Calculation of Childhood General Intelligence

Study 1: National Longitudinal Study of Adolescent to Adult Health (Add Health)

Waves I and II

At Waves I and III, Add Health administered the abbreviated version of the Peabody Picture Vocabulary Test to measure intelligence. It is a test of verbal intelligence. Each respondent is shown four pictures on a page, and asked to identify a picture that corresponds to a word given to the respondent. The full version of the Peabody Picture Vocabulary Test consists of 175 questions, increasing in difficult from the first to the last question. Add Health uses an abbreviated version of the test, consisting of 78 questions. The raw score for each respondent is standardized for age. Add Health converted the age-standardized scores into a standard IQ score, with a mean of 100 and standard deviation of 15.

Wave IV

At Wave IV, Add Health administered a word recall test and a backward digit span test to measure intelligence. For the word recall test, each respondent was read 15 words, and asked to recall them immediately and then five minutes later. I used the raw scores (number of words correctly recalled) for both the immediate recall and delayed recall. In a backward digit span test, the respondent is given an increasingly longer sequence of numbers, from two to eight digits, and asked to repeat it *backwards.* The respondent is given two sequences of a given length, for a total of 14 sequences. I used the total number of correct recalls as the raw score for the backward digit span test. I performed a principal component analysis with the three measures of intelligence (immediate word recall, delayed word recall, and backward digit span) to measure general intelligence at Wave IV. The three indicators extract only one principal component, with very high loadings: immediate word recall = .876, delayed word recall = .874, backward digit span = .539.

Childhood general intelligence

Finally, I computed the lifetime general intelligence score, by performing a principal component analysis with the IQ scores at Waves I, III, and IV. The three indicators extracted only one principal component, with very high loadings: Wave I = .854, Wave III = .834, Wave IV = .628. I converted the principal component (with the mean of 0 and standard deviation of 1) into the standard IQ metric, with the mean of 100 and standard deviation of 15. I used the lifetime intelligence in the standard IQ metric as a measure of general intelligence in Study 1.

Study 2: National Child Development Study (NCDS)

Age 7

NCDS measured childhood general intelligence at age 7 with four cognitive tests:
1. Copying Designs Test. The respondents are shown 6 different shapes (like a circle or a triangle) and are asked to copy the shape as carefully as possible.
2. Draw-a-Man Test. The respondent is asked to "make a picture of a man" within a rectangular frame, and asked to make the best picture they could and draw a whole person, not just the head or the face. A score out of 100 is given for the accuracy of the drawing.
3. Southgate Group Reading Test. Respondents are shown a picture and a list of five words, and are asked to circle the word that correctly describes the picture. There are 30 questions.
4. Problem Arithmetic Test. Respondents were verbally given 10 questions to test their quantitative knowledge (for example, "Peter had 4 toy cars and he bought 2 more. How many toy cars did he have altogether?" "How many inches are there in 2 feet?"

I subjected the raw scores of the four cognitive tests to a principal component analysis. The four indicators extract only one principle factor, with very high loadings: Copying Designs = .671, Draw-a-Man = .696, Southgate Group Reading Test = .780, Problem Arithmetic Test = .762. I converted the latent factor (with a mean of 0 and a standard deviation of 1) into the standard IQ metric (with a mean of 100 and a standard deviation of 15).

Age 11

NCDS measured childhood general intelligence at age 11 with five cognitive tests:

1. General Ability Test. The respondent is given a group of four words (for example, "foot," "yard," "inch," and "mile") and another group of three words ("pound," "stone," and "ounce"), and asked to choose the appropriate fourth word for the second group from a list of five words ("penny," "ton," "pint,," "hour," and "gallon"). There are 40 questions.

2. Nonverbal General Ability Test. The respondent is given a similar task as in the General Ability Test, except for, instead of words, the question involves shapes and symbols. The Nonverbal General Ability Test is very similar to Raven's Progressive Matrix. There are 40 questions.

