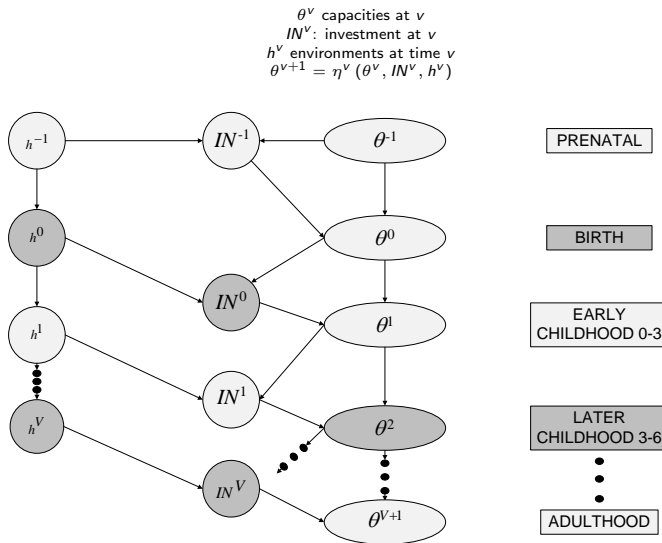
- Technology (20) is characterized by static complementarity between period v traits and period v investment.
- The higher θ^v , the higher the productivity of the investment.
- There is also dynamic complementarity if the technology determines period $v + 1$ traits (θ^{v+1}).
- This generates complementarity between investment in period $v + 1$ and investment in period s , $s > v + 1$.
- Higher investment in period v raises θ^{v+1} because technology is increasing in IN^v , which in turn raises θ^s because the technology is increasing in θ^v , for v between v and s .
- This, in turn, increases $\frac{\partial \eta^s(\cdot)}{\partial IN^s}$ because θ^s and IN^s are complements, as a consequence of (21).

- Dynamic complementarity explains the evidence that early nurturing environments affect the ability of animals and humans to learn.
- It explains why investments in disadvantaged young children are so productive.
- Early investments enhance the productivity of later investments.
- Noncognitive skills promote the development of cognitive skills (cross effect).
- But not vice versa (Cunha, Heckman and Schennach [2010]; Cunha and Heckman [2008]).
- Dynamic complementarity also explains why investment in low ability adults often has such low returns because the stock of θ^v is low.

Critical and Sensitive Periods for Investment

- If $\frac{\partial \eta^v(\cdot)}{\partial I N^v} = 0$ for $v \neq v^*$, v^* is a critical period for that investment.
- If $\frac{\partial \eta^v(\cdot)}{\partial I N^v} > \frac{\partial \eta^{v'}(\cdot)}{\partial I N^{v'}}$ for all $v \neq v'$, v is a sensitive period.
- The technology of skill formation is consistent with a body of evidence that shows critical and sensitive periods in human development for a variety of traits.

Figure 16: A Life Cycle Framework for Organizing Studies and Integrating Evidence: Period Life Cycle



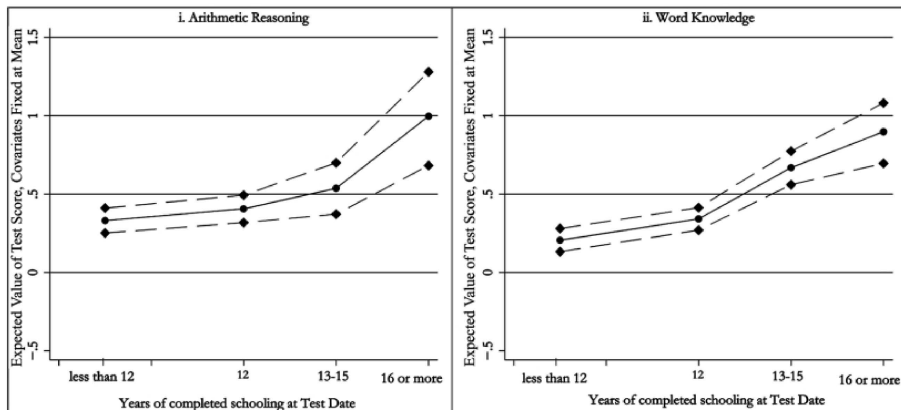
- Cunha, Heckman and Schennach [2010] estimate technology (25) using longitudinal data on the development of children with rich measures of parental investment and of child traits.
- Self-productivity becomes stronger as children become older, for both cognitive and noncognitive capability formation.
- The elasticity of substitution for cognitive inputs is smaller in second stage production, so that it is more difficult to compensate for the effects of adverse environments on cognitive endowments at later ages than it is at earlier ages.

