Personality, Education, and Health-Related Outcomes of High-Ability Individuals

Peter Savelyev[1] and Kegon T. K. Tan[2]

IZA/OECD/World Bank Workshop on Cognitive and Noncognitive Skills and Economic Development

October 3, 2014
This draft: September 25, 2014

[1]Vanderbilt University, Department of Economics
[2]University of Wisconsin–Madison, Department of Economics

Overview

How to Achieve Greater Health?

- It is a popular idea that more resources should be spent on cost-effective medical prevention
- A major complement to medical prevention: changing lifestyles through altering human development
- Expect major determinants of human development among psychological skills and education investments (Almlund et al., 2011).
- We motivate the study with a theoretical framework that shows multiple economic reasons for choices of health behaviors and the role of personality.
- We estimate effects of psychological skills and post-compulsory education on health, health behaviors, and other health-related outcomes.
    - Substantial effects of skills and education on health-related outcomes
    - Strong control for the familywise error rate (FWE)
- Contribution to two distinct fields: health economics and economics of personality.

Contribution to Health Economics Literature

- Some papers claim a strong causal effect of education on health-related outcomes (Grossman, 2004; Grossman and Kaestner, 1997; Lleras-Muney, 2005; Lundborg et al., 2012), while others do not (Behrman et al., 2011; Clark and Royer, 2013; Kohler et al., 2011; Mazumder, 2008).
- The controversy is likely due to the fact that IV (and RDD) methods have serious limitations.
  - Validity, monotonicity, weakness, loss of precision.
  - Effect identified only for a specific sub-population that is induced by the instrument to change behavior, so the effect is not necessarily policy-relevant (Heckman and Vytlacil, 2007).
- We take an approach in this paper that serves as an alternative to natural experiments (Heckman et al., 2006).
- We provide additional evidence in favor of the causal effect of college education on health-related outcomes.
- We acknowledge limitations of the method.

Contribution to Economics of Human Development

- Seminal paper by Heckman et al. (2006): strong effects of cognitive and one-dimensional noncognitive skills on numerous life outcomes.
- Heckman, Conti, and Urzúa (2013) show effects of endowments and education on multiple health-related outcomes based on the British Cohort data.
- HCU, however, only have health outcomes till age 42 and use a one-dimensional personality skill.
- In this paper we account for personality factors closely linked to the contemporary Big Five theory of personality, and use longitudinal data for ages 12–86.
- We find strong effects of multiple psychological skills on health-related outcomes over life cycle.
- Association between some personality skills and health-related outcomes has been established by psychologists (Friedman and Martin, 2011), who, however, missed important results since they **did not** document the EFA and CFA, eliminate the attenuation bias, attempt to establish causal inference, or control for the FWE.

Terman Data

- A sample of over 1,500 school children from California
- Children of IQ>140 born on average in 1910
- Unique combination of data ideal for studying human development
    - Detailed data on IQ, personality, childhood health, and family background gathered in 1922 (about age 12)
    - Prospective life-cycle data for about 70 years
    - Health behaviors, health measures, and other lifestyle choices and outcomes
        - **Health-related consumption and proxies**: alcohol consumption, smoking, BMI, physical activity
        - **Health**: general health, mental health
        - **Lifestyles**: marriage, memberships in organizations
        - **Income**

Why Use Sample of High Ability People?

- **Exploring a limiting case**: which relationships to expect when IQ is high
- The limiting case helps us to **verify some claims in the literature**
- Auld and Sidhu (2005): schooling has a large effect on health...
  - (1) "only for individuals who obtain low levels of schooling, particularly low-ability individuals"
  - (2) "years of schooling beyond high school contribute very little to health."
- On the contrary, we find that...
  - ...college education strongly improves health-related outcomes...
  - ...even for individuals of extraordinarily high ability.
- **Good econometric properties:** IQ is not a confounding factor by study design since all participants have cognitive potential to get post-compulsory education
- Also, we argue that our results for people with extraordinary IQ are **likely generalizable to a broader population** of smart people

Table 1: Description of Nearly Big Five Personality Measures

Openness	Conscientiousness	Extraversion	Agreeableness	Neuroticism
Desire to know	Prudence	Fondness for large groups	Easy to get along	Miserable
Originality	Conscientiousness	Leadership	Avoid arguments	Touchy
Intelligence	Truthfulness	Popularity	Critical	Periods of Loneliness
			Tactful	Lonely when with others
			Unfeeling	Remorseful
			Domineering	Lack self confidence
			Inflated self-opinion	Worry about humiliation
				Emotionally unstable
				Easily hurt
				Hard to be serene
				Moody
				Sensitive

- Openness, Conscientiousness, Extraversion based on teachers' and parents' ratings. Agreeableness and Neuroticism based on self-ratings.

Mechanisms of Longevity Production

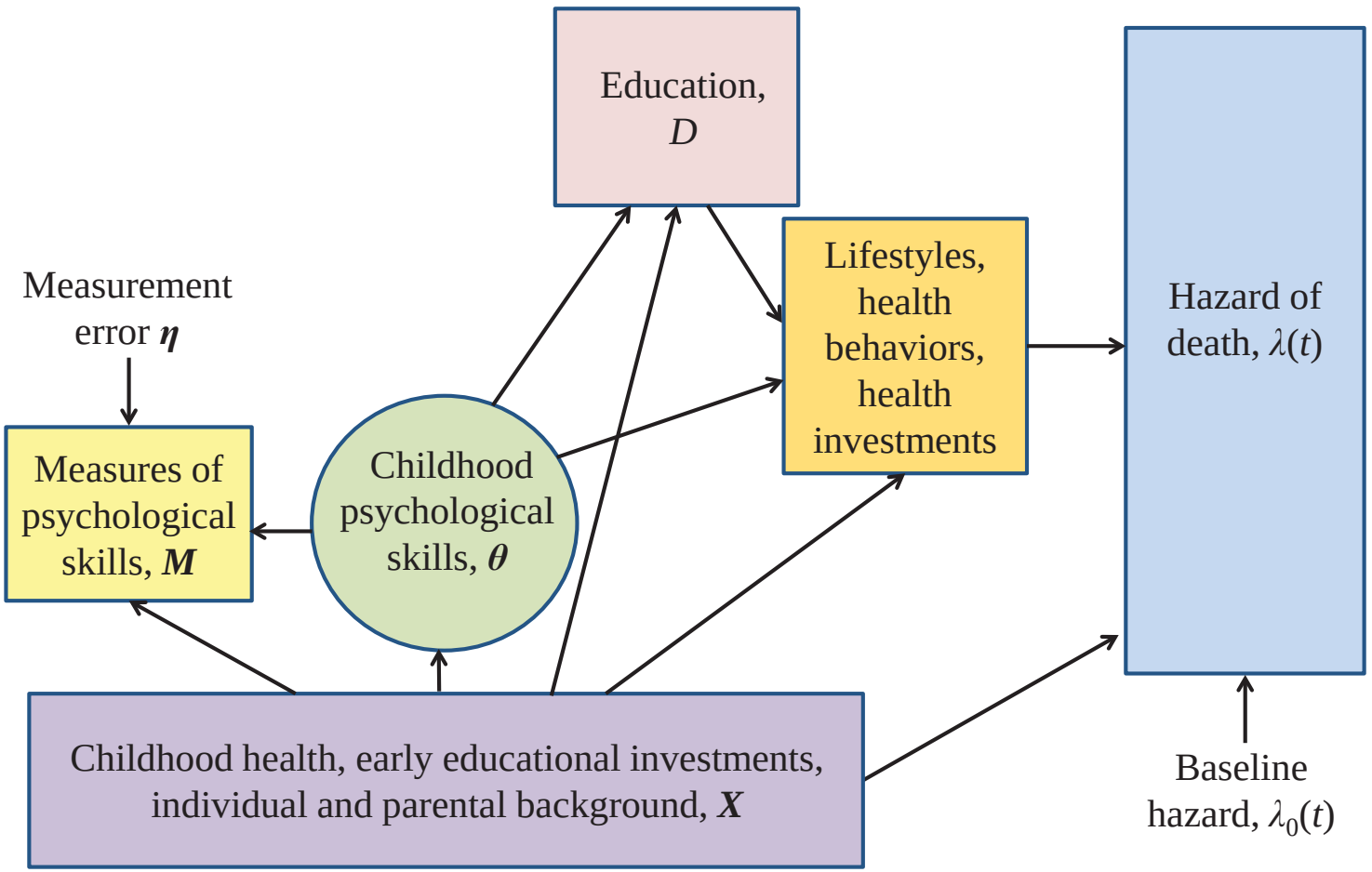


Table 2: Qualitative Summary of Main Results

	Health-beneficial effects			
	Males		Females	
Determinant	Sign	Strong evidence	Sign	Strong evidence
A. Psychological Skills				
Conscientioiousness	+	yes		
Openness	-	yes	-	
Extraversion	+/-	yes	-	
Agreeableness	+/-	yes	+/-	
Neuroticism	-	yes	-	yes
Cognition (IQ)	+/-		-	
B. Formal Education				
College Education or above	+	yes	+	yes

Conceptual Framework

We build on a model presented in Savelyev (2014) following Becker's general framework (2007)

The Model

- Two-period model with time-separable utility
- The model is easily generalizable to more periods, but a two-period model already demonstrates the key features
- Assume perfect capital and annuity markets

$$\max u_1(C_1^N, C_1^H, H_1) + B(\Theta) \cdot S(H_2) \cdot u_2(C_2^N, C_2^H, H_2, C_1^H),$$

$$\text{where } H_2 = f(I, D, \Theta) + (1 - \delta(C_1^H))H_1,$$

$$\text{s.t. } C_1^N + p^H C_1^H + g(D, H_1, \Theta) + p^I I + \frac{S(H_2)}{1+r}(C_2^N + p^H C_2^H)$$

$$= A + Y_1(H_1, \Theta) + \frac{S(H_2)}{1+r} Y_2(D, H_2, \Theta)$$

First Order Conditions: Health-Related Consumption

$$\underbrace{\frac{\partial u_1}{\partial C_1^H}}_{\text{cons. benefit}} \underbrace{-B(\Theta)S'(H_2)\delta'(C_1^H)H_1 u_2}_{\text{longevity benefit}} \underbrace{-B(\Theta)S(H_2)\frac{\partial u_2}{\partial H_2}\delta'(C_1^H)H_1}_{\text{health benefit}}$$