3. Reading Comprehension Test. The respondent is asked to complete 35 sentences, by choosing the appropriate word from a list of 5.

4. Mathematical Test. The respondents are given 40 questions of arithmetic and geometry.

5. Copying Designs Test. This is the same as the Copying Designs Test at age 7.

I subjected the raw scores of the five cognitive tests to a principal component analysis. The five indicators extract only one principal component, with very high loadings: General Ability Test = .920, Nonverbal General Ability Test = .885, Reading Comprehension Test = .864, Mathematical Test = .903, Copying Designs Test = .486. I converted the latent factor (with a mean of 0 and a standard deviation of 1) into the standard IQ metric (with a mean of 100 and a standard deviation of 15).

Age 16

NCDS measured childhood general intelligence at age 16 with two cognitive tests:

1 Reading Comprehension Test. This is the same as the Reading Comprehension Test at age 11.

2. Mathematics Comprehension Test. The respondent was given 27 multiple-choice questions (five choices for each question) and four true-false questions about mathematics and geometry.

I subjected the raw scores of the two cognitive tests to a principal component analysis. the two indicators extracted only one principal component, with extremely high loadings: Reading Comprehension Test = .909, Mathematics Comprehension Test = .909. I converted the latent factor (with a mean of 0 and a standard deviation of 1) into the standard IQ metric (with a mean of 100 and a standard deviation of 15).

Childhood General Intelligence

In order to compute the childhood general intelligence, I subjected the IQ scores at ages 7, 11, and 16 to a second-order principal component analysis. The three indicators extracted only one principal component, with extremely high loadings: age 7 = .867, age 11 = .946, age 16 = .919. I converted the latent factor (with a mean of 0 and a standard deviation of 1) into the standard IQ metric (with a mean of 100 and a standard deviation of 15). I used the childhood general intelligence, measured at ages 7, 11, and 16, as the measure of intelligence in Study 2.

If I had obtained the childhood general intelligence in one principal component analysis, by subjecting all 11 IQ test scores in a single principal component analysis, it would not have made any difference to the result, as the childhood general intelligence computed in one vs. two principal component analyses correlate at $r = .996$.

Table S1. Descriptive statistics
National Longitudinal Study of Adolescent to Adult Health

	Quintiles by childhood general intelligence					Full Sample
	First	Second	Third	Fourth	Fifth	
Earnings at 22	10.14	11.00	11.96	12.82	11.22	11.74
	18.44	11.42	12.15	23.42	12.94	17.28
	5.00	8.00	9.00	9.00	7.00	8.00
	.00	.00	.00	.00	.00	.00
	350.00	145.00	100.00	820.00	180.00	820.00
Earnings at 29	26.75	31.41	35.21	38.37	42.88	34.79
	45.26	40.40	42.44	40.20	52.78	44.59
	22.00	27.00	30.00	35.00	35.00	30.00
	.00	.00	.00	.00	.00	.00
	1000.00	900.00	1000.00	1000.00	1000.00	1000.00
Earnings at 38	36.71	46.16	54.03	61.05	71.88	55.64
	34.56	37.33	40.77	44.92	52.55	45.44
	27.50	35.00	45.00	62.50	62.50	45.00
	2.50	2.50	2.50	2.50	2.50	2.50
	200.00	200.00	200.00	200.00	200.00	200.00
ln(Earnings at 22)	-1.36	-.05	.32	.54	.52	-.04
	5.75	4.83	4.53	4.26	4.08	4.85
	1.61	2.08	2.20	2.20	1.95	2.08
	-11.51	-11.51	-11.51	-11.51	-11.51	-11.51
	5.86	4.98	4.61	6.71	5.19	6.71
ln(Earnings at 29)	1.68	2.10	2.41	2.51	2.73	2.21
	4.19	3.92	3.59	3.64	3.37	3.89
	3.09	3.30	3.40	3.56	3.56	3.40
	-11.51	-11.51	-11.51	-11.51	-11.51	-11.51
	6.91	6.80	6.91	6.91	6.91	6.91
ln(Earnings at 38)	3.05	3.42	3.59	3.71	3.88	3.56