- Explains the evidence on ineffective cognitive remediation strategies for disadvantaged adolescents.
- Personality traits foster the development of cognition but not vice versa.
- It is estimated to be equally easy to substitute at both stages for socioemotional skills over the life cycle (Cunha, Heckman and Schennach [2010]).
- Overall, 16% of the variation in educational attainment is explained by factors extracted from adolescent cognitive traits, 12% is due to factors extracted from adolescent personality (socioemotional traits), and 15% is due to factors extracted from measured parental investments.

The Causal Effects of Schooling on Cognitive and Personality Traits

- Use the methodology of Hansen, Heckman and Mullen [2004].

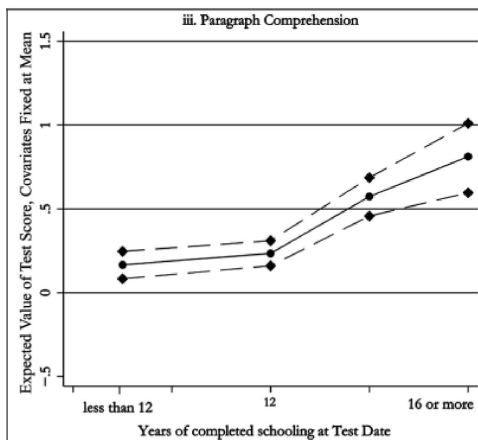
Figure 17: Causal Effect of Schooling on ASVAB Measures of Cognition



Notes: Effect of schooling on components of the ASVAB. The first four components are averaged to create male's with average ability. We standardize the test scores to have within-sample mean zero, variance one. The model is estimated using the NLSY79 sample. Solid lines depict average test scores, and dashed lines, confidence intervals.

Source: Heckman, Stixrud and Urzua [2006, Figure 4].

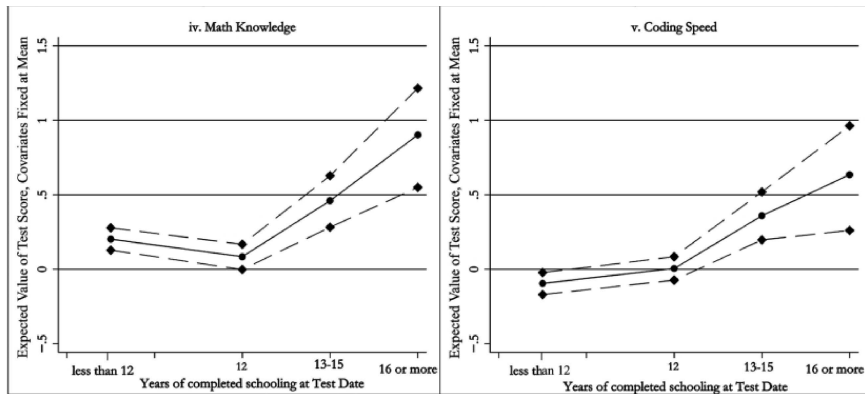
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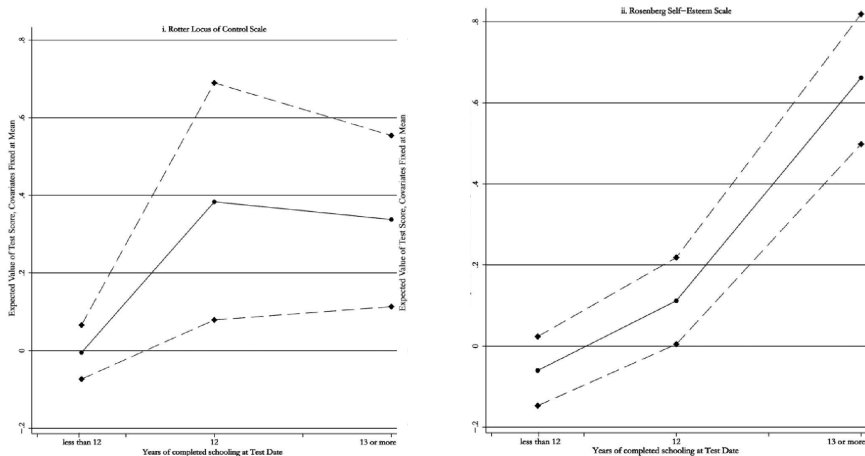
Figure 17: Causal Effect of Schooling on ASVAB Measures of Cognition



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Source: Heckman, Stixrud and Urzua [2006, Figure 4].