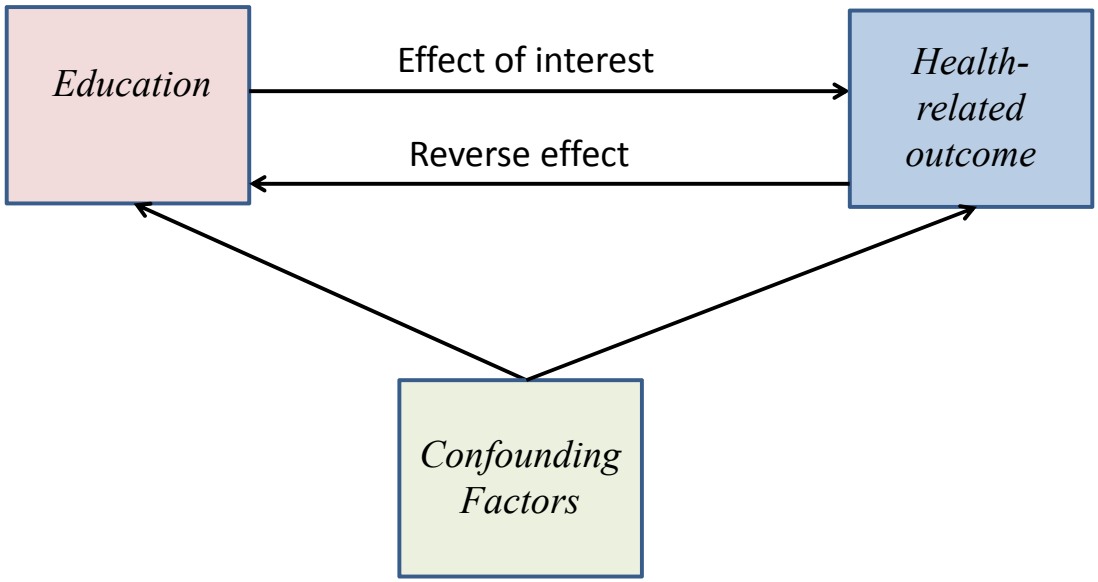
$$\underbrace{+B(\Theta)S(H_2)\frac{\partial u_2}{\partial C_1^H}}_{\text{addiction benefit}} \underbrace{+\lambda\frac{S(H_2)}{1+r}\frac{\partial Y_2}{\partial H_2}\delta'(C_1^H)H_1}_{\text{health productivity}}$$

$$= \lambda\Big(\underbrace{p^H}_{\text{price}} \underbrace{+\frac{S'(H_2)\delta'(C_1^H)H_1}{1+r}(C_2^N + p^H C_2^H - Y_2(D, H_2, \Theta))}_{\text{budget deficit}}\Big).$$

- Skills Θ affect three MBs through B.
- Skills and education affect Y; Y affects BD and u_2 through wealth effect.
- Complementarities: Θ boost D and I, while D and I boost H_2, Y_2, S, and u_2.
- D has similar complementarities.

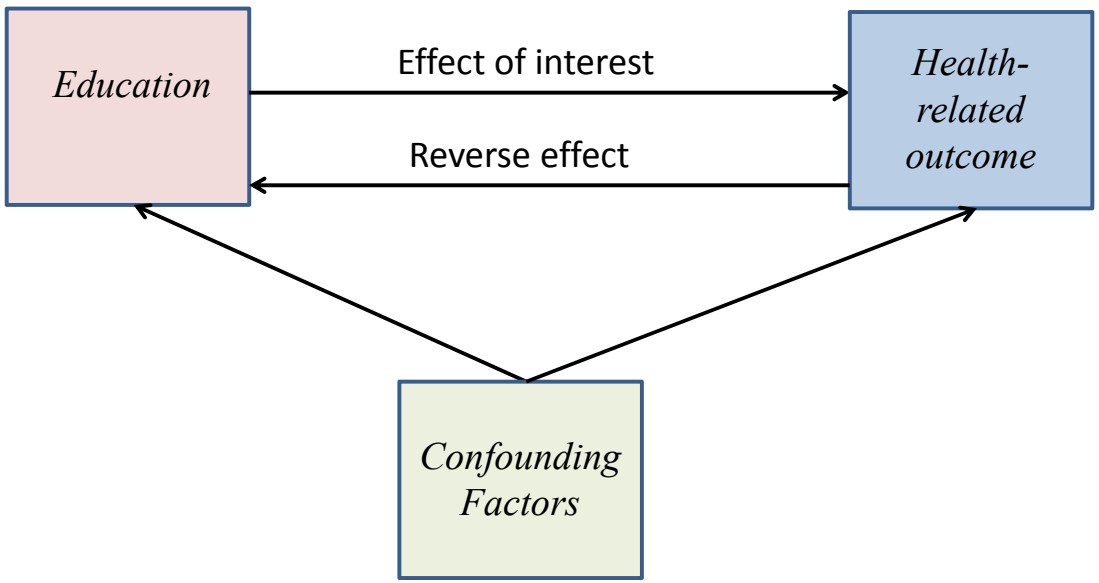
Empirical Methodology

Figure 1: Causal Effect Identification



1. The CI assumption: $(Y_0, Y_1) \not\perp\!\!\!\perp D \mid \mathbf{X}, \mathbf{\Theta}$ (Heckman et al., 2006)
   - Sample is already rather homogeneous
   - Condition on essential observables: IQ, childhood health, early childhood education, parental wealth and social status, and other family background
   - Method goes beyond matching on observables
   - Condition on a comprehensive set of latent personality factors with well-established interpretation (John and Srivastava, 1999)

Figure 2: Causal Effect Identification (Continued)



2. Minimize the influence of the reverse causality
   - Drop a few outliers with severe medical conditions in childhood
   - Drop subjects who did not survive to age 30
   - Control for childhood health, early parental deaths, and other essential background controls that may predict future health

Methodology

Full Model: Personality skills, education, and standard controls:

$$H^k = a^k D + \mathbf{b}^k \mathbf{\Theta}^P + c^k \Theta^G + \mathbf{d}^k \mathbf{X} + \epsilon^k$$

We account for multiple hypothesis testing using the stepdown procedure of Romano and Wolf (2005), a new version of the Holm-Bonferroni method with superior power

Model Comparison 1: Personality skills only

$$H^k = \mathbf{b}_p^k \mathbf{\Theta}_u^P + \epsilon_p^k,$$

Model Comparison 2: Education and standard controls only

$$H^k = a_r^k D + c_r^k \Theta^G + \mathbf{d}_r^k \mathbf{X} + \epsilon_r^k.$$

Measurement System

$$\mathbf{M} = \boldsymbol{\xi} + \boldsymbol{\psi}\boldsymbol{\Theta}^{P} + \boldsymbol{\pi}A + \boldsymbol{\gamma}\mathbf{X} + \boldsymbol{\eta}, \tag{1}$$

- $\mathbf{M}$ is a vector of the full set of K personality measures selected for estimation;
- $\boldsymbol{\xi}$ is a vector of intercepts;
- $\boldsymbol{\psi}$ is a $K \times I$ matrix of factor loadings representing relationships between I latent factors, $\boldsymbol{\Theta}$, and personality measures;
- $\boldsymbol{\pi}$ is a vector of K elements capturing the relationship between age of testing, A, and personality measures;
- $\boldsymbol{\gamma}$ is a $K \times Q$ matrix that relates a vector of Q background control variables, $\mathbf{X}$, to measures;
- $\boldsymbol{\eta}$ is a vector of measurement errors.

Stepdown Methodology

Multiple Hypothesis Testing Problem

- Consider a family of single tests. Let the chance of false rejection for every single test be $\alpha = P(H_1|H_0)$.
- The problem is that the chance of *at least one* false rejection is substantially higher than α.
- Define family-wise error rate, FWE= P(Reject at least one H_i| all H_i are true.)
  - For instance, $\alpha = 0.05$ for each single test
  - For a family of four independent tests the FWE(4)=$1-(1-0.05)^4$=0.19
  - FWE(7)=0.30; FWE(10)=0.40; FWE(60)=0.95; FWE(90)=0.99
- Hence, we want statistical inference that somehow controls for FWE
- The problem is well-recognized in genetic research where hypotheses for thousands of single genes are involved.
- In social sciences the issue is largely ignored despite substantial FWE .
- The problem is even worse because of selective reporting of statistically significant outcomes also called "cherry-picking".

Stepdown Procedure by Romano and Wolf (2005) as Implemented in this Paper

Let there be K individual hypotheses in a family and B boostrap draws of t-statistics for each hypothesis. t-statistics are absolutized since all tests are double-sided.

1. For each individual hypothesis in the family obtain the true t-statistic and B bootstrap t-statistics.
2. Find the maximal t-statistic among K true t-statistics. Do the same for each pseudo sample to get a bootstrap distribution of maximal t-statistics.
3. Use the distribution of maximal bootstrap t-statistics to test the hypothesis associated with the maximal true t-statistic. The p-value of this test is the stepdown-adjusted individual hypothesis p-value.
4. If the test cannot be rejected at chosen significance level then stop the procedure and conclude that none of the remaining tests can be rejected.
5. If the test can be rejected then exclude the rejected hypothesis from the family. If only one hypothesis is left after the exclusion then test the hypothesis individually and stop the procedure. If more than one hypotheses are left then repeat the procedure starting from (2).