	1.21 3.31 .92 5.30	1.06 3.56 .92 5.30	1.07 3.81 .92 5.30	1.10 4.14 .92 5.30	1.08 4.14 .92 5.30	1.14 3.81 .92 5.30
Physical attractiveness	-.25 .98 -.40 -3.41 2.79	-.03 .98 -.06 -3.47 2.79	.05 1.00 -11.06^{-3} -3.36 2.79	.12 1.01 .05 -3.08 2.79	.14 .99 .05 -3.47 2.79	.00 1.00 -.06 -3.47 2.79
Education at 22	12.13 1.61 12.00 6.00 20.00	12.68 1.78 12.00 6.00 22.00	13.17 1.85 13.00 8.00 20.00	13.79 1.93 14.00 6.00 22.00	14.37 1.84 14.00 6.00 22.00	13.19 1.97 13.00 6.00 22.00
Education at 29	4.36 1.97 4.00 1.00 13.00	5.17 2.00 6.00 1.00 13.00	5.70 1.91 6.00 1.00 13.00	6.30 1.89 6.00 1.00 13.00	7.20 2.10 7.00 1.00 13.00	5.67 2.20 6.00 1.00 13.00
Education at 38	5.99 3.21 6.00 1.00 16.00	7.18 3.12 8.00 1.00 16.00	8.10 3.03 9.00 1.00 16.00	9.05 2.89 10.00 2.00 16.00	10.36 2.81 10.00 2.00 16.00	8.18 3.66 9.00 1.00 16.00

Note: Within each cell, the numbers are: Mean
Standard deviation
Median
Minimum
Maximum

Source: Table created by the author.

Table S2. Descriptive statistics
National Child Development Study

	Quintiles					Full sample
	First	Second	Third	Fourth	Fifth	
Earnings at 33	5.66	6.18	7.32	8.79	11.09	9.04
	27.16	6.03	7.80	10.24	12.71	72.27
	3.56	5.90	7.19	8.59	10.80	7.20
	.00	.00	.00	.00	.00	.00
	832.00	78.00	104.00	168.00	240.00	4994.08
Earnings at 42	10.00	11.48	15.11	19.80	25.57	15.63
	39.43	17.82	54.79	117.18	116.18	65.21
	7.28	9.14	10.81	12.59	15.60	10.80
	.00	.00	.00	.00	.00	.00
	1262.40	268.00	1784.69	3876.00	2545.74	3876.00
Earnings at 47	11.36	12.38	16.15	17.38	23.04	16.57
	26.06	11.96	37.17	18.92	28.68	36.23
	9.60	11.34	13.20	15.24	19.20	13.20
	.00	.00	.00	.00	.00	.00
	520.00	192.00	918.00	360.00	453.60	2160.00
Earnings at 51	12.67	15.52	19.89	22.12	30.73	20.76
	25.53	19.40	62.18	30.42	65.38	52.70
	10.40	13.20	14.80	17.40	21.60	14.76
	.00	.00	.00	.00	.00	.00
	520.00	335.00	1900.00	576.00	1400.00	3000.00
Earnings at 55	15.46	18.52	16.97	19.26	26.73	19.82
	83.43	108.46	31.24	22.25	50.81	54.84
	9.00	12.37	14.40	15.72	19.68	14.40
	.00	.00	.00	.00	.00	.00
	1718.86	3000.00	720.00	300.00	1000.00	3000.00
ln(Earnings at 33)	-2.78	-1.58	-1.12	-.59	-.08	-1.30
	6.34	5.92	5.77	5.54	5.36	5.92

