Some Background on Inequality
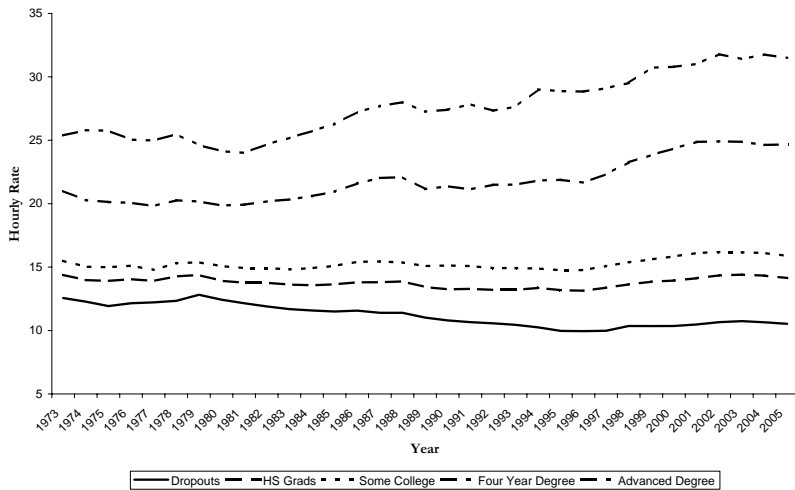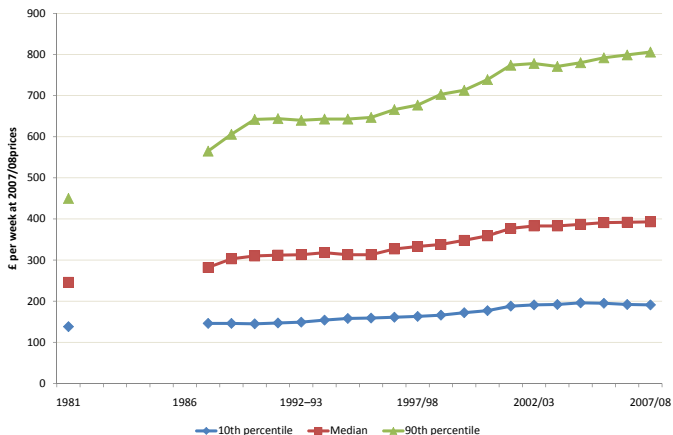
James Heckman
University of Chicago
University College Dublin

INET Summer School
July 2012
This draft, July 6, 2012

Average Hourly Wages by Education Level, US 1973-2005

Distribution of real household disposable income, UK

Comment: Income is adjusted to 2007/08 prices using the retail prices index less council tax/domestic rates. Equivalized household disposable is income before deduction of housing costs, using OECD equivalization scale. More information is available in "Social trends" 39 Appendix. Data for 1994/95 to 2001/02 are for Great Britain only.
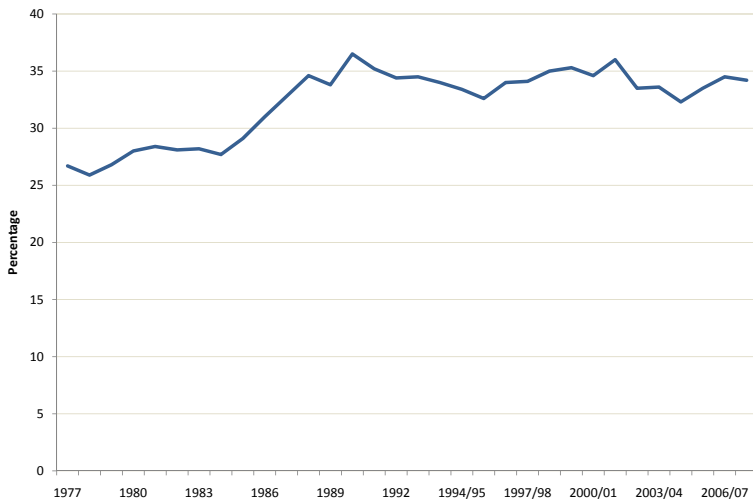
Source: Office for National Statistics

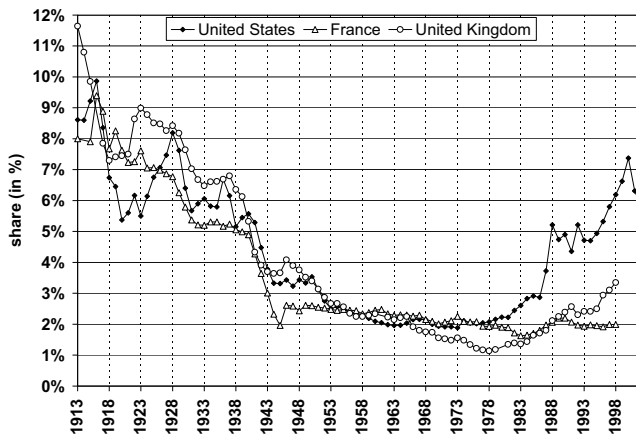**Income inequality measured by Gini, EU-27 comparison, 2007**
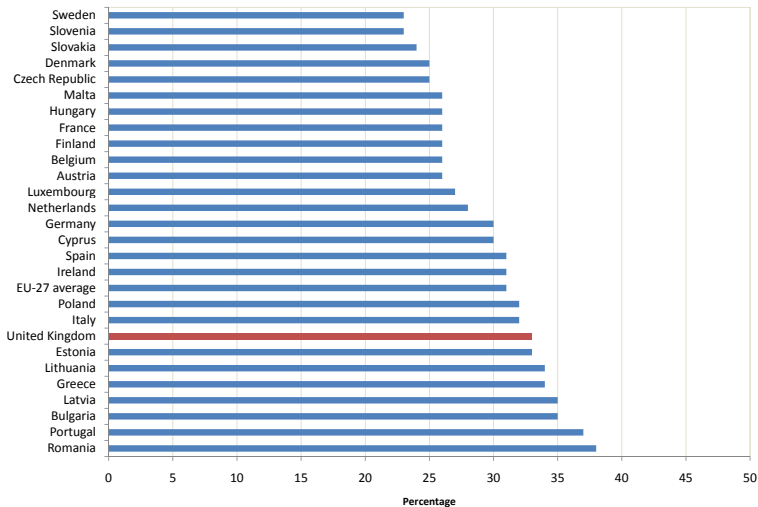
Source: Office for National Statistics

Inequality (measured by GINI) of disposable income for all households, UK

Source: Office for National Statistics

Top 0.1% Income Shares in the U.S., France, and the U.K.,1913-1998

Source: Piketty and Saez (2009).

The Decline of the American Blue-Collar Middle Class
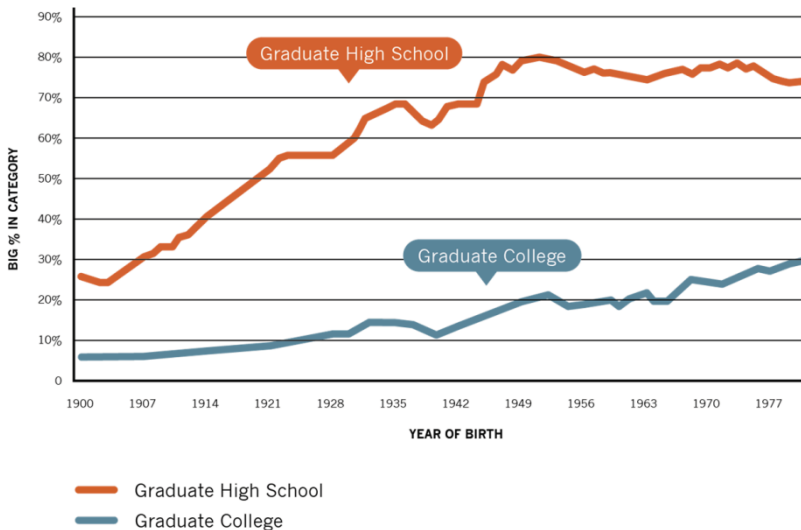
Participation in full time education and employment of 18 year olds, England
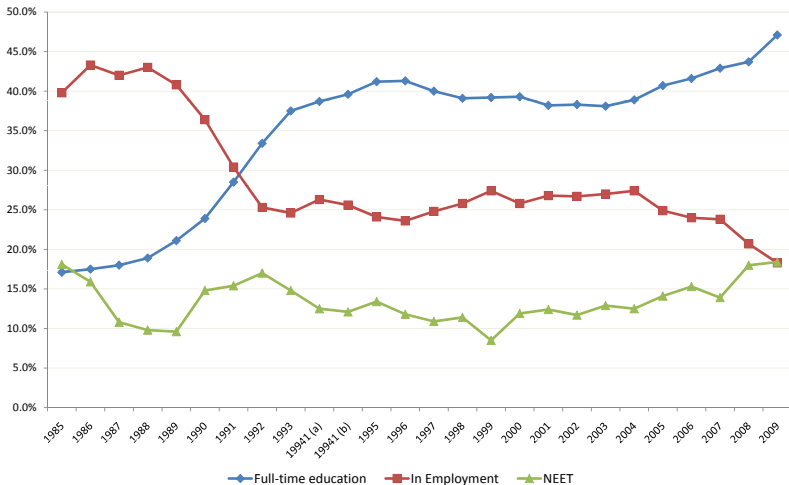
Source: National Statistics
Comment: 1994a/1994b is the break in time series is due to changes in the source of further and higher education data

Share of youth not in education, employment or training (NEET)
Ages 15-24, EU, 2007
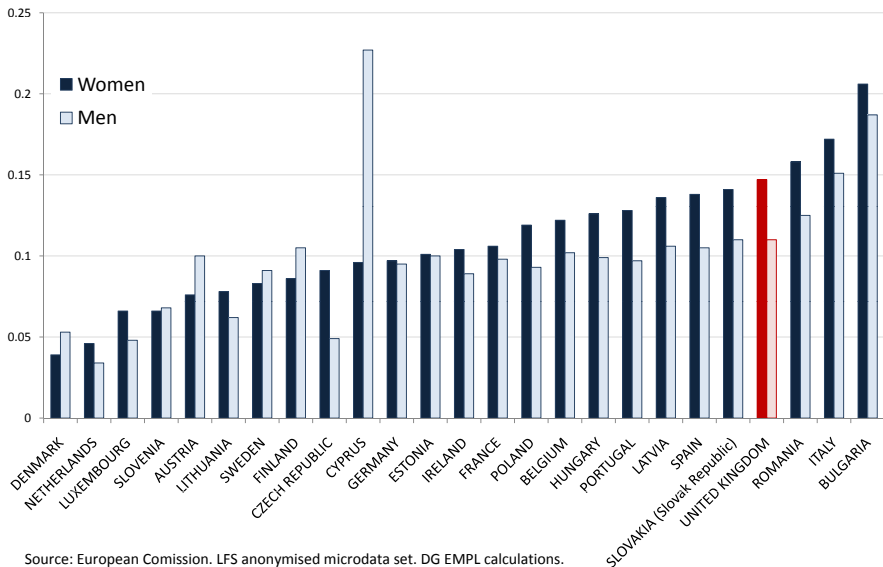
Source: European Comission. LFS anonymised microdata set. DG EMPL calculations.