Advantages of the Stepdown Procedure

- Strongly controls for the family-wise error rate (FWE)
- (Strong control: holds regardless of which subset of hypotheses happen to be true (any partial null); weak control: holds if all hypotheses are true (the complete null) (Westfall and Young, 1993))
- Tests for statistical significance of every single hypothesis, unlike standard joint tests
- A more powerful method than the computationally simpler Bonferroni and Holm-Bonferroni methods
- (Gains in power come from accounting for statistical dependencies among individual test statistics using resampling techniques)
- No need to resample t-statistics again for the subsequent stages of stepdown
- (Despite no need to resample multiple times, these calculations still took us weeks: models with five latent factors for both genders and for multiple outcomes)

Examples of Stepdown Testing

Table 3: Stepdown Example 1: Effects of Conscientiousness on Heavy Drinking

	mean	effect	std. error	p-value	stepdown adjusted p-value
Drank Heavily in 1960	.347	-.072	(.026)	***.004***	***.018***
Ever Drank Heavily	.394	-.055	(.023)	***.018***	***.036***
Drank Heavily in 1940	.267	-.046	(.022)	***.033***	***.065***
Drank Heavily in 1950	.118	-.012	(.017)	.518	.518

- All results survive if we adopt a 10% threshold

Table 4: Stepdown Example 2: Effects of Agreeableness on Heavy Drinking

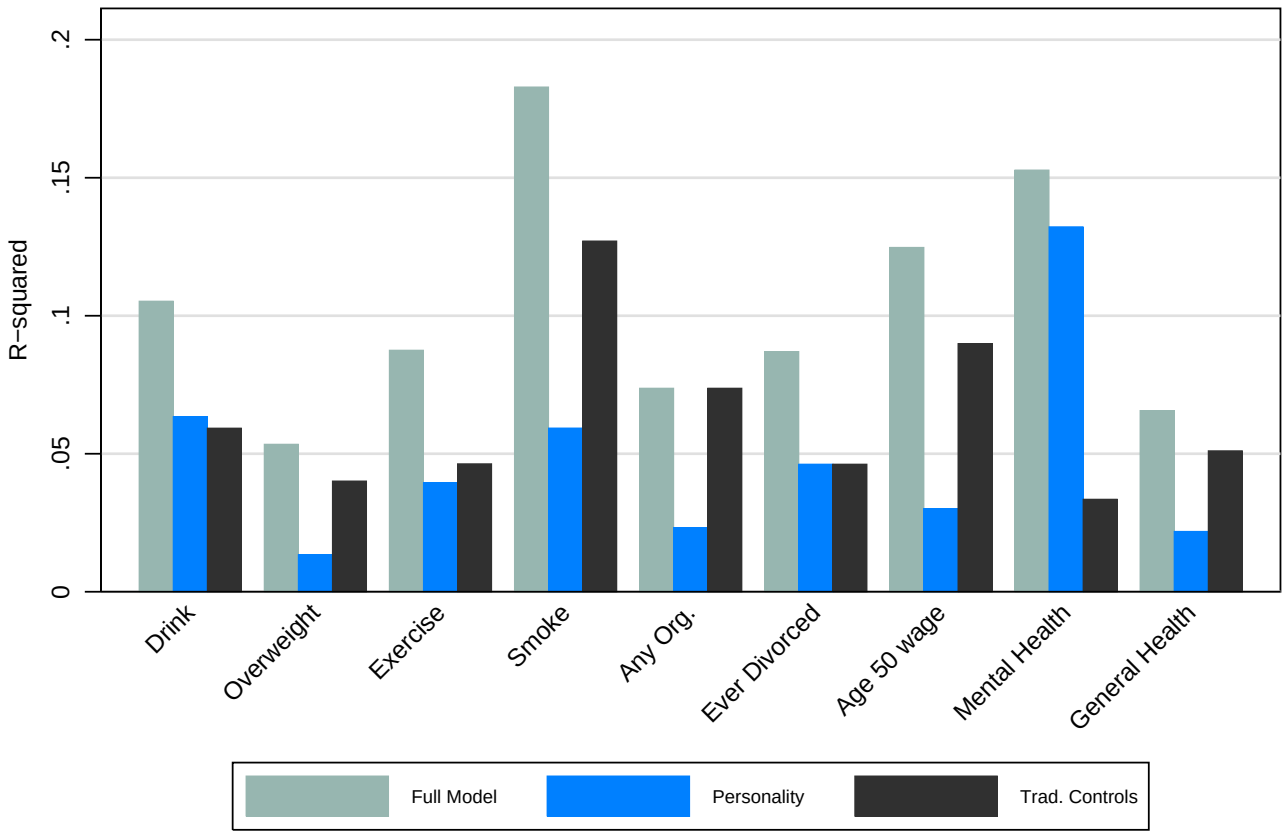
	mean	effect	std. error	p-value	stepdown adjusted p-value
Drank Heavily in 1940	.267	-.048	(.025)	***.063***	.170
Drank Heavily in 1950	.118	-.031	(.017)	***.083***	.172
Ever Drank Heavily	.394	-.045	(.027)	.103	.158
Drank Heavily in 1960	.347	-.020	(.029)	.475	.475

- None of results survive if we adopt a 10% threshold

Results and Discussion

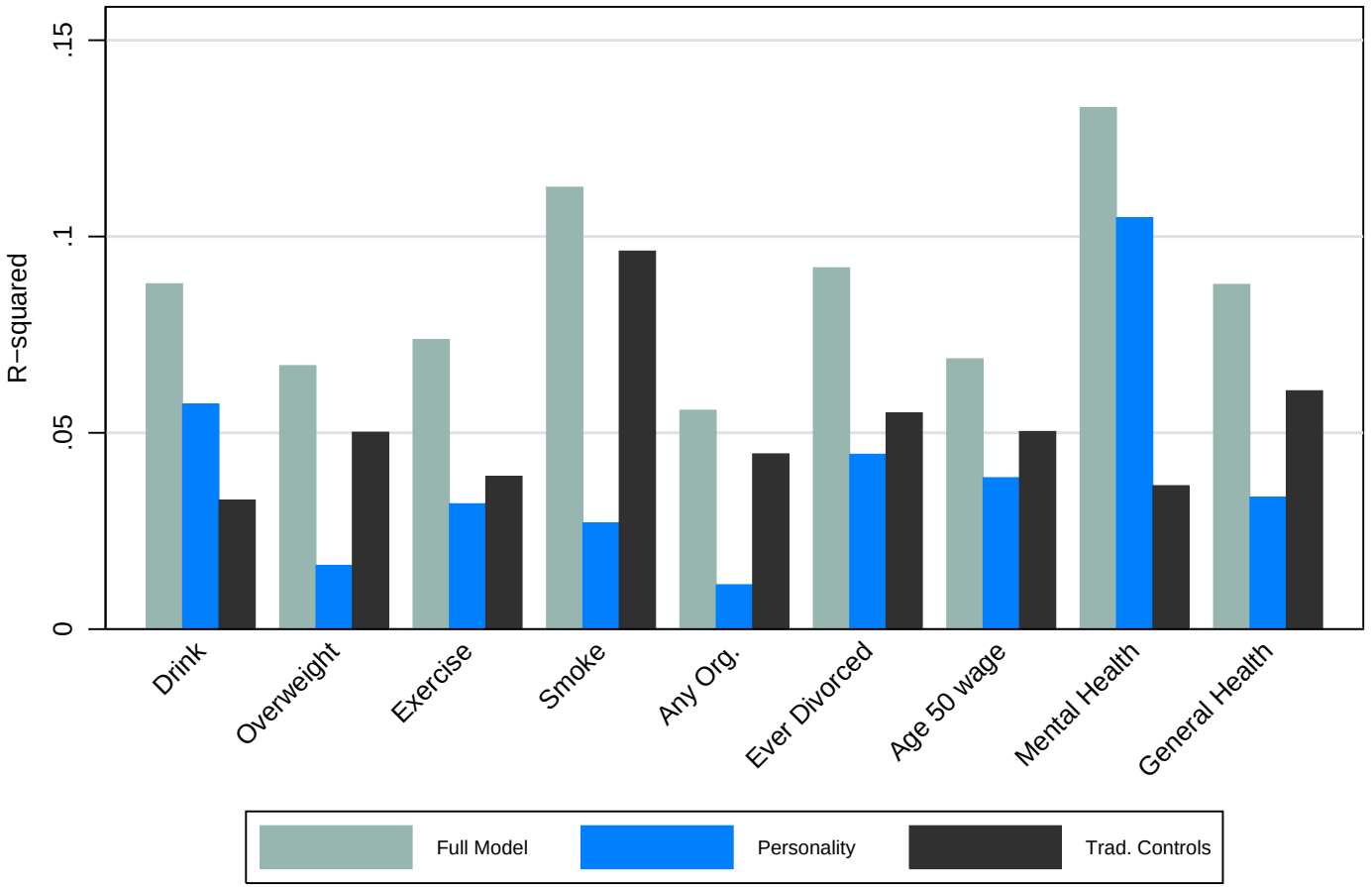
Estimating the Predictive Power of Personality

Table 5: Model Fit Comparisons, Males



- For drinking and especially mental health, personality is more predictive
- For exercise and divorce the role of personality is comparable
- For all others the role of personality is still substantial

Table 6: Model Fit Comparisons, Females



- Results are very similar for females

Summary of Results

Table 7: Summary of Effects on Health Behaviors, Males

	C	O	E	A	N	IQ	Education
A. Health behaviors and their proxies							
1940–1960 Ever Drank Heavily	-.055 **		.061 **				-.109 **
1940 Heavy Drinking	-.046 *		.044			.057 **	-.086
1950 Heavy Drinking			.040 **		.039 *		-.090 **
1960 Heavy Drinking	-.072 **	.056	.044 *				-.077
1940 Overweight				-.034		-.023	
1982 Physical Activity, Freq.		-.044 *			-.066 **		.108 *
1991 Ever Smoked	-.107 **						
1940–1960 Any Organization							.084 ***
1940 Number of Organizations						-.175 *	.245
1950 Number of Organizations				.258 *			1.172 ***
1960 Number of Organizations						.327 **	1.501 ***
Never Married	.023				.024		
Married Once and Still Married	.056 *						.120 **
Ended up Divorced	-.023 *	.050 ***			.024		
Ever Divorced	-.055 *						-.137 **
Divorced at least Twice	-.044 **	.031 *			.025		

- multiple effects of C, O, E, N and Education even after controlling for FWE
- a few mixed effects of $IQ|IQ > 130$
- Only one hypothesis rejected for A

Table 8: Summary of Effects on Health and Earnings, Males (Cont.)