	1.27 -11.51 6.72	1.78 -11.51 4.36	1.97 -11.51 4.64	2.15 -11.51 5.12	2.38 -11.51 5.48	1.97 -11.51 8.52
ln(Earnings at 42)	-1.01 5.81 1.99 -11.51 7.14	-.21 5.37 2.21 -11.51 5.59	.49 4.87 2.38 -11.51 7.49	.87 4.61 2.53 -11.51 8.26	1.14 4.59 2.75 -11.51 7.84	.13 5.26 2.38 -11.51 8.26
ln(Earnings at 47)	-1.11 6.08 2.26 -11.51 6.25	.01 5.41 2.43 -11.51 5.26	1.00 4.56 2.58 -11.51 6.82	1.27 4.39 2.72 -11.51 5.89	1.45 4.49 2.95 -11.51 6.12	.49 5.17 2.58 -11.51 7.68
ln(Earnings at 51)	-1.27 6.30 2.34 -11.51 6.25	.06 5.56 2.58 -11.51 5.81	.87 4.90 2.69 -11.51 7.55	1.27 4.64 2.86 -11.51 6.36	1.55 4.58 3.07 -11.51 7.24	.39 5.46 2.69 -11.51 8.01
ln(Earnings at 55)	-2.19 6.70 2.20 -11.51 7.45	-1.13 6.38 2.52 -11.51 8.01	-.22 5.87 2.67 -11.51 6.58	-.29 6.07 2.75 -11.51 5.70	-.13 6.18 2.98 -11.51 6.91	-.77 6.32 2.67 -11.51 8.01
Physical attractiveness	.35 .48 .00 .00 1.00	.62 .49 1.00 .00 1.00	.74 .44 1.00 .00 1.00	.81 .39 1.00 .00 1.00	.84 .36 1.00 .00 1.00	.62 .49 1.00 .00 1.00
Education	.99 1.06 1.00 .00	1.68 1.05 2.00 .00	2.16 1.06 2.00 .00	2.81 1.14 3.00 .00	3.53 1.18 3.00 .00	2.23 1.43 2.00 .00

	4.00	5.00	5.00	5.00	5.00	5.00

Note: Within each cell, the numbers are: Mean
Standard deviation
Median
Minimum
Maximum

Source: Table created by the author.

Table S3.
Robustness check.
Associations between physical attractiveness and earnings, by IQ tertiles.
National Longitudinal Study of Adolescent to Adult Health in the United States

	Earnings measured at					
	Age 22			Age 29		
	(1)	(2)	(3)	(4)	(5)	(6)
	First tertile	Second tertile	Third tertile	First tertile	Second tertile	Third tertile
Physical attractiveness	.591***	.182*	.003	.229**	.133*	.111
	(.104)	(.085)	(.074)	(.076)	(.068)	(.062)
	.107	*.040*	*.001*	*.055*	*.036*	*.032*
Sex	1.427***	.942***	.281	1.636***	1.675***	1.217***
	(.206)	(.167)	(.148)	(.150)	(.134)	(.125)
	.129	*.105*	*.035*	*.198*	*.226*	*.175*
Race						
Black	-.938***	-.798***	-.134	.562***	.211	.265
	(.231)	(.222)	(.231)	(.168)	(.176)	(.194)
	-.083	*-.067*	*-.010*	*.066*	*.021*	*.024*
Asian	-.744	-.642	-1.104***	.507	.546*	.041
	(.392)	(.340)	(.285)	(.280)	(.270)	(.244)
	-.036	*-.035*	*-.070*	*.034*	*.036*	*.003*
Native American	.037	*.386*	.369	-.302	-.462	-.273
	(.394)	(.364)	(.418)	(.287)	(.294)	(.352)
	.002	*.020*	*.016*	-.019	*-.028*	*-.014*
Hispanic	-.254	-.514*	-.590	.770***	.273	.537*
	(.261)	(.243)	(.254)	(.287)	(.193)	(.215)
	-.020	*-.039*	*-.042*	*.079*	*.026*	*.044*
Age	.242***	.163**	.330***	.020	-.029	.020
	(.060)	(.050)	(.050)	(.044)	(.040)	(.040)
	.076	*.061*	*.126*	*.008*	*-.013*	.009
Education	.234***	.114*	-.099*	.351***	.239***	.141***
	(.061)	(.047)	(.043)	(.038)	(.035)	(.030)
	.073	*.046*	*-.044*	*.172*	*.124*	*.085*
Constant	-9.141	-4.956	-5.173	-1.493	.966	.430
	(1.420)	(1.135)	(1.047)	(1.282)	(1.160)	(1.153)
R^2	.044	.025	.023	.072	.063	.037
Number of cases	2,865	2,961	3,045	2,967	3,027	3,097