Disparities by Education
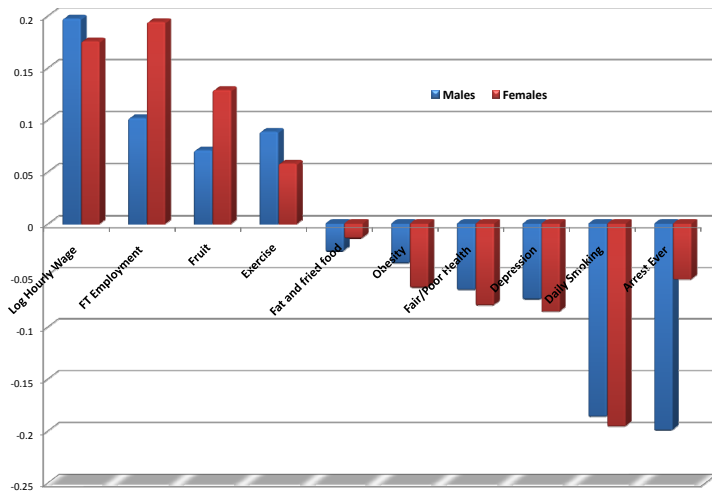
Disparities at age 30: British Cohort Study of 1970 births (Conti, Heckman and Urza, 2010)

Health by Education
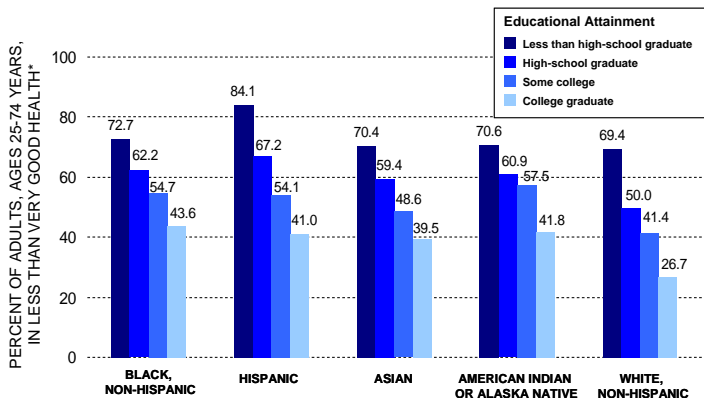
Source: Behavioral Risk Factor Surveillance System Survey Data, 2005-2007.
† Based on self-report and measured as poor, fair, good, very good or excellent.
* Age-adjusted.

Proportion of adults with fair/poor health, by education and race/ethnicity. Source: Robert Wood Johnson Foundation,

Commission to Build a Healthier America.

Income Mobility Over Generations

Intergenerational Correlations

- $$\underbrace{y_{g+1}}_{\substack{\text{Income} \\ \text{of} \\ \text{Child}}} = \alpha + \beta \underbrace{y_g}_{\substack{\text{Income} \\ \text{of} \\ \text{Parent}}} + U_g$$

- $\beta = .65$ in US, .45–.57 in UK, .14 in Sweden
- Mobility higher in Nordic countries where income distribution is compressed.

I have devoted myself for the last twenty-five years to the problem of poverty, and very little of my work has been devoted to any inquiry which does not bear upon that.

— Alfred Marshall (Report to Royal Commission on the Aged Poor, 1893)

The most valuable of all capital is that invested in human beings; and of that capital the most precious part is the result of the care and influence of the mother.
— Alfred Marshall (1890, paragraph VI.IV.11)

The human will, guided by careful thought, can so modify circumstances as largely to modify character; and thus to bring about new conditions of life still more favourable to character; and therefore to the economic, as well as the moral, well-being of the masses of the people.
— Alfred Marshall (1907)

He had no objection to commonplaces about human values and loved to preach the Gospel of the Noble Life . . . I confess that few things are so irritating to me as is the preaching of mid-Victorian morality, seasoned by Benthamism, the preaching from a schema of middle-class values that knows no glamour or passion.

— Schumpeter, AER, 1941

Recent Studies In The Economics of Human Development Establish That:

1. A core low-dimensional set of capabilities along with the incentives in situations explain a variety of diverse socioeconomic outcomes.

2. Cognitive and personality ("noncognitive") capabilities are both important causal determinants of achievement.

3. Early biological factors including nutrition also play an important role in explaining adult health and a variety of other outcomes (e.g., education, wages).

4. Capabilities evolve over the life cycle as a consequence of investment.

⑤ Define a capability vector at age t

$$\theta_t = (\ \underbrace{\theta_{C,t}}_{\text{Cognitive}}\ ,\ \underbrace{\theta_{N,t}}_{\text{Noncognitive}}\ ,\ \underbrace{\theta_{H,t}}_{\text{Health}})$$

Each subvector can be a vector.

⑥ Outcome j at time t, $Y_{j,t}$ depends on capabilities θ_t and effort $e_{j,t}$ as well as social context variables $\theta_{t,P}$:

$$Y_{j,t} = \phi_{j,t}\left(\theta_t, e_{j,t}, \theta_{t,P}\right) \qquad \begin{aligned} j &= 1, \ldots, J \\ t &= 1, \ldots, T \end{aligned}$$

Effort in j at time t, $e_{j,t}$, depends on rewards and endowments.

$$e_{j,t} = \eta_{j,t}(\ \underbrace{R_{j,t}}_{\text{Rewards to effort}}\ ,\ \underbrace{\theta_t}_{\text{Capabilities}}\ ,\ \underbrace{\theta_{t,P}}_{\text{Context and background}}\ )$$

7. Technology of Capability Formation (Cunha and Heckman, 2007, and Heckman, 2007).

$$\theta_{t+1} = f_t(\underbrace{\theta_t}_{\substack{\text{self} \\ \text{productivity}}} , \underbrace{I_t}_{\substack{\text{investment} \\ \text{(including} \\ \text{education)}}} , \underbrace{\theta_{t,P}}_{\text{background}})$$

8. This framework has been applied to analyze a variety of data sets on a variety of outcomes.

9. A variety of data sources show critical periods in early life for cognitive skills and sensitive periods for noncognitive skills later through adolescence. (Cunha, Heckman and Schennach, 2010)

Strong evidence of synergies:

$$\frac{\partial \theta_{t+1}}{\partial \theta_t} \geq 0$$

Complementarity:

$$\frac{\partial^2 \theta_{t+1}}{\partial \theta_t \partial I_t'} \geq 0$$

Productivity of Investment:

$$\frac{\partial \theta_{t+1}}{\partial I_t} \geq 0$$

A Life Cycle Framework for Organizing Studies and Integrating Evidence

$\theta_t = (\theta_C, \theta_N, \theta_H)$ capacities at t

I_t: investment at t

$\theta_{t+1} = f_t(\theta_t, I_t, \theta_{t,P})$
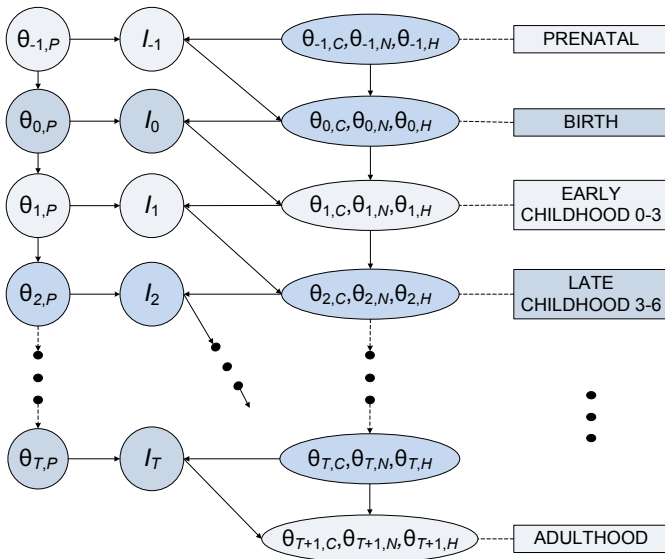
10. Gaps in capabilities open up early; they persist at later ages. Little malleability for cognition after the first decade of life. Noncognitive—personality—traits are more malleable.

Trend in mean by age for cognitive score by maternal education
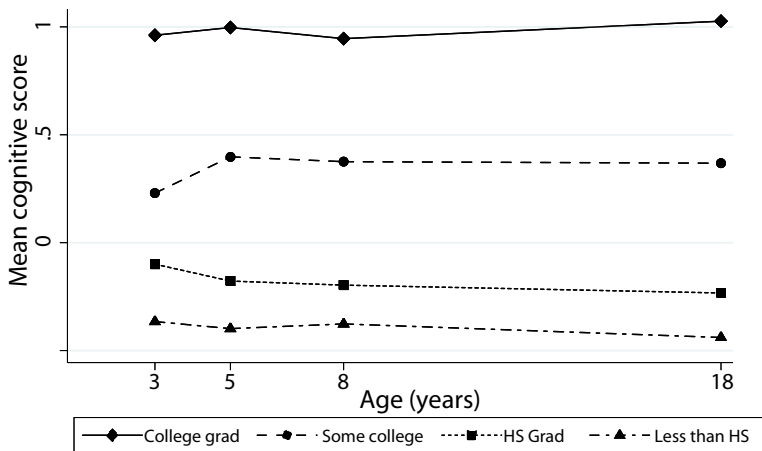
Each score standardized within observed sample. Using all observations and assuming data missing at random. Source: Brooks-Gunn et al. (2006).