	C	O	E	A	N	IQ	Education
B. Earnings							
Lifetime earnings, 3%			79.908 **	-94.713 **		44.431	209.191 ***
Earnings at age 40				-6.556 ***		3.280	14.585 ***
Earnings at age 50			4.122	-6.787 **	-6.553 **	4.758 *	19.788 ***
Earnings at age 60			5.814 *		-7.466 **		30.530 ***
C. Mental Health (MH)							
Ever Poor/Fair MH	-.071 ***	.085 ***	-.051 *		.134 ***		
1940 Mental Difficulty	-.078 ***	.086 ***	-.077 ***		.120 ***		
1950 Mental Difficulty	-.040 *				.111 ***		
1960 Mental Difficulty	-.080 ***	.091 ***	-.101 ***		.120 ***		
D. General Health (GH)							
Never Poor/Fair GH		-.032 *			-.021		
1940 General Health					-.279 ***		
1950 General Health	.135 **	-.152 **	.096		-.242 ***		
1960 General Health					-.211 ***		

- C, O, and education as above
- E is good here despite positive effect on heavy drinking
- No effect of education on self-reported health (despite strong effect on longevity)
- Again, multiple effects of skills and education

Table 9: Summary of Effects on Health Behaviors, Females

	C	O	E	A	N	IQ	Education
A. Health behaviors and their proxies							
1940–1960 Ever Drank Heavily		-.073 **	.054 *				
1940 Heavy Drinking				-.041 *			
1950 Heavy Drinking							
1960 Heavy Drinking		-.060 *	.049				
1940 Overweight					-.037 *		-.074 *
1982 Physical Activity, Freq.							
1991 Ever Smoked							
1940–1960 Any Organization							.066 **
1940 Number of Organizations							.789 ***
1950 Number of Organizations							.877 ***
1960 Number of Organizations						-.352 **	1.213 ***
Never Married							.074 ***
Married Once and Still Married							.129 *
Ended up Divorced							
Ever Divorced							-.111 **
Divorced at least Twice							-.054 *

- Strong role of education but differences for drinking, overweight, and physical activity
- Similar role of extraversion for heavy drinking
- Unlike for males, productive roles of O and A for heavy drinking
- Unlike for males, no effect of C

Table 10: Summary of Effects on Health and Earnings, Females (Cont.)

	C	O	E	A	N	IQ	Education
B. Earnings							
Lifetime earnings, 3%							
Earnings at age 40							3.946 *
Earnings at age 50							
Earnings at age 60					-4.650		
C. Mental Health (MH)							
Ever Poor/Fair MH					.152 ***		
1940 Mental Difficulty					.137 ***		
1950 Mental Difficulty					.134 ***		
1960 Mental Difficulty					.123 ***		
D. General Health (GH)							
Never Poor/Fair GH					-.044 ***		.116 ***
1940 General Health				-.133 *	-.318 ***		.283 **
1950 General Health				-.094	-.267 ***		.172
1960 General Health					-.241 ***		

- The same role of Neuroticism as for males
- Education improves general health but not longevity, the opposite as for males (Savelyev, 2013)

Conclusions

Conclusions for the High-Ability Individuals

- Strong role of personality in generating health-related outcomes
  - Variance explained by personality is comparable to that of key background variables: early health, parental controls, and education taken together
- According to the model, personality affects health behaviors through multiple channels related to discount rate, efficiency of health investments, earnings, and education costs
- The strongest predictors of health-related outcomes of high-ability individuals are Conscientiousness (+), Openness (-), Neuroticism (-), and education (+). Extraversion and Agreeableness show mixed effects on behaviors, but extraversion increases longevity (Savelyev, 2014).
- Potential health policy variables: education, Conscientiousness, Extraversion and Neuroticism.

APPENDIX

Stepdown on Aggregates

Table 11: Stepdown on Aggregates: 1960 variables, Males

1960 Outcomes and Proxies	C	O	E	A	N	IQ	Edu
Drank Heavily	-.072 **						
1940 Overweight							
1982 Physical Activity, Freq.					-.066 *		
1991 Ever Smoked	-.107 *						
# of Organization						.327 *	1.501 ***
Ever Divorced	-.055 *						-.137 **
Age 50 earnings				-6.787 *	-6.553 *		19.788 ***
Mental Difficulty	-.080 **	.091 ***	-.101 ***		.120 ***		
General Health					-.211 ***		

- Consider a conservative approach with strong FWE control for a family of all available aggregated health-related outcomes
- Still, C, N, and education remain determinants of multiple health-related outcomes
- In line with strong effect of C and education on longevity (Savelyev 2013)

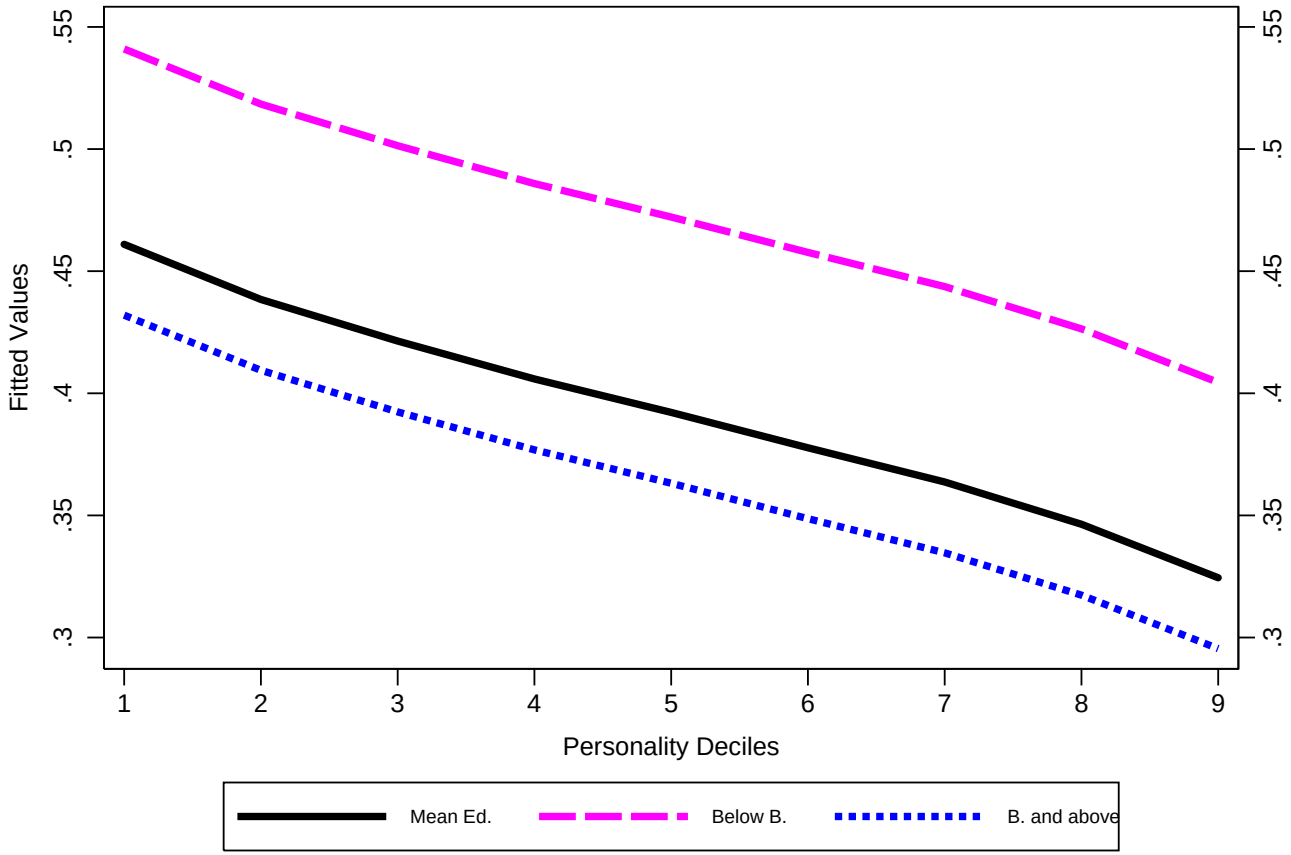
Table 12: Stepdown on Aggregates: 1960 variables, Females

	C	O	E	A	N	IQ	Edu
1960 Outcomes and Proxies							
Drank Heavily							
1940 Overweight							
1982 Physical Activity, Freq.							
1991 Ever Smoked							
# of Organization						-.352 *	1.213 ***
Ever Divorced							-.111
Age 50 earnings							
Mental Health					.123 ***		
General Health					-.241 ***		

- No effects of C as before
- Strong effect of education on the # of organizations only
- Strong effect of N on mental and general health only
- In line with no effect of skills and education on longevity found in Savelyev (2013)