Table S3 (continued).
Robustness check.
Associations between physical attractiveness and earnings, by IQ tertiles.
National Longitudinal Study of Adolescent to Adult Health in the United States

	Earnings measured at Age 38		
	(7)	(8)	(9)
	First tertile	Second tertile	Third tertile
Physical attractiveness	.161*** (.025) *.136*	.159*** (.022) *.146*	.050* (.021) *.046*
Sex	.527*** (.050) *.219*	.560*** (.044) *.256*	.565*** (.042) *.258*
Race			
Black	-.256*** (.056) *-.105*	-.212*** (.060) *-.072*	.041 (.070) *.011*
Asian	.145 (.112) *.028*	.224* (.106) *.042*	.158 (.090) *.033*
Native American	-.087 (.219) *-.008*	.020 (.240) *.002*	-.144 (.304) *-.009*
Pacific Islander	.211 (.214) *.020*	-.002 (.311) *-1.116^{-4}*	.453 (.291) *.029*
Hispanic	.248*** (.067) *.084*	.146* (.072) *.041*	.149 (.084) *.033*
Age	-.006 (.013) *-.009*	.018 (.012) *.031*	.018 (.012) *.027*
Education	.127*** (.008) *.348*	.104*** (.007) *.293*	
Constant	2.420 (.500)	1.817 (.457)	1.803 (.462)
R^2	.199	.170	.144
Number of cases	1,957	2,164	2,487

Note: Main entries are unstandardized regression coefficients.
(Numbers in parentheses are standard errors.)
Numbers in italics are standardized regression coefficients.

* $p < .05$ ** $p < .01$ *** $p < .001$

Source: Table created by the author.

Table S4.
Robustness check.
Associations between physical attractiveness and earnings, by IQ tertiles.
National Child Development Study in the United Kingdom

	Earnings measured at					
	Age 33			Age 42		
	(1)	(2)	(3)	(4)	(5)	(6)
	First tertile	Second tertile	Third tertile	First tertile	Second tertile	Third tertile
Physical attractiveness	.667	.752	.362	1.267**	1.365***	.076
	(.411)	(.398)	(.403)	(.395)	(.333)	(.346)
	.053	*.056*	*.025*	*.109*	*.121*	*.006*
Sex	3.308***	3.873***	4.004***	2.369***	2.378***	2.478***
	(.409)	(.360)	(.303	(.389)	(.296)	(.259)
	.257	*.313*	(.361)	*.203*	*.234*	*.267*
Education	.956***	.405*	.195	.604***	.334*	-.039
	(.186)	(.162)	(.124)	(.176)	(.136)	(.105)
	.166	*.073*	*.043*	*.117*	*.073*	*-.010*
Constant	-5.451	-4.314	-3.160	-3.270	-2.227	-.079
	(.369)	(.468)	(.557)	(.363)	(.395)	(.469)
R^2	.097	.106	.133	.068	.077	.071
Number of cases	911	1,070	1,172	851	1,090	1,204