Average percentile rank on anti-social behavior score, by income quartile

(The higher the score, the worse are behavioral problems)
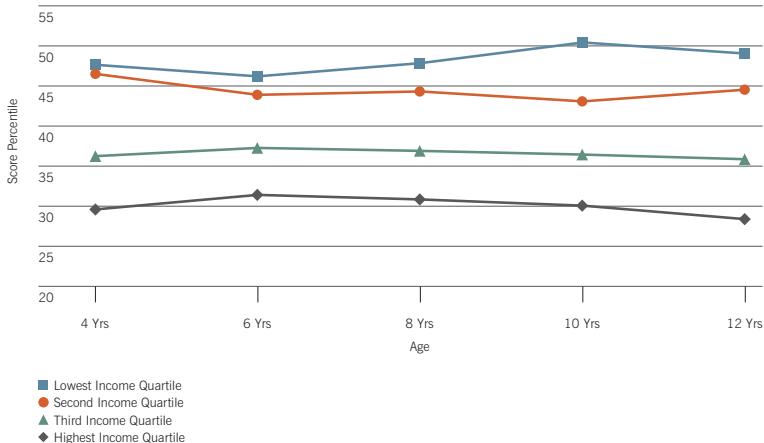
Health and income for children and adults, U.S. National Health Interview Survey 1986-1995. From Case, A., Lubotsky, D. & Paxson, C. (2002), American Economic Review, Vol. 92, 1308-1334.
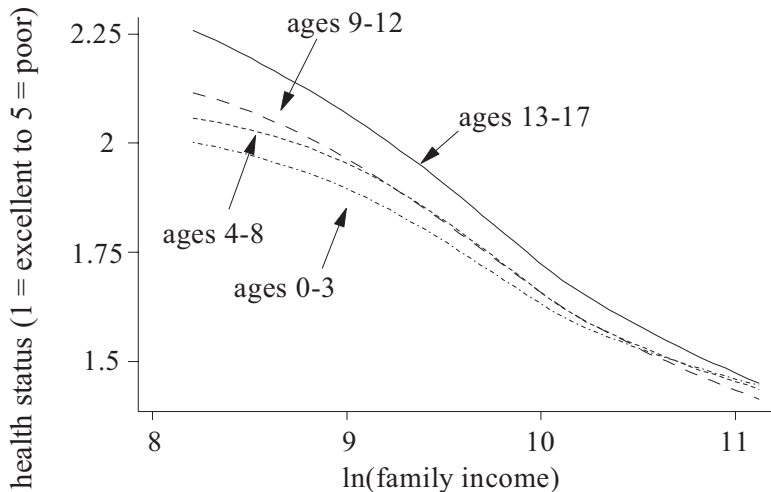
11. Many early childhood interventions operate primarily through enhancing noncognitive capabilities. (Heckman, 2000; Cunha, Heckman, Lochner and Masterov, 2006; Heckman, Malofeeva, Pinto, Savelyev, 2008)

12. Adolescent remediation is ineffective especially for cognitive deficits.

Returns to a unit dollar invested.
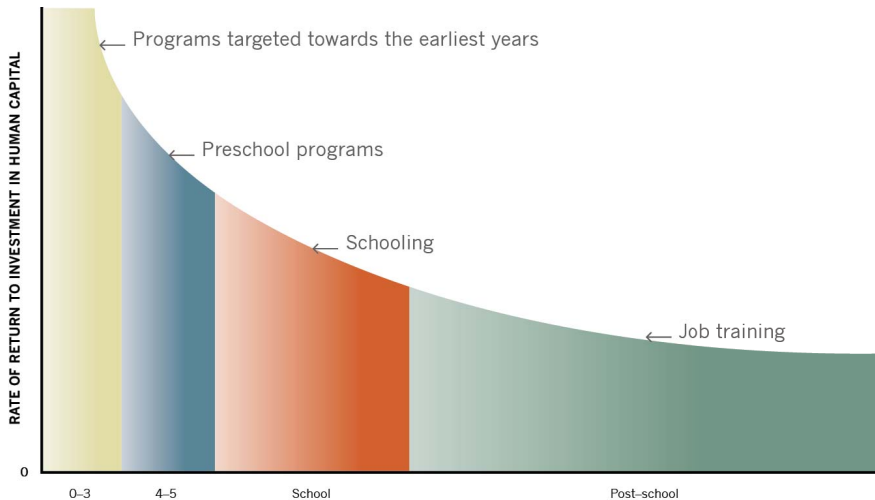
Source Heckman (2008).

- Evidence on the early emergence of gaps leaves open the question of which aspects of families are responsible for producing these gaps.

- Is it due to genes?

- Family environments?

- Parenting and family investment decisions?

- The evidence from the intervention studies suggests an important role for investments and family environments in determining adult capacities above and beyond genes, and also in interactions with the genes.

- Parental attachment is a powerful predictor of adult success.

Today's Lecture

- In my lecture today, I want to discuss "character" or in modern parlance "personality."
- How can economists think about it? Is it just time preference? Risk preference? Something new?
- How predictive are these personality traits? Do they have causal status?
- In my lecture tomorrow, I will discuss the evolution of capabilities, policies to foster capabilities and what recent evidence suggests is optimal policy.

Lecture I:
Personality Psychology and Economics

Understanding and Producing "Character"

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?

I draw heavily 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

A Brief History of Personality Psychology

Binet [1916, p. 254]

"...[success in school] 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."

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.*"

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

Math Reasoning
Quantitative Reasoning
Math Problems

Visual Perception
Visualization
Spatial Relations
Closure Speed
Closure Flexibility
Serial Perceptual Integration
Spatial Scanning
Imagery

Closure
Closure Speed
Closure Flexibility

Gf
(Fluid Intelligence)
Sequential Reasoning
Inductive Reasoning
Quantitative Reasoning
Piagetian Reasoning

Perceptual Speed
Number Computation
RT and other Elementary Cognitive Tasks
Stroop
Clerical Speed
Digit/Symbol

Gc
(Crystallized Intelligence)
Verbal Comprehension
Lexical Knowledge
Reading Comprehension
Reading Speed
"Cloze"
Spelling
Phonetic Coding
Grammatical Sensitivity
Foreign Language
Communication
Listening
Oral Production
Oral Style
Writing

General
Intelligence

Learning and Memory
Memory Span
Associative Memory
Free Recall Memory
Meaningful Memory
Visual Memory

Ideational Fluency
Ideational Fluency
Naming Facility
Expressional Fluency
Word Fluency
Creativity
Figural Fluency
Figural Flexibility

Knowledge and Achievement
General School Achievement
Verbal Information and Knowledge
Information and Knowledge, Math and Science
Technical and Mechanical Knowledge
Knowledge of Behavioral Content

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

Personality Traits

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

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
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)	**Internal vs. External Locus of control Core self-evaluation** 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].

The Person-Situation Debate

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.*"

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

The Predictive Power of Personality Traits

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 if skills evolve past the point of measurement.

- Only recently have economists started to systematically address the question of causality.

Main Findings from Predictive Analyses

- **Conscientiousness is the most predictive Big Five trait across many outcomes.**

  a. Educational attainment, grades

  b. Job performance across a range of occupational categories (predictive power of "g" decreases with job complexity)

  c. Longevity
  d. Criminality

- Neuroticism (and related *locus of control*)

  a. Predicts schooling outcomes

  b. Labor market search

- Other traits play roles at finer levels. (The "Facets" of the Big Five)

Educational Attainment and Achievement

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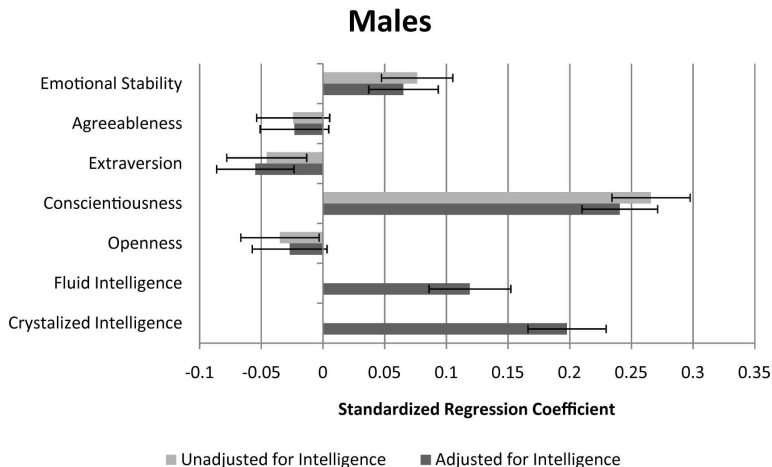
Males

Standardized Regression Coefficient

■ Unadjusted for Intelligence   ■ Adjusted for Intelligence

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.

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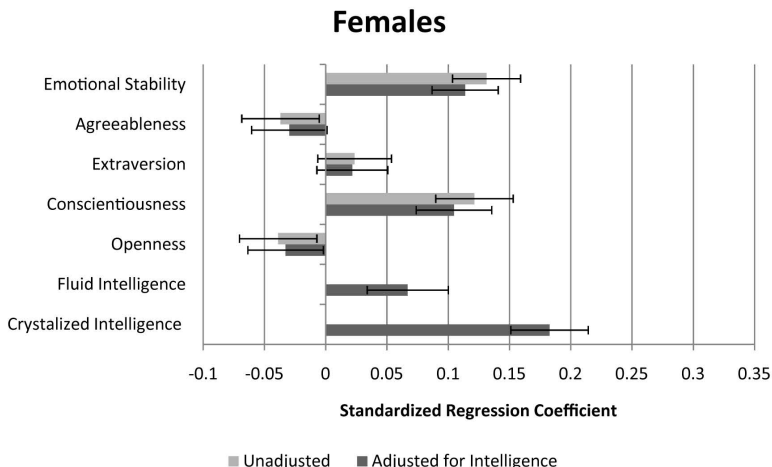
**Females**