Estimating the Predictive Power of Personality

Table 13: Heavy Drinking by Conscientiousness and Education, Males



- Change in Conscientiousness from decile 1 to 9 about the same effect as getting college education

Data Limitations and External Validity

Generalizing Results to Somewhat Lower IQs

- Theoretical consideration:
  - Unlike for cognitively loaded activities, such as professional chess playing, health production does not require an extraordinarily high cognitive ability
  - Smart and very smart people likely have similar health productivity: $\partial\delta/\partial G \approx 0$ if G is high enough
  - Limitation: some evidence of the effect of IQ on wage even for high IQ people leading to a possible wealth effect
- Evidence from Data:
  - IQ interacts neither with personality, nor with education for IQ above 130
  - Expect similar effects for somewhat lower IQ

Generalizing for Later Cohorts

Overall:

- Trade-off: life-cycle data on health behaviors and health vs. contemporary cohort
- Qualitatively, expect similar effects on a number of outcomes:
  - Education and Conscientiousness still create incentives for better health behaviors
  - For an outcome like heavy drinking, we can expect effects of the same sign and comparable magnitude
- Quantitatively, effects might be different:
  - Contemporary cohorts have better knowledge of the role of lifestyles such as smoking, healthy diet, and exercise
  - Since people act on their health knowledge, the effects of education and Conscientiousness might be even stronger today

Females:

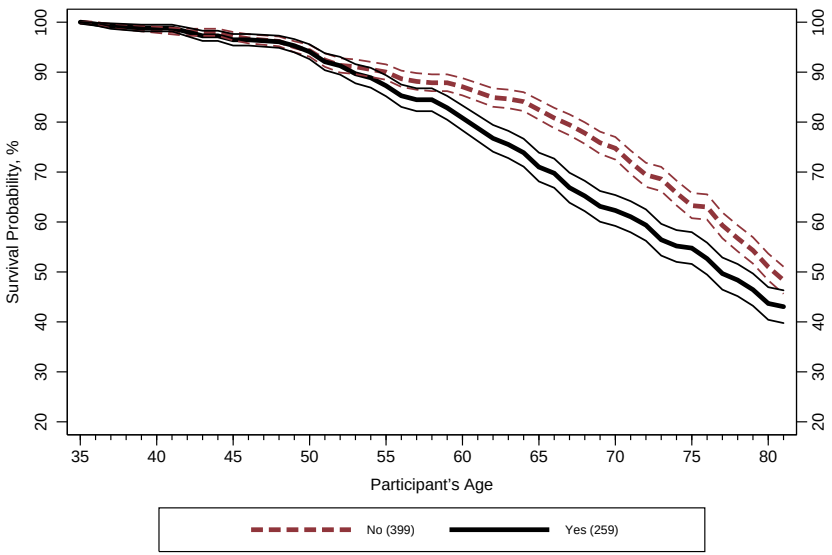
- Consider as historical results
- Women today have both superior health knowledge and wider variety of lifestyles

Descriptive Statistics

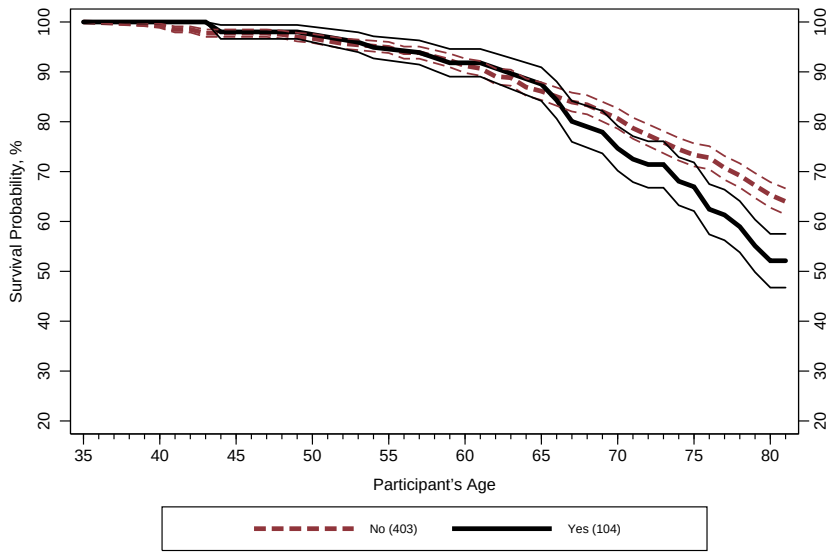
- In (Hong, Savelyev, and Tan, 2013) we show effects of various type of consumption on longevity
- Here we present correlational evidence to stress the links between certain types of consumption and health

Figure 3: Survival by Heavy Drinking

(a) Heavy Drinking, Males



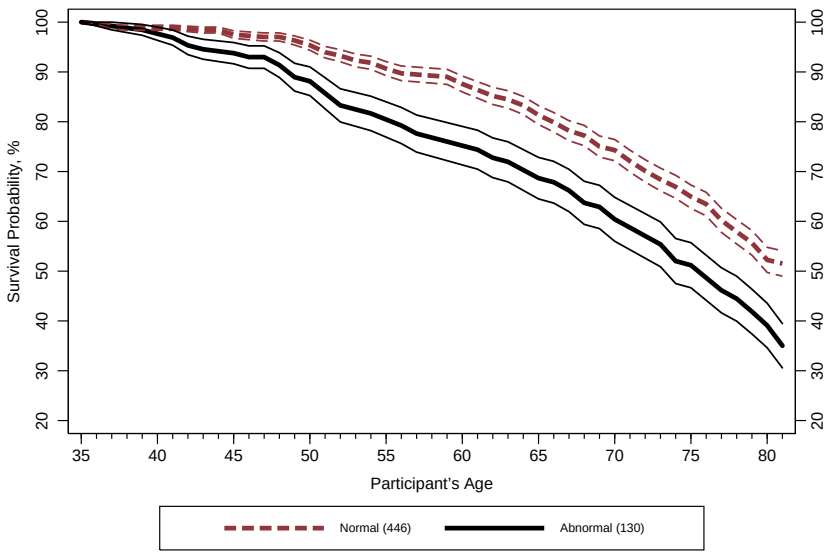
(b) Heavy Drinking, Females



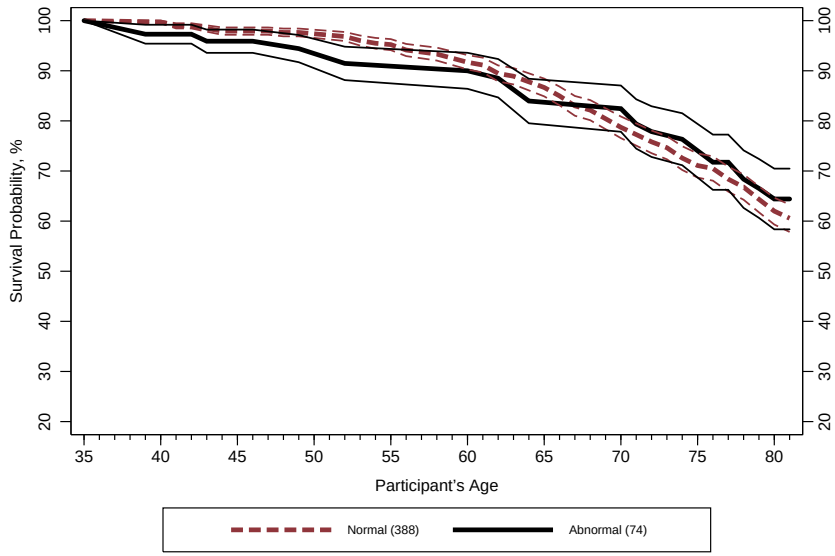
- Outcome: heavy drinking reported at least once over 1940-1960 period
- An example of health-related consumption

Figure 4: Survival by BMI

(a) BMI, Males



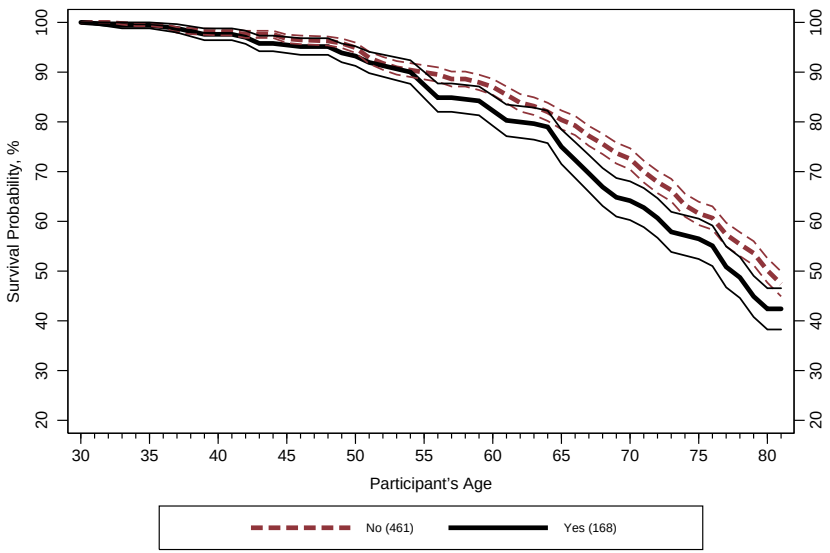
(b) BMI, Females



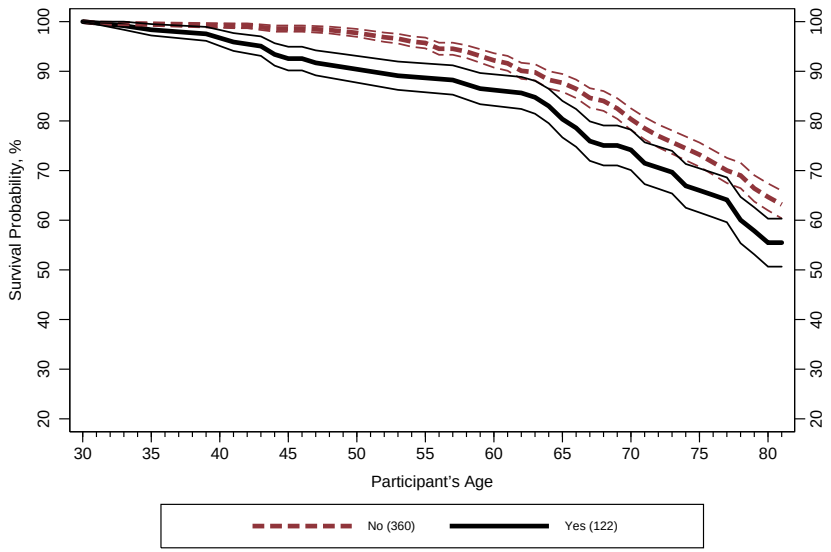
- BMI Recorded in 1940.
- A proxy of unhealthy diet and/or lack of physical exercise

