Six Facts
The Technology of Skill Formation
Cunha and Heckman, AER 2007

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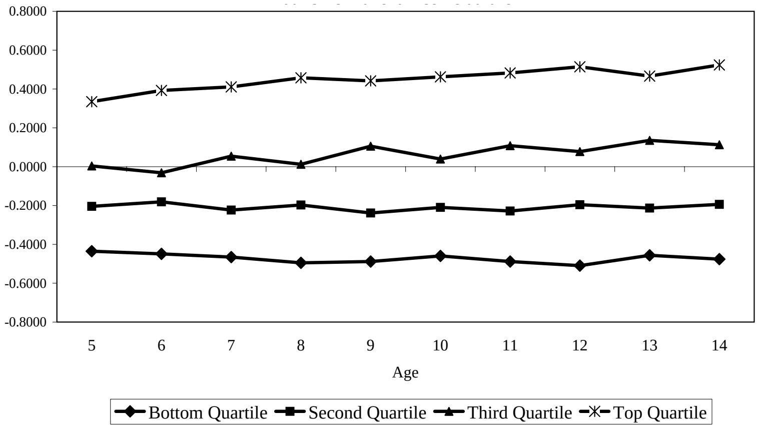
Economics 350, Winter 2021
March 3, 2021

Six Facts

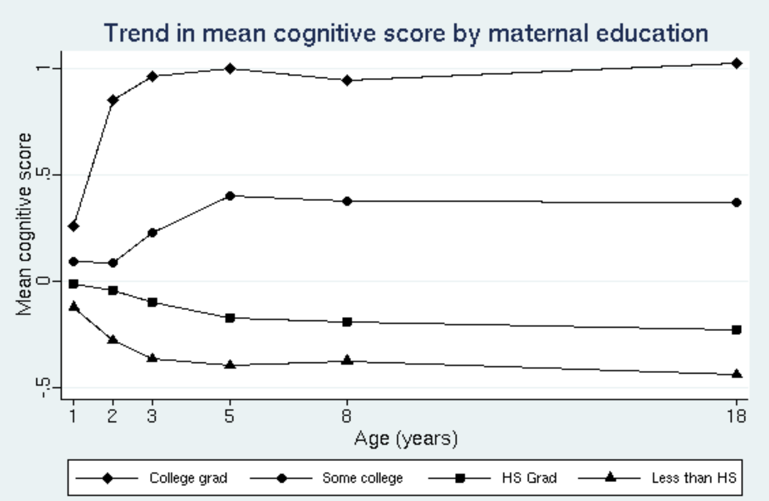
- First, *ability gaps between individuals and across socioeconomic groups open up at early ages, for both cognitive and noncognitive skills*.
- Adjusting for family background by regression analysis reduces these gaps.
- Experimental manipulations of early environments (Perry, Abecedarian et al.) show that these effects are causal.

Figure 1: Children of NLSY Average Standardized Score PIAT Math by Permanent Income Quartile



Source: Full Sample of CNLSY

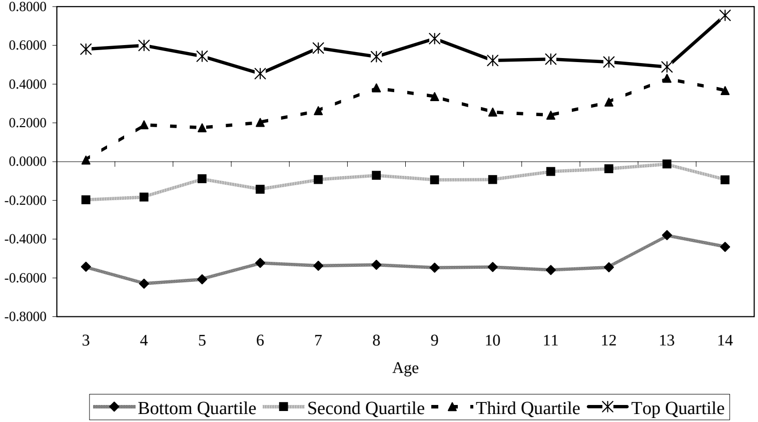
Figure D0: Trend in Mean Cognitive Score by Maternal Education



Source: Brooks-Gunn et al., (2006).

- The dramatic results on the importance of the early years in creating differences among children shown in the previous graph arise if "Bayley scores" are used as a measure of cognition at age 1.
- As Michael Lewis and Harry McGurk (1972) point out, this is illegitimate since the Bayley score tests other aspects of child development in addition to cognition.