■ Unadjusted ■ Adjusted for Intelligence

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.
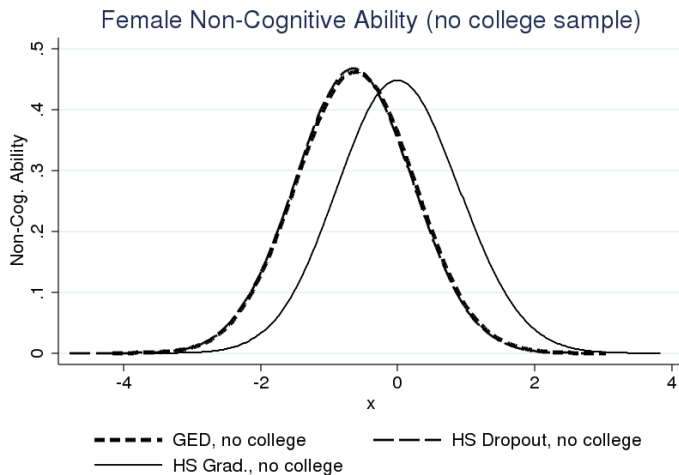
GEDs

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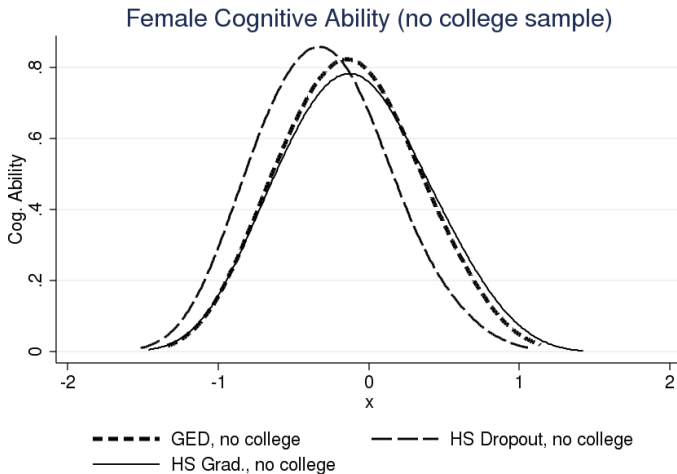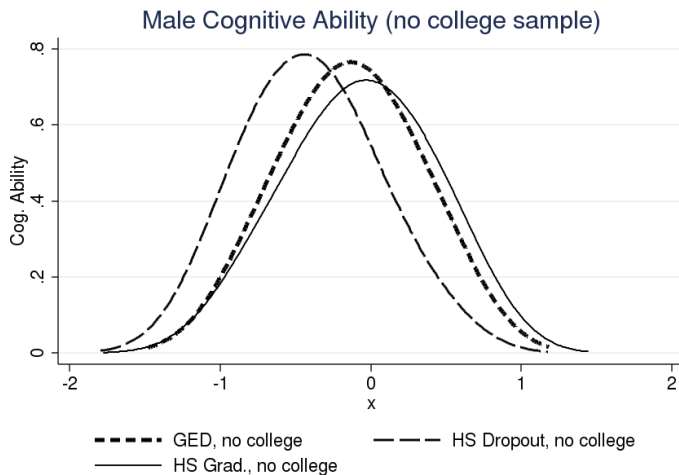

Source: Heckman, Humphries, Veramendi, and Urzua (2010).

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

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

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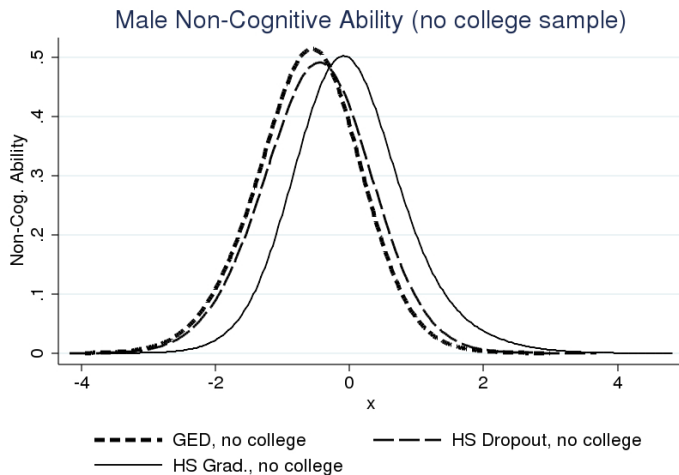

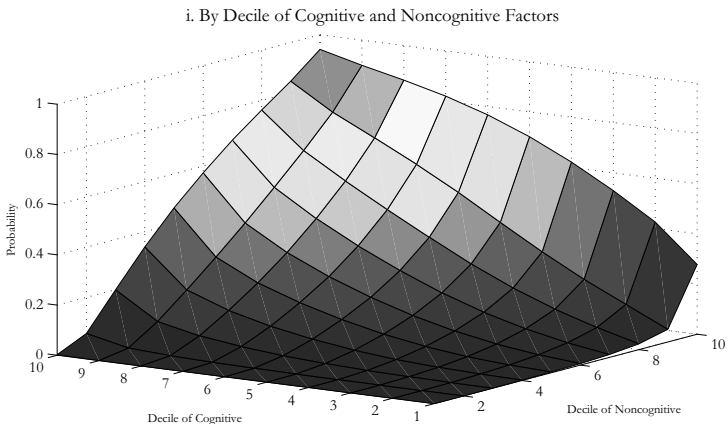Source: Heckman, Humphries, Veramendi, and Urzua (2010).

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

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

- Yet GEDs, adjusting for their higher cognitive ability, earn at the level of dropouts.

Figure 4: Probability of Being a 4-year-college Graduate or Higher at Age 30, 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.
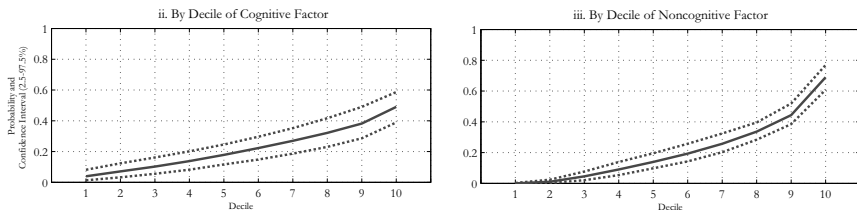Source: Heckman, Stixrud and Urzua [2006, Figure 21].

Figure 4: 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 5: Correlations of the Big Five and Intelligence with Course Grades
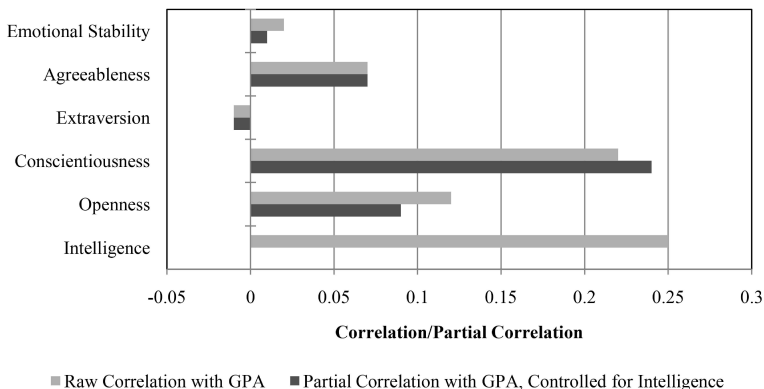
Notes: All correlations are significant at the 1% level. The correlations are corrected for scale reliability and come from a meta analysis representing a collection of studies representing samples of between N=31,955 to N=70,926, depending on the trait. The meta-analysis did not clearly specify when personality was measured relative to course grades.
Source: Poropat [2009].

Labor Market Outcomes

Figure 6: Associations with Job Performance
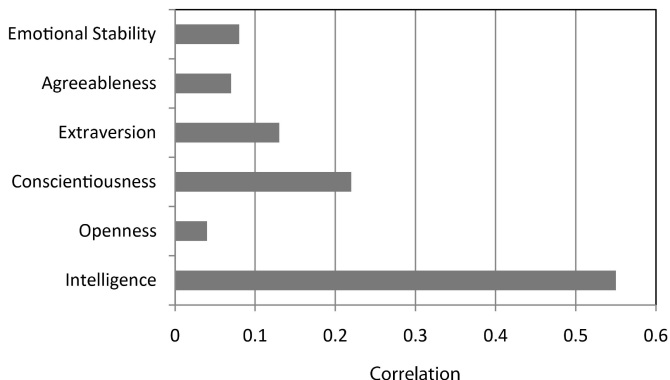
Notes: The values for personality are correlations that were corrected for sampling error, censoring, and measurement error. Job performance was based on performance ratings, productivity data and training proficiency. The authors do report the timing of the measurements of personality relative to job performance. Of the Big Five, the coefficient on Conscientiousness is the only one that is statistically significant with a lower bound on the 90credibility 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].

Mean log wages by age 30 (males)
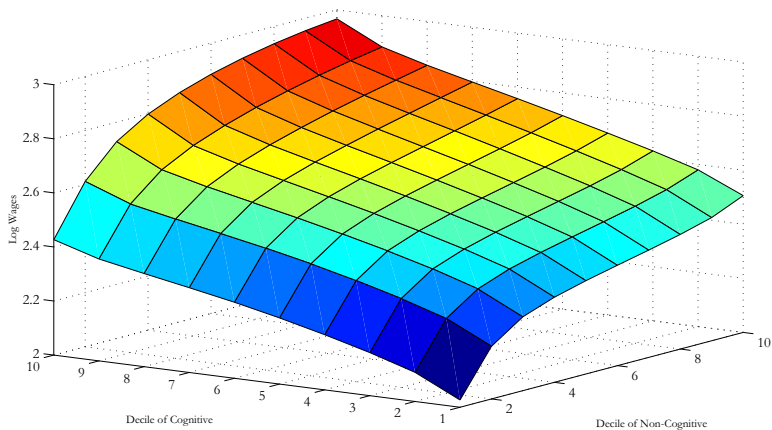
Mean log wages by age 30 (males)
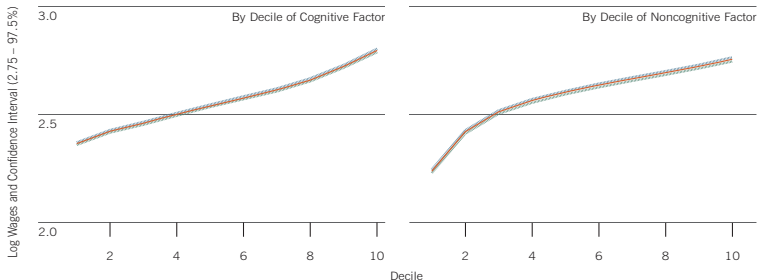
Notes: The data are simulated from the estimates of the model and our NLSY79 sample. We use the standard convention that higher deciles are associated with higher values of the variable. The confidence intervals are computed using bootstrapping (50 draws).