Figure 5: Survival by Marital Stability

(a) Ever Divorced, Males



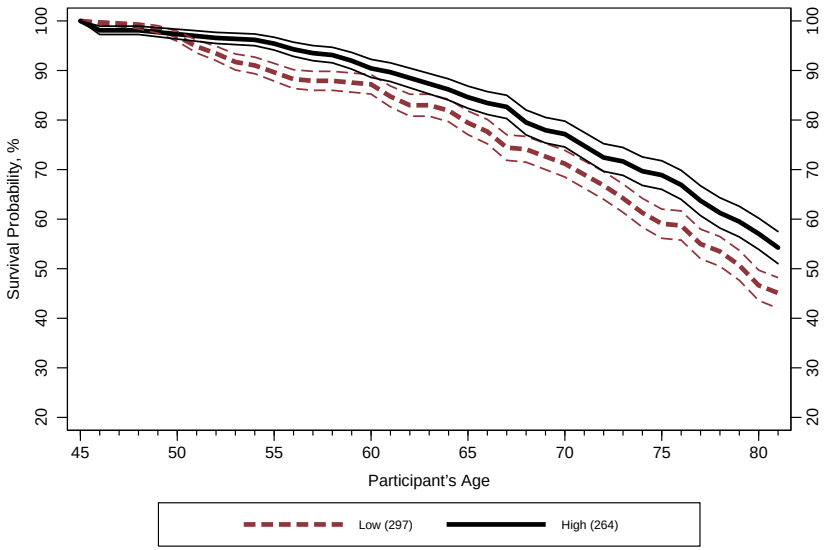
(b) Ever Divorced, Females



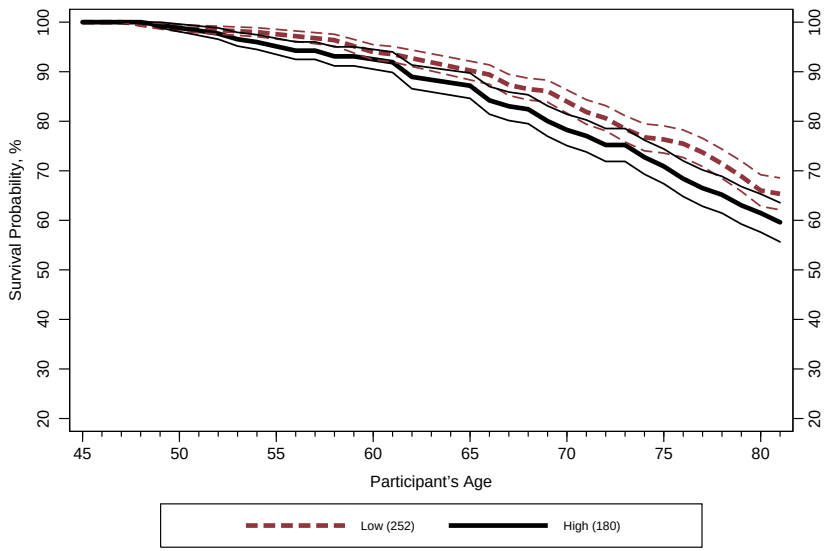
- A proxy of consumption complementary with having a stable family (family dinners, trips)

Figure 6: Survival by Group Membership

(a) Membership, Males



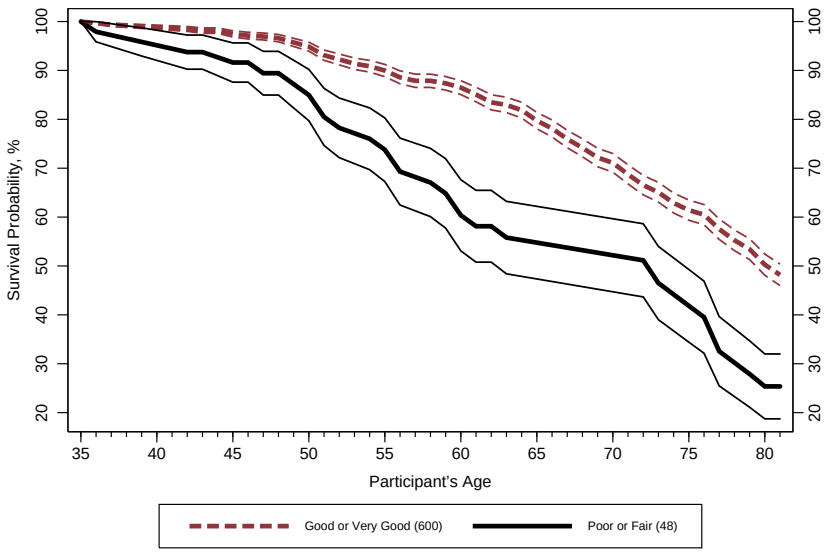
(b) Membership, Females



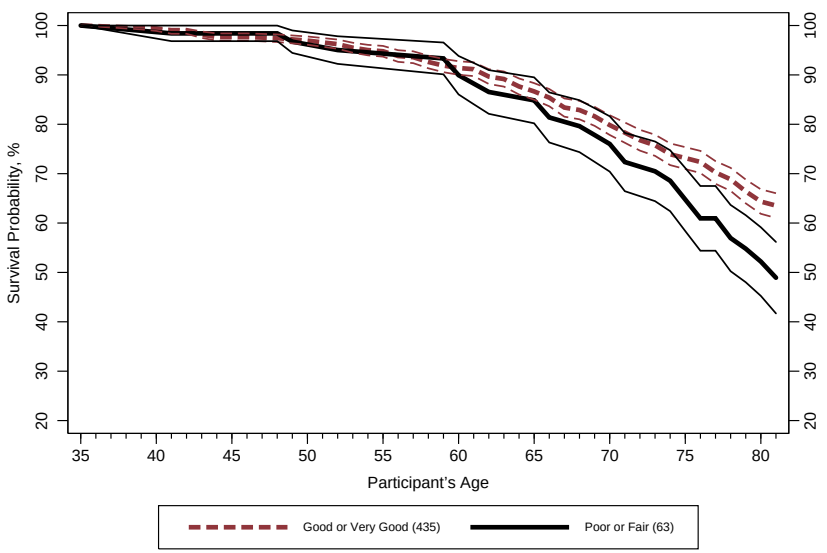
- A proxy of consumption complementary with socializing (consuming services of a church or a club)
- Recorded in 1950.

Figure 7: Survival by General Health

(a) General Health, Males



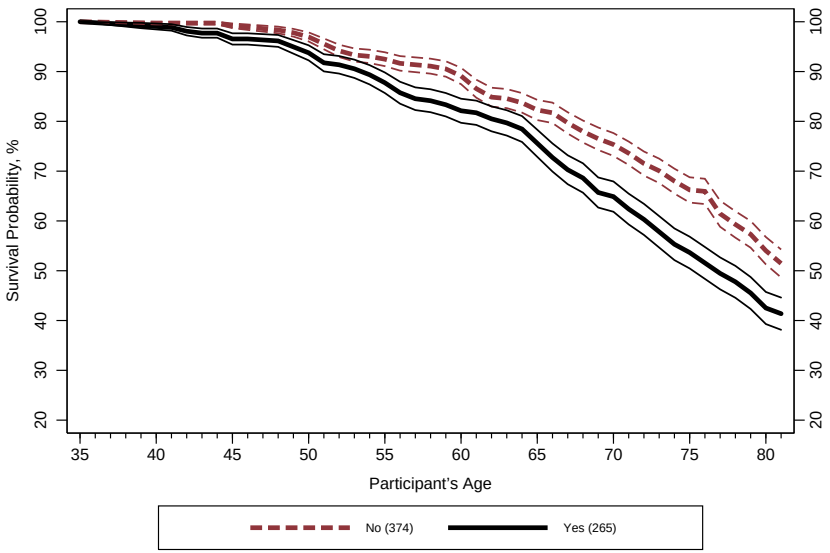
(b) General Health, Females



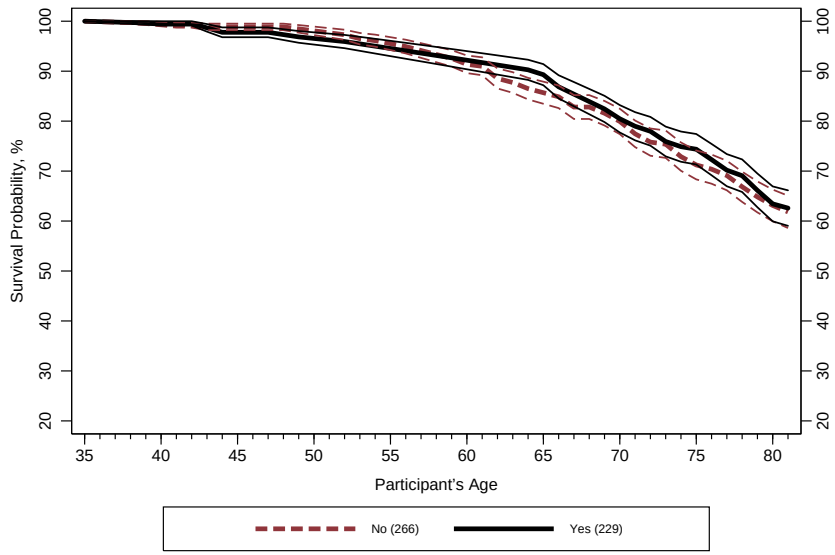
- Self-reported general health correlated with longevity