Figure D00: Children of NLSY Average Standardized Score Peabody Picture Vocabulary Test by Permanent Income Quartile



Source: Full Sample of CNLSY

Figure D1a. Average percentile rank on PIAT-Math score, by income quartile

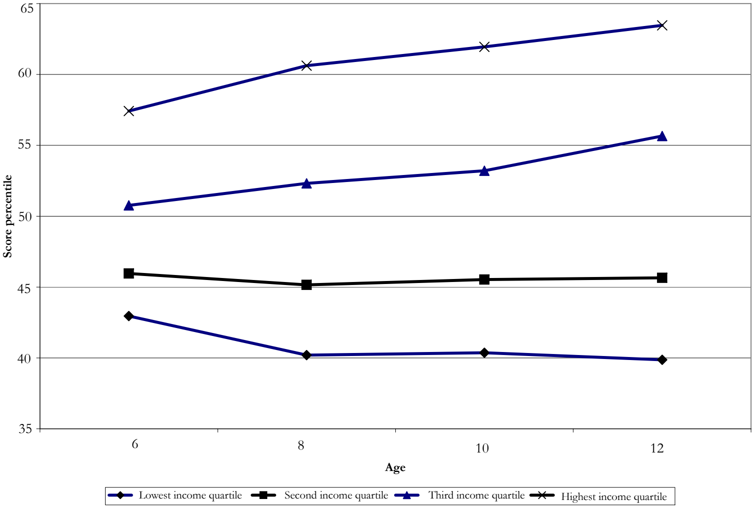
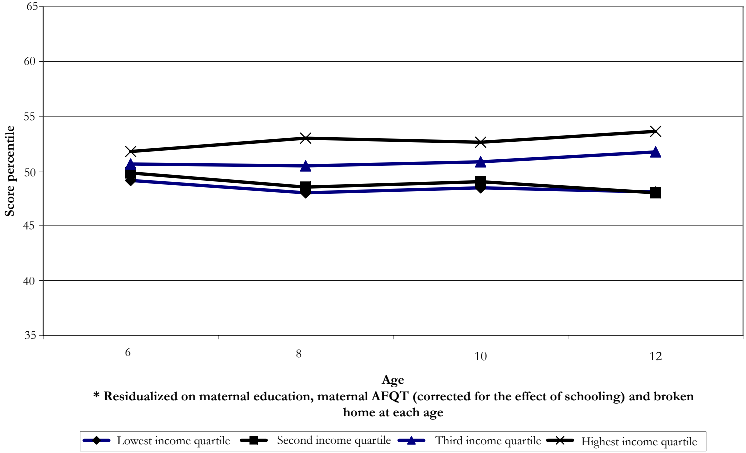


Figure D1b. Adjusted average PIAT-Math score percentiles, by income quartile



*** Residualized on maternal education, maternal AFQT (corrected for the effect of schooling) and broken home at each age**

Figure D2a. Average percentile rank on PIAT-Math score, by race

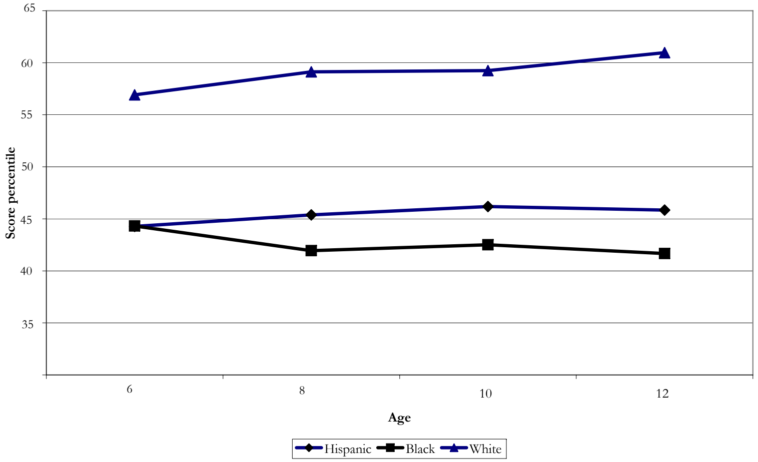


Figure D2b. Adjusted average PIAT-Math score percentiles, by race

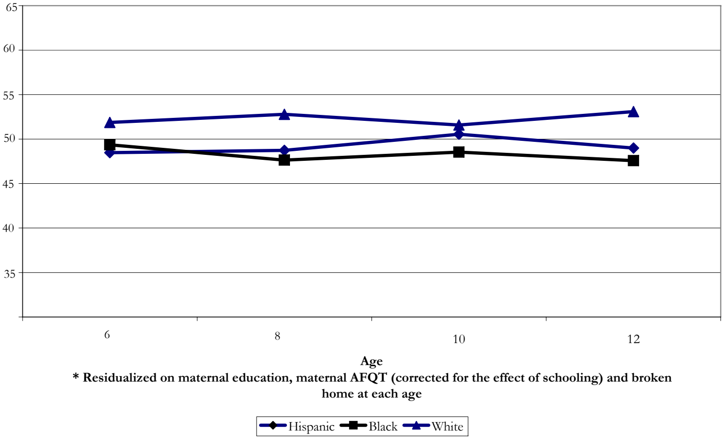


Figure D3a. Average percentile rank on anti-social behavior score, by income quartile