Overt Discrimination is No Longer a First-Order Problem in American Society

Ability Gaps Are Major Determinants of Minority-Majority Differences in Performance

Minority AFQT Scores Placed in the White Distribution
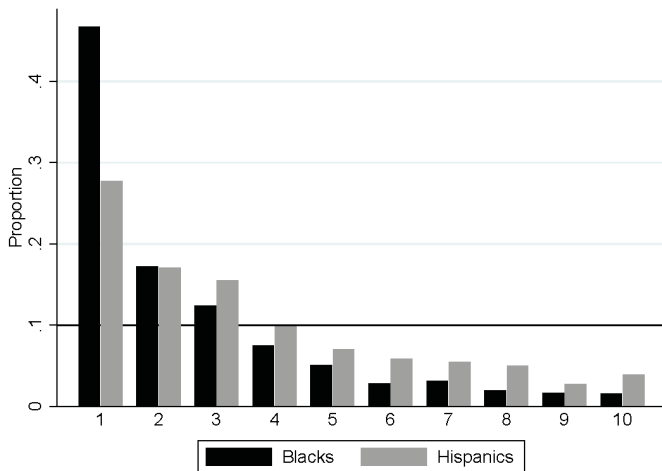
Source: National Longitudinal Survey of Youth 1979.

Shortfalls in Hourly Wages for Blacks and Hispanics in the Last Twenty Years: Actual Disparity and Disparity Adjusted for Ability

	Males		Females	
	Actual	Adjusted	Actual	Adjusted
Black	-25%	-6%	-17%	12%
Hispanic	-15%	3%*	-7%	17%

*Denotes not statistically significant from zero, that is, the adjusted gap is likely to arise from chance. Source: Authors calculations from the National Longitudinal Survey of Youth. For details, see the Web appendix at http://jenni.uchicago.edu/understanding_b-w_gap/. The wages are adjusted for age.

Differences in College Entry Proportions Between Minorities and Whites, Mid-1990s

	Black-White	Hispanic-White
Actual	-0.12	-0.14
Adjusted	0.16	0.15

Source: Stephen V. Cameron and James J. Heckman, "The Dynamics of Educational Attainment for Black, Hispanic, and White Males," *Journal of Political Economy* 109 (3) (2001).

Personality and Health

Figure 7: Correlations of Mortality with Personality, IQ, and Socioeconomic Status (SES)
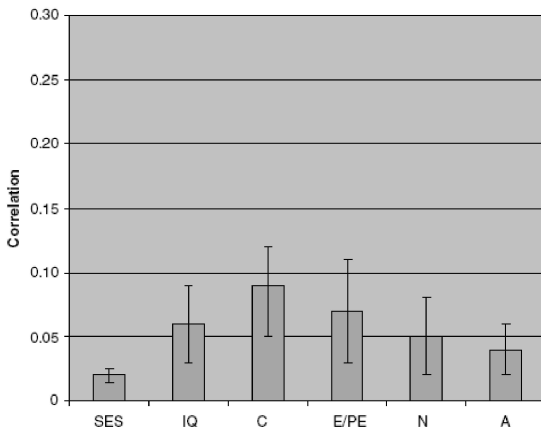
Notes: The figure represents results from a meta-analysis of 34 studies. Average effects (in the correlation metric) of low socioeconomic status (SES), low IQ, low Conscientiousness (C), low Extraversion/Positive Emotion (E/PE), Neuroticism (N), and low Agreeableness (A) on mortality. Error bars represent standard error. The lengths of the studies represented vary from 1 year to 71 years.
Source: Roberts, Kuncel, Shiner et al. [2007]

Probability of daily smoking by age 18 (males)

ii. By Decile of Cognitive Factor
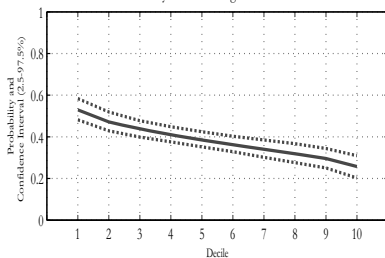
iii. By Decile of Noncognitive Factor
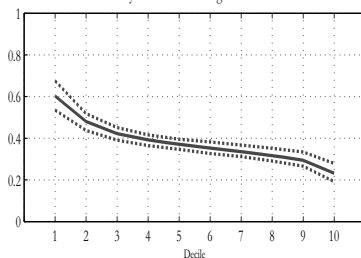
Notes: The data are simulated from the estimates of the model and our NLSY79 sample. We use the standard convention that higher deciles are associated with higher values of the variable. The confidence intervals are computed using bootstrapping (200 draws).

Probability of being single with children (females)
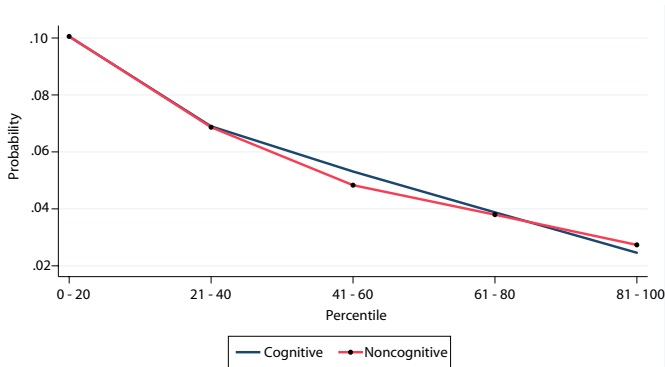
Note: This figure plots the probability of a given behavior associated with moving up in one ability distribution for someone after integrating out the other distribution. For example, the lines with markers show the effect of increasing noncognitive ability after integrating the cognitive ability.

Source: Heckman, Stixrud, and Urzua (2006).

Personality and Crime

Figure 8: 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].

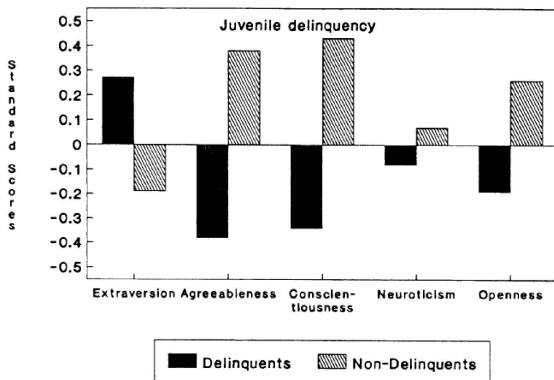## Ever been in jail by age 30, by ability (males)

Note: This figure plots the probability of a given behavior associated with moving up in one ability distribution for someone after integrating out the other distribution. For example, the lines with markers show the effect of increasing noncognitive ability after integrating the cognitive ability.

Source: Heckman, Stixrud, and Urzua (2006).

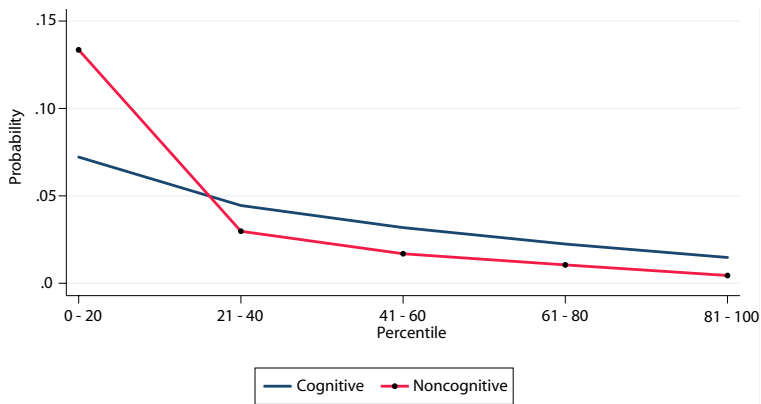**How to Conceptualize These Correlations and Establish a Causal Basis for Them?**

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

- ⓐ Place the concept of personality within economic model(s).

- ⓑ Define personality as an *emergent property* of a system.

- ⓒ Use the economic model(s) to frame and solve a central identification problem in empirical psychology (cognitive and noncognitive).

- ⓓ 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 9: Roberts's Model of Personality Psychology
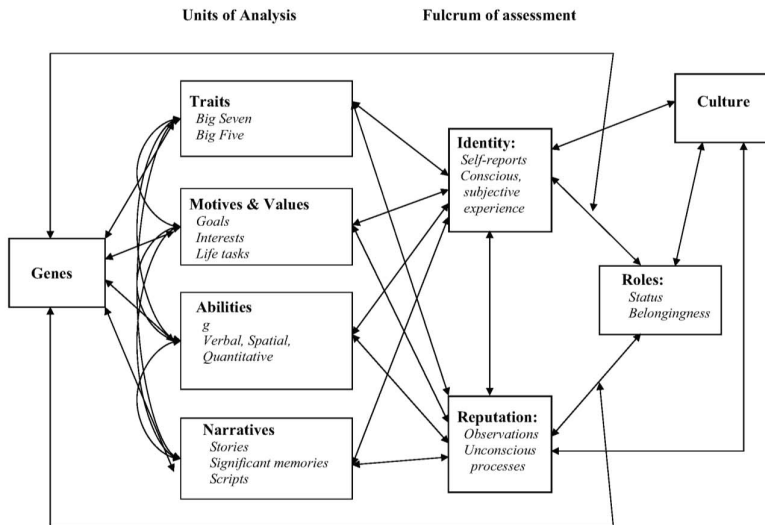
Source: Roberts [2006].

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? (Möbius, Niderle, Niehaus, and Rosenblat (2010))

    or

- All three?

Personality Traits Help to Determine Comparative Advantage Across Many Tasks

- Generalized Roy Framework
  (Heckman, Urzua and Stixrud, 2006).
- Agents can perform one of J tasks with productivity
  $P_j, j \in \{1, \ldots, J\}$.
- "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:

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

- Traits are endowments.

- θ: public good.

- Effort e_j: divisible and fixed in supply.

- $\sum\limits_{j=1}^{J} e_j = \bar{e}$, where $\bar{e}$ is the endowment of total effort.

- R_j: reward per unit productivity in task j.

- Possible to productively engage in only one of the J tasks at any time.

- Pick $\hat{j}$:

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

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

- $R_j \uparrow \Pr(j \text{ is selected}) \uparrow$

Multiple Tasks

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

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

subject to

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

- $R_j \uparrow e_j \uparrow$

A Fundamental Identification Problem:
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.