Figure 8: Survival by Mental Health

(a) Mental Difficulty, Males



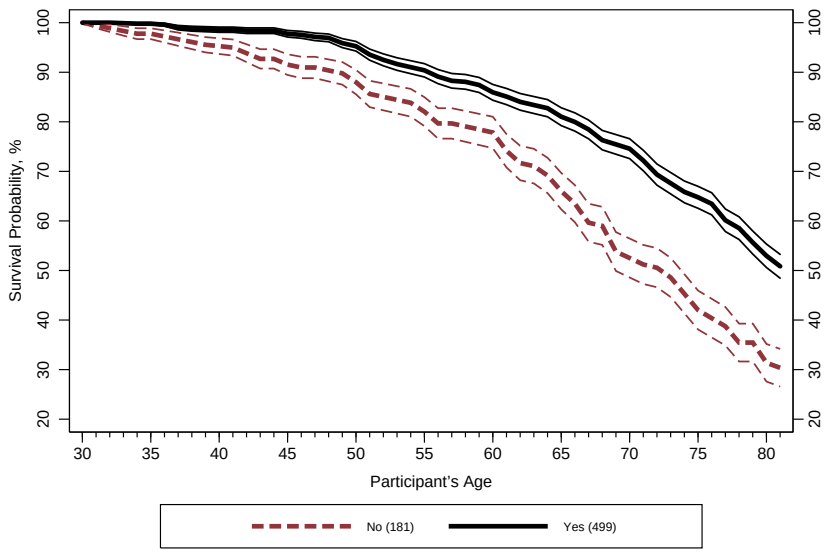
(b) Mental Difficulty, Females



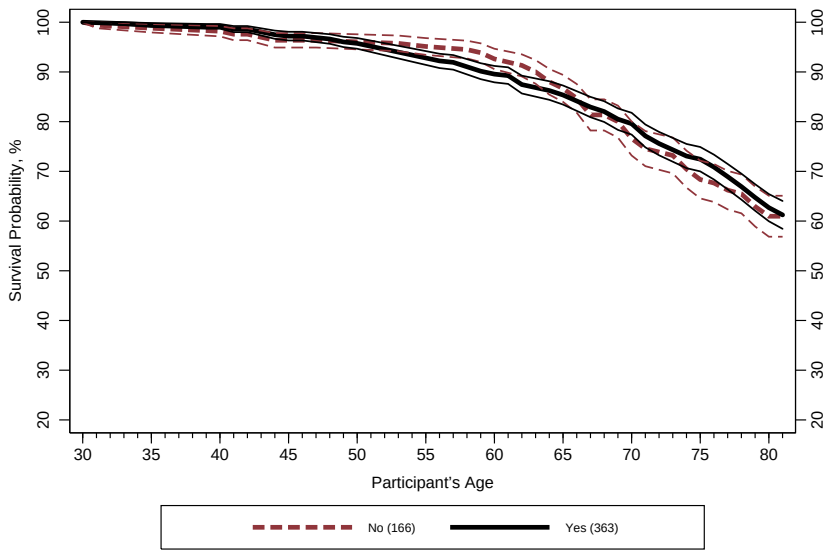
- Self-reported mental health correlates with longevity as well, at least for males

Figure 9: Survival by Education

(a) College, Males



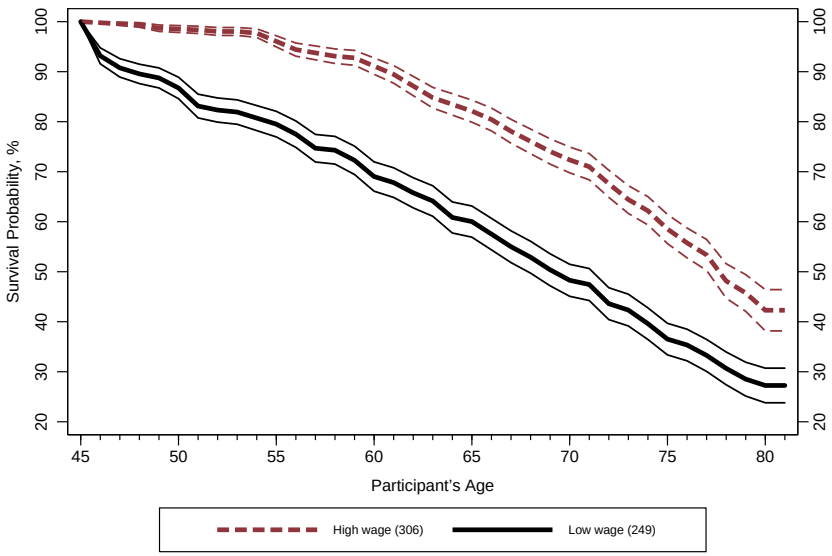
(b) College, Females



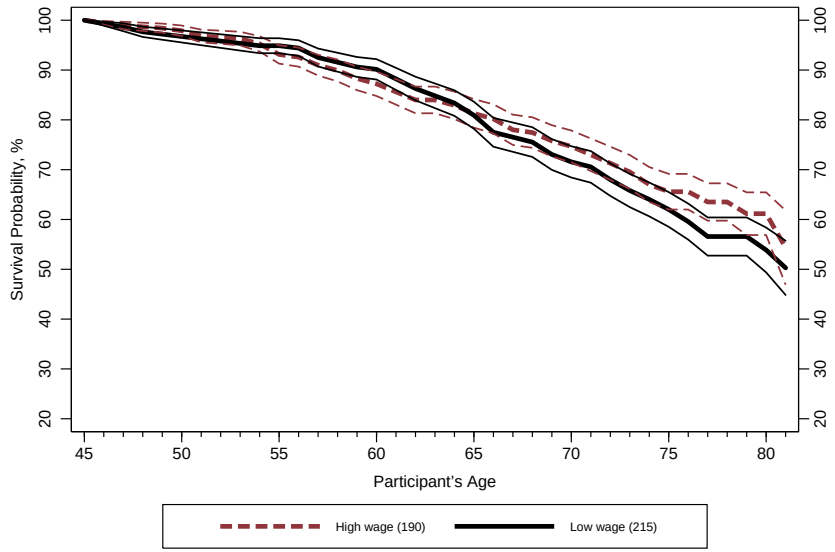
- Education correlates with longevity for males

Figure 10: Survival by Income at Age 50

(a) Above Median, Males



(b) Above Median, Females



- Income correlates with longevity of males
- Median income for females is zero, so we use an indicator for any earnings for females
- (View results for females as historical)

Table 14: Background Characteristics

Subject's Background	Parental Background
IQ	Mother dead
Bachelor's degree or above	Father dead
Extraordinary birth	Parents divorced
No breastfeeding	Father's education
Childhood health	Parental finances
Childhood energy	Parental social standing
Age at 1922	Mother working
Cohort 1915-1918	Father high skilled
Cohort 1907-1910	Parent born abroad
Participation in World War II	Parent born in Europe
Combatant in World War II	Duration of private tutoring (weeks)
	Home investment (hours)

The Big Five Personality Traits

Trait	Definition
1. Openness to Experience (Intellect)	The breadth, depth, originality, and complexity of individual's mental and experimental life
2. Conscientiousness	A propensity to follow socially prescribed norms for impulse control, to be task- and goal- directed, to be planfull, to delay gratification, and to follow norms and rules
3. Extraversion	An energetic approach to the social and material world, which includes traits such as sociability, activity, assertiveness, and positive emotionality
4. Agreeableness	A prosocial and communal orientation towards others (as opposed to antagonism), which includs traits such altruism, tender-mindedness, trust, and modesty
5. Neuroticism (Emotional Stability)	An emotional stability and even-temperedness as opposed to negative emotionality, such as feeling anxious, nervous, sad, and tense

Source: John and Srivastava (1999).