Table S4 (continued).
Robustness check.
Associations between physical attractiveness and earnings, by IQ tertiles.
National Child Development Study in the United Kingdom

	Earnings measured at					
	Age 47			Age 51		
	(7)	(8)	(9)	(10)	(11)	(12)
	First tertile	Second tertile	Third tertile	First tertile	Second tertile	Third tertile
Physical attractiveness	.843	.976*	.124	.799	.784*	.774*
	(.457)	(.383)	(.366)	(.459)	(.377)	(.363)
	.073	*.087*	*.011*	*.067*	*.069*	*.064*
Sex	1.983***	1.773***	2.082***	1.830***	1.474***	1.684***
	(.459)	(.344)	(.280)	(.457)	(.335)	(.273)
	.168	*.174*	*.233*	*.151*	*.144*	*.184*
Education	.650**	.397**	.112	.841***	.275	.086
	(.203)	(.151)	(.113)	(.203)	(.149)	(.111)
	.126	*.090*	*.031*	*.158*	*.061*	*.023*
Constant	-2.608	-1.496	.032	-2.896	-.987	-.193
	(.426)	(.449)	(.497)	(.431)	(.444)	(.494)
R^2	.051	.048	.056	.056	.031	.038
Number of cases	642	838	971	676	909	1,093

Table S4 (continued).
Robustness check.
Associations between physical attractiveness and earnings, by IQ tertiles.
National Child Development Study in the United Kingdom

	Earnings measured at Age 55		
	(13)	(14)	(15)
	First tertile	Second tertile	Third tertile
Physical attractiveness	.278 (.552) *.021*	1.227* (.476) *.090*	.830 (.489) *.052*
Sex	1.647** (.553) *.123*	1.192** (.424) *.097*	1.485*** (.369) *.124*
Education	.785** (.249) *.131*	.212 (.193) *.038*	.226 (.150) *.046*
Constant	-3.767 (.536)	-2.253 (.578)	-2.084 (.669)
R^2	.036	.019	.020
Number of cases	575	826	1,052

Note: Main entries are unstandardized regression coefficients.
(Numbers in parentheses are standard errors.)
Numbers in italics are standardized regression coefficients.
* $p < .05$ ** $p < .01$ *** $p < .001$

Source: Table created by the author.

Table S5.
Associations between childhood general intelligence and earnings, by requisite skill level
National Child Development Study

	Age				
Social class	33	42	47	51	55
Unskilled	r = .048	r = .006	r = .098	r = .071	r = .074
	n = 743	n = 164	n = 83	n = 124	n = 90
	p = .194	p = .942	p = .380	p = .434	p = .487
Semiskilled/	r = .117	r = -.107	r = -.074	r = -.062	
Semiskilled	n= 496	n = 656	n = 453	n = 491	
manual	p = .009	p = .006	p =.116	p = .171	
Partly	r = .176				r = .027
skilled/	n = 282				n = 444
Semiskilled	p =.003				p = .565
nonmanual					
Skilled	r = .135	r = .037	r = .074	r = -.040	r = -.024
manual	n = 63	n = 1,053	n = 672	n = 792	n = 680
	p = .292	p =.226	p = .055	p = .261	p = .531
Skilled	r = .021	r = .096	r = .124	r = .132	r = .008
nonmanual	n = 1,659	n = 1,202	n = 932	n = 937	n = 728
	p = .400	p < .001	p < .001	p < .001	p = .820
Managerial/	r = .039	r = .134	r = .236	r = .125	r = .086
Managerial/	n = 1,092	n = 2,039	n = 1,729	n = 1,980	n = 1,633
Technical	p = .194	p < .001	p < .001	p < .001	p < .001
Professional	r = .045	r = .145	r = .078	r = .164	r = .011
	n = 910	n = 278	n = 203	n = 275	n = 261
	p = .179	p = .016	p = .270	p = .006	p = .858

Source: Table created by the author.