- Task j output is

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

- 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

- Consider the following case of two productivity measures for the two tasks j and j':

$$P_j = \phi_j \left(\theta_{1,\mu}, \theta_{1,\pi}, e_j \right)$$
$$P_{j'} = \phi_{j'} \left(\theta_{1,\mu}, \theta_{1,\pi}, e_{j'} \right), \qquad j \neq j'.$$

- Standardize measurements at a common level of effort $e_j = e_{j'} = e^*$.

- 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^* *assuming that the ϕ_k () are known*.

- **Only the pair is identified**.

- 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.

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 *special education* 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 10: AFQT Score Decomposed by IQ, Rosenberg, and Rotter

■ IQ, Rosenberg, and Rotter   ■ IQ   ▨ Rosenberg and Rotter
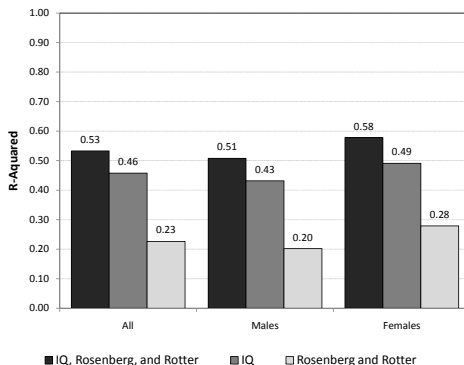
Notes: The data come from the NLSY. Rosenberg, and Rotter were administered in 1979. The ASVAB was administered in 1980.To account for varying levels of schooling at the time of the test, scores have been adjusted for schooling at the time of the test conditional on final schooling using the method developed 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 11: DAT scores and GPA decomposed by IQ and Personality
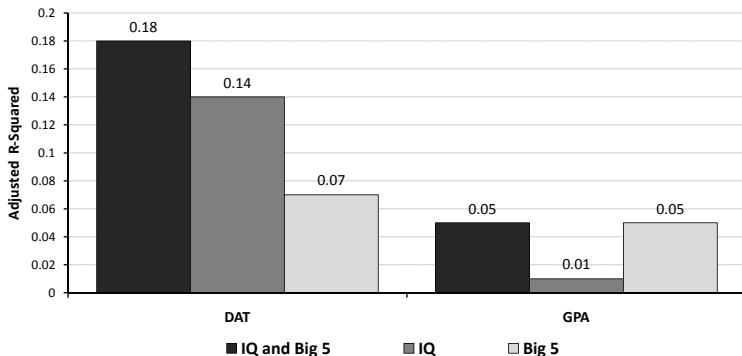
Notes: Data is from Stella Maris, a high school in the Netherlands. Students were administered part of a Raven's IQ test and personality questions based on the Big 5. DAT and GPA are from high school records.
Source: Borghans, Golsteyn, Heckman et al. [2010].

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.

- $P_{n,l}^q$: qth measurement on trait l for person n.

- The qth measurement of factor l for person n is

$$P_{n,l}^q = \mu_l^q + \lambda_l^q T_{n,l} + \epsilon_{n,l}^q, \tag{4}$$
$$q = 1, \ldots, Q_l, n = 1, \ldots, N, l = 1, \ldots, L$$

- More general case:

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

- 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 $\left(\epsilon_{n,l}^q \neq 0\right)$.

2. *Reverse causality*.

3. Especially problematic when interpreting contemporary correlations between personality measurements and outcomes.

The Quantitative Importance of Measurement Error

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)
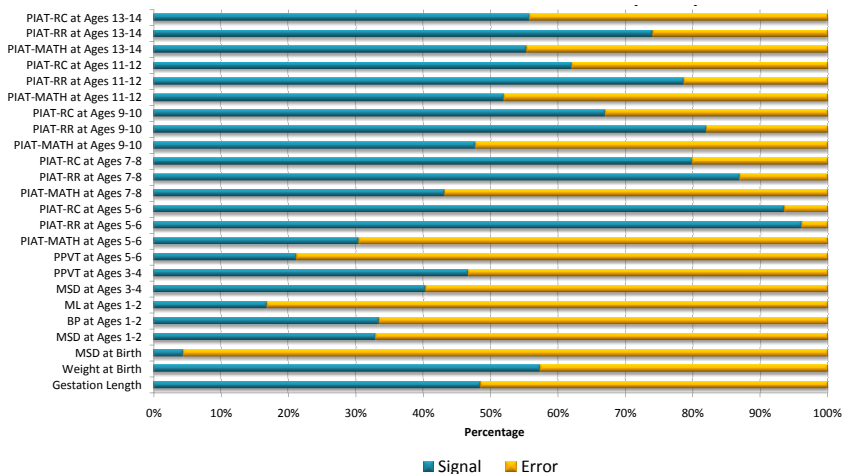
Source: Cunha, Heckman and Schennach [2010].

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)
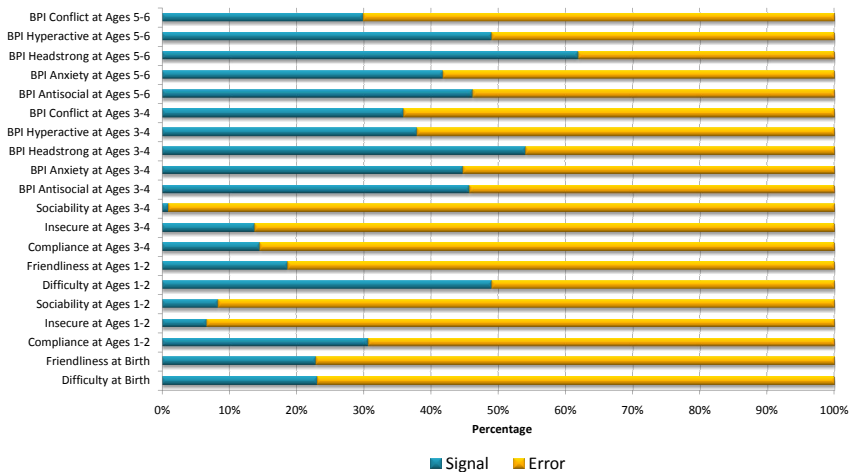
Source: Cunha, Heckman and Schennach [2010].

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)
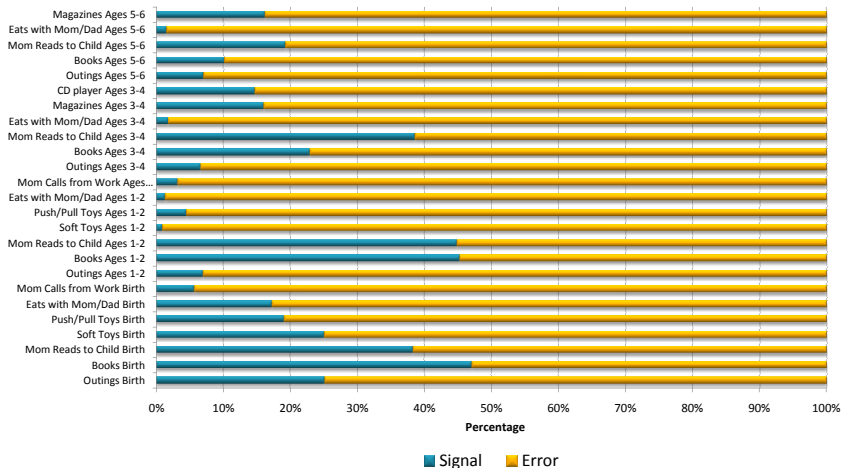
Source: Cunha, Heckman and Schennach [2010].

Extending The Simple Economic Models in Order to Produce a Precise Definition of Personality

Adding Preferences and Goals

- Preferences and goals (see Figure 9) may also shape effort.

- These are central features of "social-cognitive" theories of personality: Bandura and Mischel.

- Consider a model with multitasking.

Figure 9: Roberts's Model of Personality Psychology
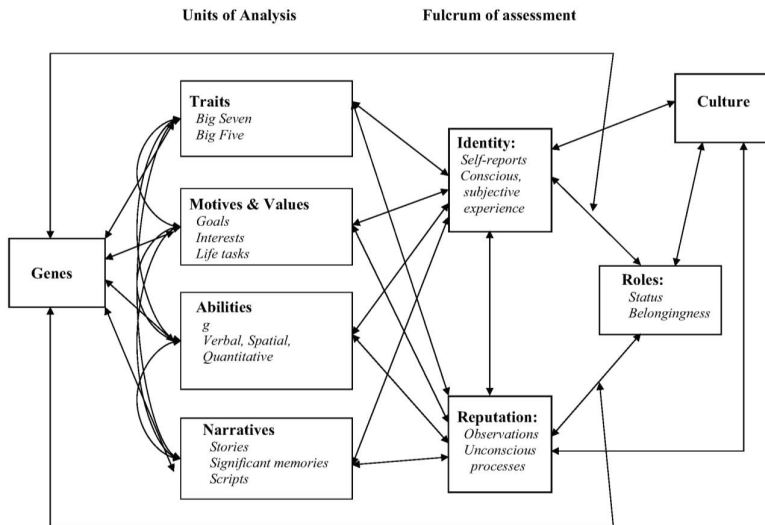
Source: Roberts [2006].

- Preferences:

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

- Agent maximizes (6) with respect

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

- Y is a flow of unearned income available:

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

- 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.

- The agent can be interpreted as making decisions based on

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

- 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.

- 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.

- Tasks can be accomplished by taking actions.

- The ith possible action to perform task j: $a_{i,j}$, $i \in \{1, \ldots, K_j\}$.

- Array actions in a vector $a_j = (a_{1,j}, \ldots, a_{K_j,j}) \in \mathcal{A}$.

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

$$P_j = \tau_j \left(a_{1,j}, a_{2,j}, \ldots, a_{K_j,j} \right). \qquad (10)$$

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

$$a_{i,j} = \nu_{i,j} \left(\theta, e_{i,j} \right) \qquad (11)$$

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.

- $\mathcal{M}$: the set of indexes of actions, including actions that do not directly contribute to productivity.

-

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

- The agent solves

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

with respect to X and e given the stated constraints.

Introduce "Situations"

- Situations indexed by $h \in \mathcal{H}$.

Personality is a response function.

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

- **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**.