Figure 18: Causal Effect of Schooling on Two Measures of Personality

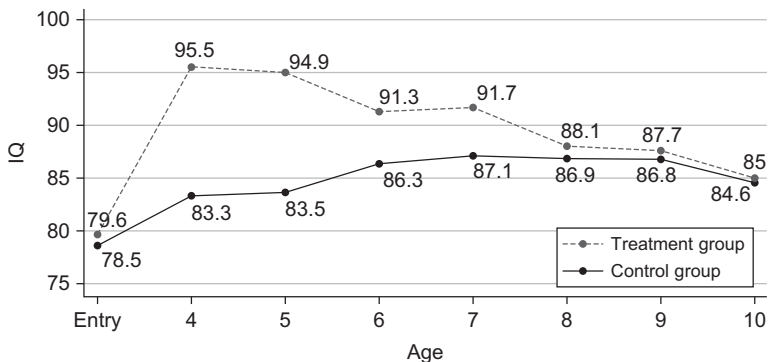


Source: Heckman, Stixrud and Urzua [2006].

Evidence from Interventions

- Perry Preschool Program did not have a lasting improvement on cognitive ability, but did improve important later-life outcomes through personality (Heckman, Malofeeva, Pinto et al. [2010]).

Figure 19: Perry Preschool Program: IQ, by Age and Treatment Group

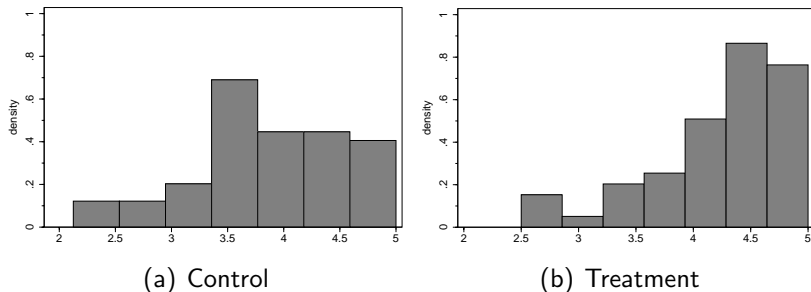


Notes: IQ measured on the Stanford-Binet Intelligence Scale (Terman and Merrill [1960]). Test was administered at program entry and each of the ages indicated.

Source: Cunha, Heckman, Lochner et al. [2006] and Heckman and Masterov [2007] based on data provided by the High Scope Foundation.

- The Perry Preschool Program worked primarily through socioemotional channels.
- Raised scores on achievement tests but not IQ tests.
- Socioemotional factors and cognitive factors both explain performance on achievement tests (Duckworth, 2006; Borghans et al., 2008; Borghans et al., 2009).

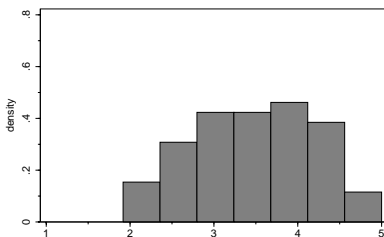
Figure 20: Personal Behavior Index by Treatment Group
(1 is worst, 5 is best)



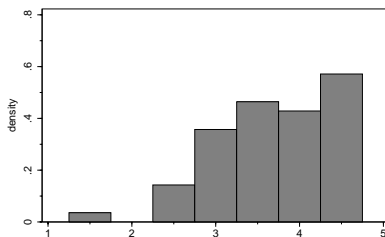
Source: Heckman, Malofeeva, Pinto, and Savelyev (2010).

- Personal Behavior Index is an unweighted average of four items: “absences and truancies”, “lying or cheating”, “steals” and “swears or uses obscene words”.