Table 15: Measures of Personality Skills, Part I

Measures of personality skills[a]	Year of measure-ment	Cronbach's alpha[b]	
		males	females
Conscientiousness		0.814[c]	0.783[c]
Prudence and forethought	1922		
Conscientiousness	1922		
Truthfulness	1922		
Extraversion		0.730[c]	0.697[c]
Fondness for large groups	1922		
Leadership	1922		
Popularity with other children	1922		
Openness		0.763[c]	0.713[c]
Desire to know	1922		
Originality	1922		
Intelligence	1922		

Table 16: Measures of Personality Skills, Part II

Measures of personality skills[a]	Year of measure-ment	Cronbach's alpha[b]	
		males	females
Agreeableness		0.690[d]	0.652[d]
Easy to get along with	1940		
Tries to avoid arguments[e]	1940		
Considered to be critical of others[e]	1940		
Careful to avoid saying things that might hurt others[e]	1940		
Ignores feelings of others[e]	1940		
Tries to get own way even if has to fight for it[e]	1940		
Considered to have a high opinion of self[e]	1940		

Table 17: Measures of Personality Skills, Part III

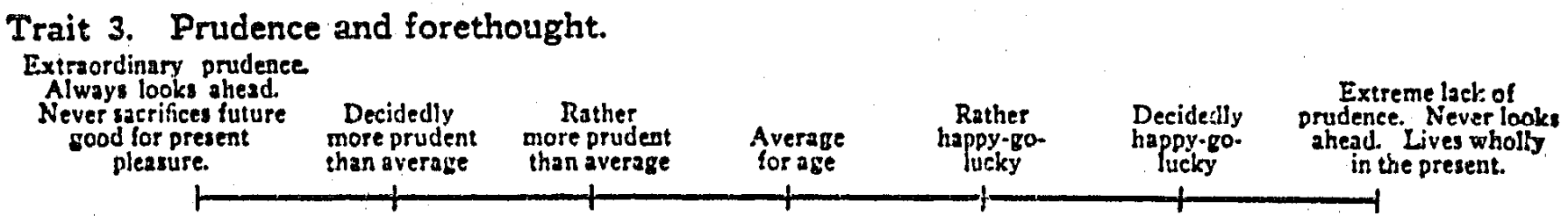
Measures of personality skills[a]	Year of measure-ment	Cronbach's alpha[b]	
		males	females
Neuroticism		0.802[d]	0.788[d]
Often feels miserable[e]	1940		
Touchy on various subjects[e]	1940		
Experiences periods of loneliness[e]	1940		
Often feels lonely when with others[e]	1940		
Frequently burdened by remorse and regret[e]	1940		
Lacks self-confidence[e]	1940		
Worries about humiliating experiences[e]	1940		
Feels happy and sad alternately without apparent reason[e]	1940		
Easily feels hurt[e]	1940		
Does not feel serene and cheerful easily[e]	1940		
Moodiness	1940		
Sensitive feelings	1940		

Importance of the Measurement Error

Measurement Error in Measures of Traits

- Fuchs (1982) studied the role of *time preference* as a potential confounding factor
  - Fuchs found no strong evidence
  - Likely reason acknowledged by Fuchs: high measurement error
- Cutler and Lleras-Muney (2010) dismiss the role of personality as a confounding factor
  - Authors do not specifically account for the trait of childhood Conscientiousness
  - They acknowledge that their use of noisy proxies may dismiss potentially important theories
- In my paper, I explicitly account for the measurement error
  - Eliminate attenuation bias
  - Find that Conscientiousness is a confounding factor

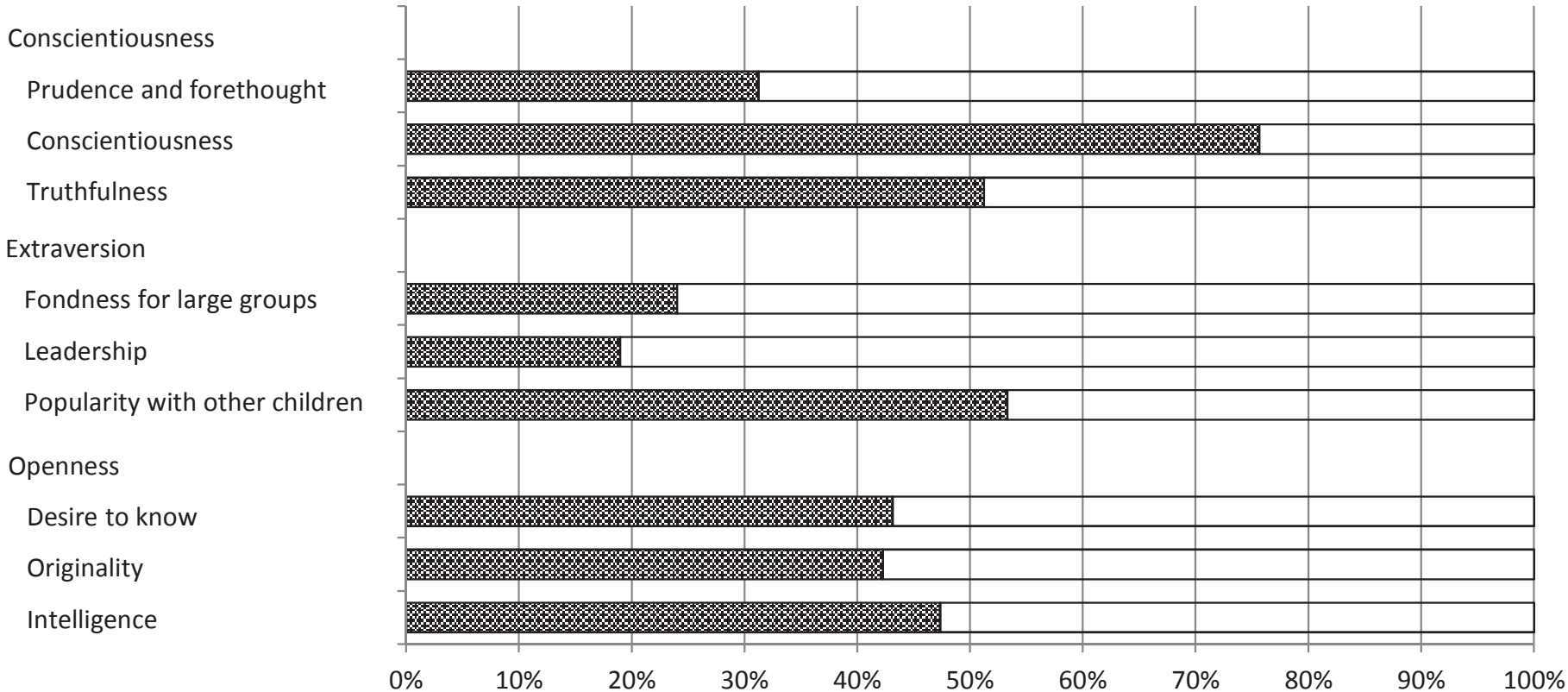
Figure 11: Questionnaire Example: Prudence



Source: Terman (1986)

Merriam-Webster: Prudence is the ability to govern and discipline oneself by the use of reason.

Figure 12: Share of Signal in Measures of Conscientiousness, Extraversion, and Openness



"Signal" is the share of explained variance in the total variance of measure $M^i_{k^i}$, calculated by formula $100\% \cdot (\psi^i_k)^2 \cdot var(\theta^i)/var(M^i_{k^i} - \pi^i_{k^i} A - \gamma_{k^i} \mathbf{X})$

Almlund, M., A. Duckworth, J. J. Heckman, and T. Kautz (2011). Personality psychology and economics. In E. A. Hanushek, S. Machin, and L. Wößmann (Eds.), *Handbook of the Economics of Education*, Volume 4, pp. 1–181. Amsterdam: Elsevier.

Auld, M. C. and N. Sidhu (2005, October). Schooling, cognitive ability and health. *Health Economics 14*(10), 1019–1034.

Behrman, J. R., H.-P. Kohler, V. M. Jensen, D. Pedersen, I. Petersen, P. Bingley, and K. Christensen (2011). Does more schooling reduce hospitalization and delay mortality? New evidence based on Danish twins. *Demography 48*, 1347–1375.

Clark, D. and H. Royer (2013). The effect of education on adult mortality and health: Evidence from Britain. *American Economic Review 103*(6), 2087–2120.

Cutler, D. M. and A. Lleras-Muney (2010, January). Understanding differences in health behaviors by education. *Journal of Health Economics 29*(1), 1–28.

Friedman, H. S. and L. R. Martin (2011). *The Longevity Project* (first edition ed.). United States of America: Hudson Street Press.

Fuchs, V. R. (1982). Time preference and health: An exploratory study. In V. R. Fuchs (Ed.), *Economic Aspects of Health*, pp. 93–120. Chicago, IL: University of Chicago Press.

Grossman, M. (2004). The demand for health, 30 years later: A very personal retrospective and prospective reflection. *Journal of Health Economics 23*(4), 629–636.

Grossman, M. and R. Kaestner (1997). Effects of education on health. In J. R. Behrman and N. Stacey (Eds.), *The Social Benefits of Education*, pp. 69–124. Ann Arbor, MI: University of Michigan Press.

Heckman, J. J., J. Stixrud, and S. Urzúa (2006, July). The effects of cognitive and noncognitive abilities on labor market outcomes and social behavior. *Journal of Labor Economics 24*(3), 411–482.

Heckman, J. J. and E. J. Vytlacil (2007). Econometric evaluation of social programs, part II: Using the marginal treatment effect to organize alternative economic estimators to evaluate social programs and to forecast their effects in new environments. In J. Heckman and E. Leamer (Eds.), *Handbook of Econometrics*, Volume 6B, Chapter 71, pp. 4875–5143. Amsterdam: Elsevier.

John, O. P. and S. Srivastava (1999). The Big Five trait taxonomy: History, measurement and theoretical perspectives. In L. A. Pervin and O. P. John (Eds.), *Handbook of Personality: Theory and Research*, Chapter 4, pp. 102–138. New York: The Guilford Press.

Kohler, H., J. Behrman, and J. Schnittker (2011). Social science methods for twins data: integrating causality, endowments, and heritability. *Biodemography and Social Biology 57(1)*, 88–141.

Lleras-Muney, A. (2005). The relationship between education and adult mortality in the United States. *Review of Economic Studies 72*(1), 189–221.

Lundborg, P., C. H. Lyttkens, and P. Nystedt (2012). Human capital and longevity: Evidence from 50,000 twins. Unpublished manuscript, University of York, Health, Econonometrics and Data Group.

Mazumder, B. (2008). Does education improve health? A reexamination of the evidence from compulsory schooling laws. *Economic Perspectives 32*(2), 2–16.

Romano, J. P. and M. Wolf (2005, March). Exact and approximate stepdown methods for multiple hypothesis testing. *Journal of the American Statistical Association 100*(469), 94–108.

Terman, L. M. (1986). Terman Life-Cycle Study of Children with High Ability by Terman L. M. et al., 1922-1986 [computer file]. 2nd ICPSR release. Palo Alto, CA: Robert R. Sears [producer], 1986. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributor], 1989. doi:10.3886/ICPSR08092.