- Many personality psychologists (e.g. Roberts as previously quoted) define personality as

    "*enduring patterns of thoughts, feelings and behaviors*"

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

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

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

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

- $g\left(h, e_{i,j} \mid T = (\theta, \psi, \bar{e}), \mathcal{I}\right)$ 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.

Stability and Change in Personality Traits and Preferences

- Traits change over the life cycle.
- They are *not* set in stone.

Figure 12: Cumulative Mean-Level Changes in Personality Across the Life Cycle

Social Vitality
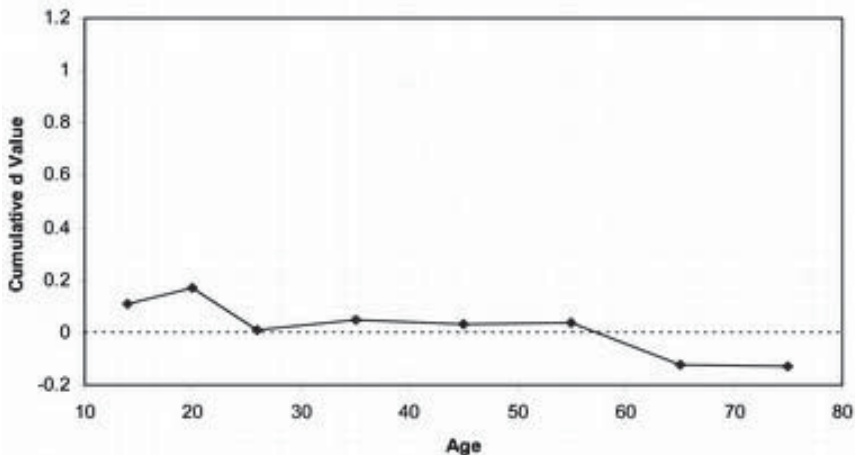
Note: Social vitality and social dominance are aspects of Big Five Extraversion. Cumulative d values represent total lifetime change in units of standard deviations ("effect sizes").
Source: Figure taken from Roberts, Walton and Viechtbauer [2006] and Roberts and Mroczek [2008]. Reprinted with permission of the authors.

Figure 12: Cumulative Mean-Level Changes in Personality Across the Life Cycle

Social Dominance

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.

Figure 12: Cumulative Mean-Level Changes in Personality Across the Life Cycle
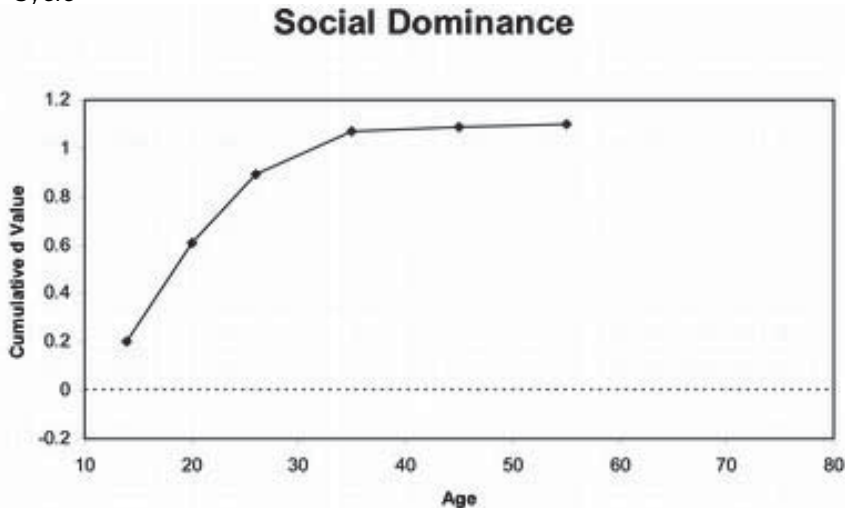

Note: Social vitality and social dominance are aspects of Big Five Extraversion. Cumulative d values represent total lifetime change in units of standard deviations ("effect sizes").
Source: Figure taken from Roberts, Walton and Viechtbauer [2006] and Roberts and Mroczek [2008]. Reprinted with permission of the authors.

Figure 12: Cumulative Mean-Level Changes in Personality Across the Life Cycle
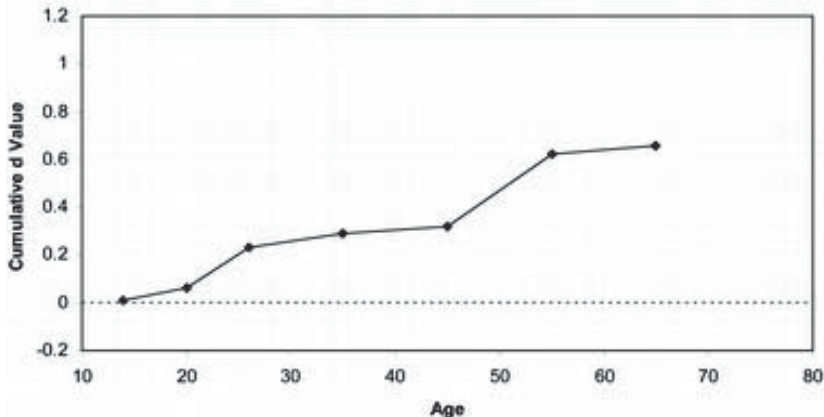

Conscientiousness

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.

Figure 12: Cumulative Mean-Level Changes in Personality Across the Life Cycle

Emotional Stability

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.

Figure 12: Cumulative Mean-Level Changes in Personality Across the Life Cycle
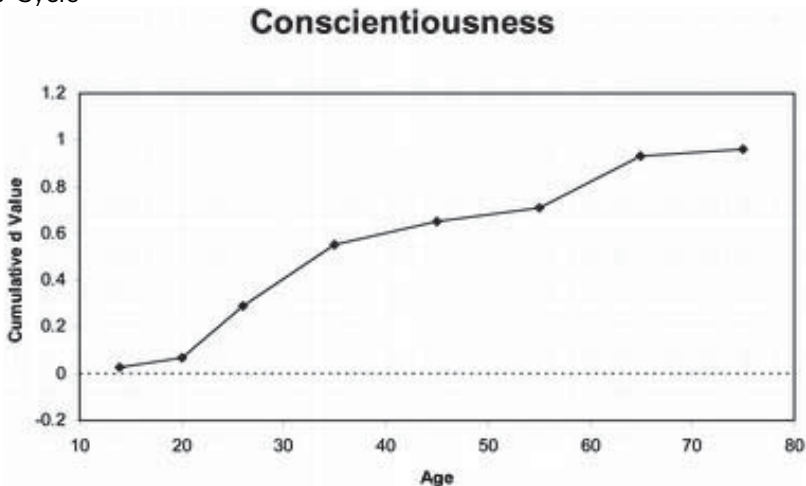

Openness to Experience
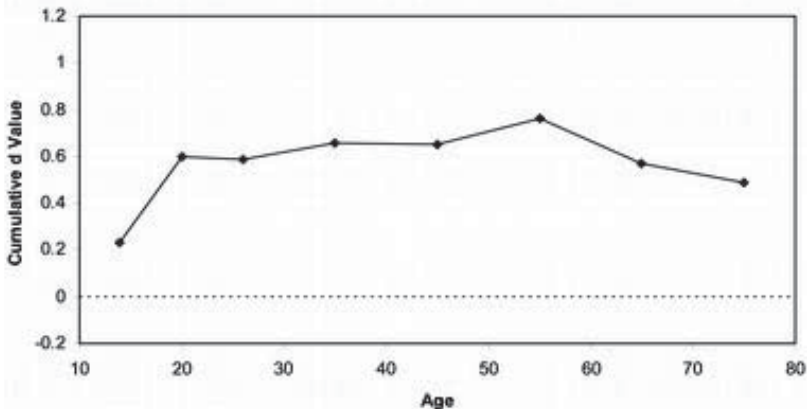
Note: Social vitality and social dominance are aspects of Big Five Extraversion. Cumulative d values represent total lifetime change in units of standard deviations ("effect sizes").
Source: Figure taken from Roberts, Walton and Viechtbauer [2006] and Roberts and Mroczek [2008]. Reprinted with permission of the authors.
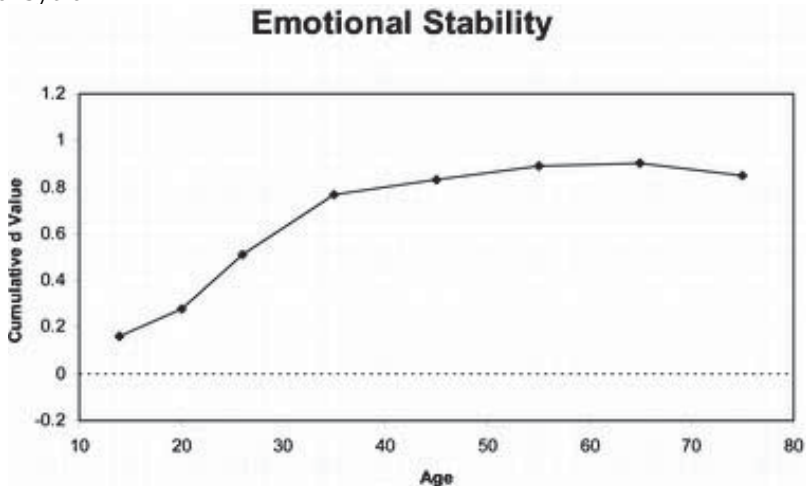
Figure 13: Longitudinal Analysis of Cognitive Skills
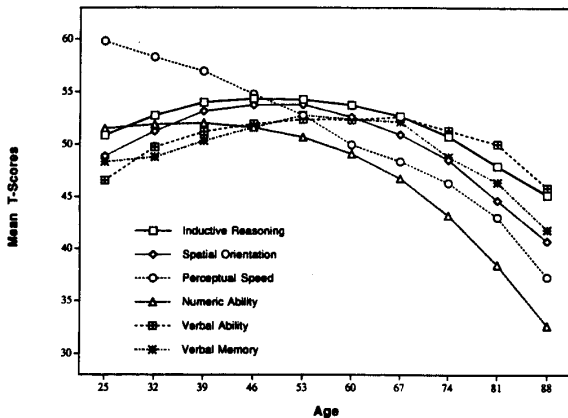
Notes: T-scores on the y-axis are standardized scores with a mean of 50 and a standard deviation of ten.
Source: Figures taken from Schaie [1994]. Used with permission of the publisher.