Figure 21: Socio-Emotional Index by Treatment Group
(1 is worst, 5 is best)



(a) Control



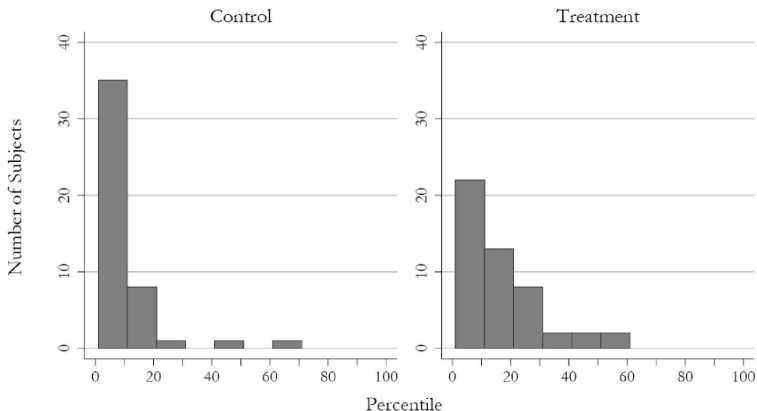
(b) Treatment

Source: Heckman, Malofeeva, Pinto, and Savelyev (2010).

- The Socio-Emotional index is an unweighted average of four items: “appears depressed”, “withdrawn and uncommunicative”, “friendly and well-received by pupils”, and “appears generally happy”.

How Personality Affects Achievement Tests

Figure 22: Perry Age 14 Total CAT Scores, by Treatment Group



CAT = California Achievement Test

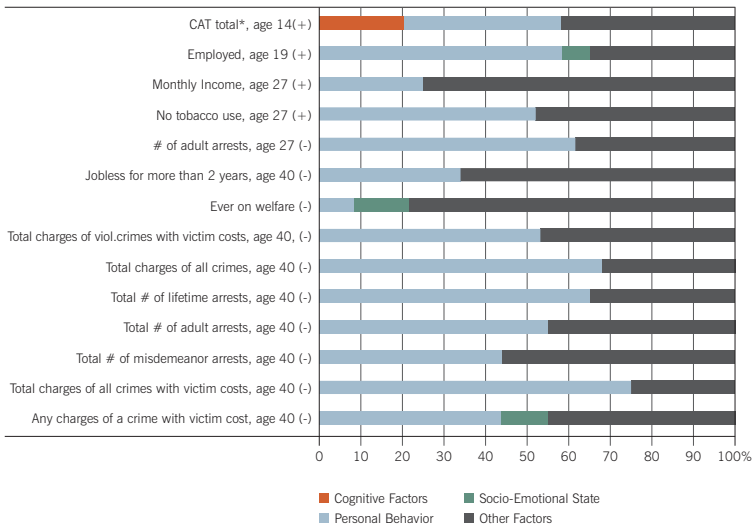
Treatment: $N = 49$; Control: $N = 46$

Statistically Significant Effect for Males and Females (p-values 0.009, 0.021 respectively)

Source: Heckman, Malofeeva, Pinto et al. [2010].

Decomposing Treatment Effects of Perry

Decomposition of Treatment Effects, Males



Source: Heckman, Malofeeva, Pinto, and Savelyev (2010).

ADHK Survey a Variety of Interventions

- Gottschalk Study

Table 6: The Effect of Interventions on Personality

Author(s)	Main Variable(s)	Data and Methods
Gottschalk [2005]	<p><u>Outcome(s)</u>: <i>Personality</i> –four measures of locus of control based on whether the respondent agrees strongly, agrees, disagrees, or strongly disagrees with statements</p> <p><u>Intervention</u>: A subsidy for full-time work during a 36-month period</p>	<p><u>Data</u>: Self-Sufficiency Project; 4,958 single parents over the age of 19 in New Brunswick and British Columbia</p> <p><u>Methods</u>: The subsidy was randomly offered to a population of people receiving Income Assistance (IA)</p>
	<p>Causal Evidence</p> <p><u>Control Variables</u>: age, age squared, region, gender, speaks French, number of children</p> <p><u>Timing of Measurements</u>: <i>Baseline</i> – Locus of control was measured before the program.</p> <p><i>During treatment</i> – Locus of control was measured again 18 and 36 months after the baseline.</p>	<p>Main Result(s)</p> <p>Using whether the participant received the subsidy as an instrument for hours worked, the authors find that working tends to improve locus of control by the 36 month re-interview.</p>

General Pattern of Other Studies

- Most studies are short term in character.
- Whether effects are lasting is unknown.

Personality and Preference Parameters

- Measures of personality predict a wide range of life outcomes that economists study.
- However, the latent nature of traits makes it difficult to relate them to economic models.
- Since personality psychologists define traits as relatively stable, person-specific determinants of behavior, preferences are the natural counterpart of these traits in economics.
- Preferences are also, at least in most models, unaffected by changes in constraints.
- While personality might relate to preferences, the exact link is unclear.

Table 7: Standard Preference Parameters and Conceptually Similar Measures in the Psychology Literature

Preference parameter	Personality measures
Time preference	Conscientiousness Self-control Affective mindfulness Consideration of future consequences Elaboration of consequences Time preference
Risk aversion	Impulsive sensation seeking Balloon Analogue Risk Task
Leisure Preference	Achievement Striving Endurance Industriousness
Social preference	Warmth Gregariousness Trust Altruism Tender-mindedness Hostility

Table 8: Overview of Empirical Studies of the Links Between Preferences and Traits

Preferences	Personality measure	Empirical study
Time Preference	Conscientiousness, Self-control, Affective mindfulness, Elaboration of consequences, Consideration of future consequences.	Daly, Delaney and Harmon [2009]
	Extraversion Time Preference	Dohmen, Falk, Huffman et al. [2010]
Risk Aversion	Sensation Seeking	Zuckerman [1994], Eckel and Grossman [2002]
	Openness	Dohmen, Falk, Huffman et al. [2010]
	Neuroticism, ambition, Agreeableness	Borghans, Golsteyn, Heckman et al. [2009]
	Balloon Analogue Risk Task	Lejuez, Aklin, Zvolensky et al. [2003]
Social Preferences		
Altruism	Neuroticism, Agreeableness	Ashton, Paunonen, Helmes et al. [1998], Osiński [2009], Bakkens [2006]
Reciprocity	Neuroticism, Agreeableness, Conscientiousness	Dohmen, Falk, Huffman et al. [2008]
Trust	Neuroticism, Agreeableness, Openness, Conscientiousness	Dohmen, Falk, Huffman et al. [2008]

See ADHK for more complete discussion.

Summary and Conclusions

What can economists take from and contribute to personality psychology?

What do we learn from personality psychology?

- 1 Personality traits predict many behaviors sometimes with the same strength as conventional cognitive traits.
- 2 Personality psychology considers a wider array of actions than are considered by economists—enlarges the economist's way to describe and model the world.
- 3 Cognition is one aspect of personality broadly defined.
- 4 Personality traits are not set in stone. They change over the life cycle. They are a possible avenue for intervention and policy.

How Economists Can Contribute to Personality Psychology

- 1 Personality psychologists lack precise models. Economics provides a clearer framework for recasting the field.
- 2 Economics now plays an important role in clarifying the concepts and empirical content of psychology.
- 3 More precise models reveal basic identification problems that plague measurement in psychology. This analysis shows that, at an empirical level, “cognitive” and “noncognitive” traits are not easily separated.
- 4 Personality psychologists typically present correlations not causal relationships.
- 5 Many contemporaneously measured relationships suffer from the problem of reverse causality.

- ⑥ Economists can apply their tools to define and estimate causal mechanisms and to understand the causes of effects.
- ⑦ Psychological measures have substantial measurement error.
- ⑧ Econometric tools account for measurement error, and doing so makes a difference.
- ⑨ Economists can formulate and estimate mechanisms of investment—how traits can be changed for the better.

Challenges

- ① Linking the traits of psychology with the preferences, constraints and expectation mechanisms of economics.
- ② Developing rigorous methods for analyzing causal relationships in both fields.
- ③ Developing a common language and framework to promote interdisciplinary exchange.
- ④ Danger in assuming that basic questions of content and identification have been answered by psychologists at the level required for rigorous economic analysis.
- ⑤ In explaining outcomes, how important is person? How important is situation? How important is their interaction?

For more details see

“Personality Psychology and Economics.”

Mathilde Almlund, Angela Duckworth, James Heckman and Tim Kautz.

Forthcoming, *Handbook of the Economics of Education*,

E. Hanushek, S. Machin and L. Wössman (eds.).

Amsterdam: Elsevier, 2011.

- Posted at the website for the conference.