Three Processes of Development Discussed in the Literature

- Ontogeny (programmed developmental processes common to all persons).

- 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 life cycle.

Life Cycle Dynamics of the Model

- T^v: traits at age v, $v \in \{1, \ldots, V\} \in \mathcal{V}$.

- Information $\mathcal{I}^v$ may be updated through various channels of learning.

- The technology of skill formation
  (Cunha and Heckman [2007; 2009]):

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

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

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

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

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

Personality and Economic Preference Parameters

- Measures of personality predict a wider 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 remains unclear.

Table 6: 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 7: 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] , Bekkers [2006]
Reciprocity	Neuroticism, Agreeableness, Conscientiousness	Dohmen, Falk, Huffman et al. [2008]
Trust	Neuroticism, Agreeableness, Openness, Conscientiousness	Dohmen, Falk, Huffman et al. [2008]

Figure 14: Pairwise Correlations between Time Preference (Impatience), Risk Tolerance, Personality, and Cognitive Ability for Males and Females

Time Preference							
0.008 0.86	O						
0.068 0.13	0.109 0.00	C					
0.066 0.14	0.416 0.00	0.105 0.00	E				
0.083 0.06	0.083 0.01	0.290 0.00	0.049 0.12	A			
0.060 0.18	0.193 0.00	0.064 0.04	−0.013 0.69	−0.012 0.71	N		
−0.119 0.01	0.162 0.00	−0.152 0.00	0.146 0.00	−0.137 0.00	−0.064 0.05	Symbol Test	
−0.101 0.03	0.154 0.00	−0.130 0.00	0.117 0.00	−0.183 0.00	−0.082 0.02	0.404 0.00	Word Test

Notes: *statistically significant at the10 percent level; **statistically significant at the 5 percent level; ***statistically.
O-Openness to Experience; C-Conscientiousness; E-Extraversion; A-Agreeableness; N-Neuroticism. The value in each box is the pairwise correlation. Darker shaded boxes have lower p-values. The measures of the Big Five are based on 3 questions each. The measures of cognitive ability (symbol test and word test) are based on timed modules similar to the Wechsler Adult Intelligence Scale (WAIS). Time preference and risk tolerance were elicited through a real-stakes experiment.
Source: The data come from Dohmen, Falk, Huffman et al. [2010], available online. The calculations were conducted by the authors.

Table 8: Link between Personality Traits and Preferences

Author(s)	Main Variable(s)	Data and Methods	Causal Evidence	Main Result(s)
Altmann, Dohmen and Wibral [2008]	Outcome(s): *trust* – amount the first-player sends in a real-stakes experimental trust game	Data: Collected by authors; 240 students from the University of Bonn	Controls: gender	Reciprocity and trust are positively related (p<0.01). Risk aversion and trust are positively related (p<0.05).
			Timing of Measurements: The measures are contemporaneous.	
	Explanatory Variable(s): *reciprocity* – amount returned by the second player in a real-stakes experimental trust game; *risk aversion* – certainty equivalent as measured by real-stakes choices over lotteries	Methods: OLS	Theory: People might generally value adhering to social norms associated with trust and reciprocity.	
Borghans, Golsteyn, Heckman et al. [2009]	Outcome(s): *risk aversion* – choices over real-stakes lotteries; *ambiguity aversion* – comparison of the willingness to bet on lotteries when the probability distribution is unknown	Data: Collected by authors; 347 students aged 15 to 16 from a Dutch high school	Controls: n/a	Men are less risk averse than women (p<0.001) but more ambiguity averse (p<0.05). Risk-aversion is mediated by personality (p<0.05), while ambiguity aversion is not. Risk-aversion is positively associated with Agreeableness and Neuroticism and is negatively associated with ambition (p<0.05).
			Timing of Measurements: The measures are contemporaneous.	
		Methods: OLS, F-test	Theory: Risk aversion and ambiguity aversion represent different preferences and might reflect different personality traits.	
	Explanatory Variable(s): *gender*; *personality* – self-reported measures of The Big Five, ambition, flexible thinking, and self-control			

Table 8: Link between Personality Traits and Preferences

Author(s)	Main Variable(s)	Data and Methods	Causal Evidence	Main Result(s)
Borghans, Meijers and ter Weel [2008]	Outcome(s): *cognitive ability* – number of correct answers on an IQ test; *effort* – time spent on each question Explanatory Variable(s): *risk aversion* – survey response to lotteries; *time preference* – survey response to trade-offs across time; *leisure preference* – survey response; *experiment incentives* – payment for correct answers to the IQ test; *personality* – self-reported Big Five, performance motivation, positive and negative fear of failure, locus of control, social desirability, curiosity, resilience, enjoyment of success, attitude toward work	Data: Collected by authors; 128 university students from a Dutch University Methods: probit	Controls: type of cognitive test, the amount of incentive pay, and time constraints Timing of Measurements: They measured IQ both before and after providing incentives. Theory: People with different personalities and preferences might be willing to expend different amounts of mental effort during a test.	Performance motivation, fear of failure, internal locus of control, curiosity, low discount rates, and risk aversion are positively associated with more correct answers (p<0.05). Negative fear of failure, Extroversion, Openness to Experience, and Agreeableness are negatively associated with answering the question correctly (p<0.05). Incentives did not affect the number of questions answered correctly. Intrinsic motivation, curiosity, internal locus of control, Emotional Stability, Conscientiousness, and discount rates are negatively associated with responsiveness to incentives (p<0.05). Risk aversion is negatively associated with responsiveness to incentives (p<0.10). Leisure preference and Openness to Experience are positively associated with responsiveness (p<0.05).

Table 8: Link between Personality Traits and Preferences

Author(s)	Main Variable(s)	Data and Methods	Causal Evidence	Main Result(s)
Burks, Carpenter, Goette et al. [2009]	Outcome(s): *risk aversion* – choices over real-stakes lotteries; *time discounting* – choices over real-stakes payments at different times; *inconsistent risk and time preference* – making at least one inconsistent choice in the experiments eliciting preferences; *job performance* – whether a worker leaves before the end of the first year Explanatory Variable(s): *cognitive ability* – IQ as measured by an adaptation of Raven's Standard Progressive Matrices	Data: Collected by authors, administrative data; 892 trainee truckers from a U.S. trucking company (2005-2006) Methods: OLS, interval regressions, linear probability model, Cox proportional hazard	Controls: race, age, age squared, education, household income, absorption, achievement, aggression, alienation, control harm avoidance, social closeness, social potency, stress reaction, traditionalism, and well-being Timing of Measurements: The measures are contemporaneous, except for job-turnover which was evaluated after the experiment. Theory: People with higher IQ can better forecast the future.	An increase in IQ from the bottom quartile to the top quartile is associated with an increase in risk-taking consistency of 25 percentage points (p<0.001), an increase of intertemporal consistency of 15 percentage points (p<0.001), a decrease in discount rate (p<0.001), and a decrease in risk aversion (p<0.001). People in the lowest quartile of IQ are about twice as likely to leave the job within the first year (p<0.001).

Table 8: Link between Personality Traits and Preferences

Author(s)	Main Variable(s)	Data and Methods	Causal Evidence	Main Result(s)
Daly, Delaney and Harmon [2009]	Outcome(s): *time preference* – discount rate measured by a real-stakes choices over delayed payments Explanatory Variable(s): *health* – blood pressure, body fat, blood glucose, weight, height, heart rate; *personality* – questionnaire measures of The Big Five, self-control, consideration of future consequences, elaboration of potential outcomes, emotional regulation, cognitive and affective mindfulness, suppression of unwanted thoughts, experiential avoidance	Data: Collected by authors; 204 students from Trinity College Dublin Methods: factor analysis, OLS	Controls: age and sex Timing of Measurements: The measures are contemporaneous. Theory: Personality traits and health indicators might be associated with willingness to delay gratification.	Age and sex do not predict the estimated discount rate. A factor that loads heavily on self-control, consideration of future consequences, elaboration of consequences, affective mindfulness, and Conscientiousness is negatively associated with the discount rate (p<0.01). A factor that loads on blood pressure is positively associated with the discount rate (p<0.10).

Table 8: Link between Personality Traits and Preferences

Author(s)	Main Variable(s)	Data and Methods	Causal Evidence	Main Result(s)
Dohmen, Falk, Huffman et al. [2011]	Outcome(s): *experimental risk measure* – measured by real-stakes choices over lotteries and cash payments	Data: Collected by the authors; 450 adults from Germany	Controls: gender, age, height, and other personal characteristics	Survey measures of general risk attitude predict incentive compatible, experimentally elicited measures of risk attitude (p<0.01).
	Explanatory Variable(s): *survey risk measure* – survey responses on an 11-point scale, relating to general risk preference and risk preference relating to car driving, financial matters, leisure and sports, career and health	Methods: OLS	Timing of Measurements: The measures are contemporaneous.	
			Theory: Survey and experimentally-elicited risk measure the same concept	
Ding, Hartog and Sun [2010]	Outcome(s): *experimental risk measure* – measured by real-stakes choices over lotteries and cash payments	Data: Collected by the authors; 121 students of PKU in Beijing who participated in an experiment (2008)	Controls: major, gender, family income, and class rank	The survey measures of risk explain at most 10 percent of the variance in the experimental measures of risk (general risk attitude and financial risk are the best). Self-assessed risk depends much on the domain or context; the highest correlation between context-based survey questions is r=0.55. Women are more risk averse than men; risk-aversion decreases with parental income; and risk attitudes depend on domain (context). People view winning and losing money differently.
	Explanatory Variable(s): *survey risk measure* – responses on an 11 point scale, relating to general risk preference and risk preference relating to car driving, financial matters, leisure and sports, career and health, survey responses to hypothetical lotteries	Methods: OLS, correlations	Timing of Measurements: The measures are contemporaneous.	
			Theory: There could be an underlying risk parameter that applies in all situations.	

Open Question

Given the disappointing knowledge currently available from much of personality psychology it may well prove more fruitful to use economics to define and measure personality parameters.

- Psychological measures originate in description.
- Economic preference parameters designed to describe and predict behavior.
- 20 years from now, psychology may well be based on preferences elicited by economic personality choice data.
- See the essay by Corr, Ferguson and Heckman (2011) that summarizes a new literature *by psychologists* eliciting personality traits from economic choice experiments.

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 currently 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?

6. To develop a new choice-based, behavior-based taxonomy of traits to supplement or improve on the Big Five.