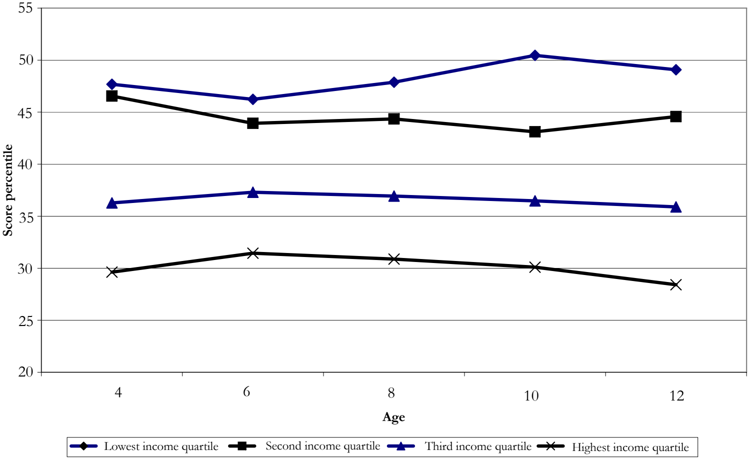
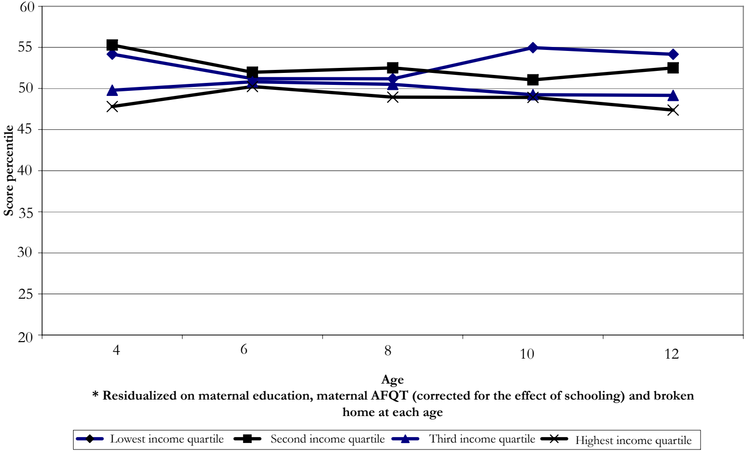


Figure D3b. Adjusted average anti-social behavior score percentile, by income quartile



*** Residualized on maternal education, maternal AFQT (corrected for the effect of schooling) and broken home at each age**

Figure D4a. Average percentile rank on anti-social behavior score, by race

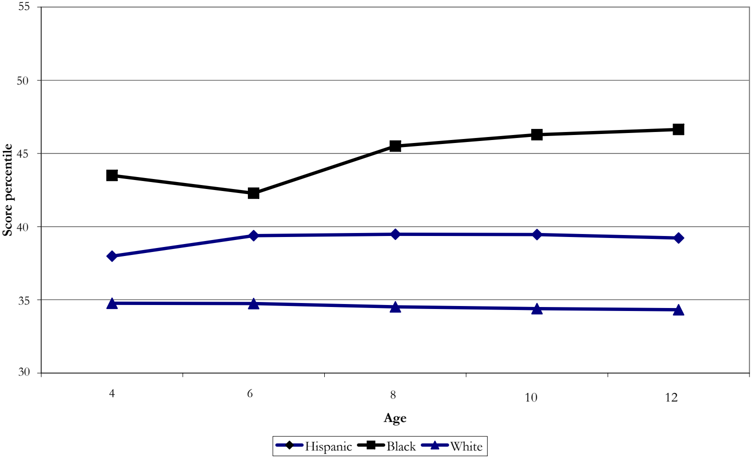
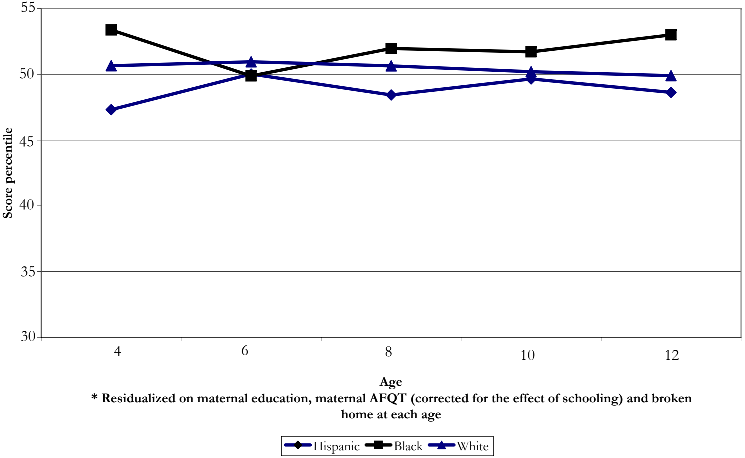
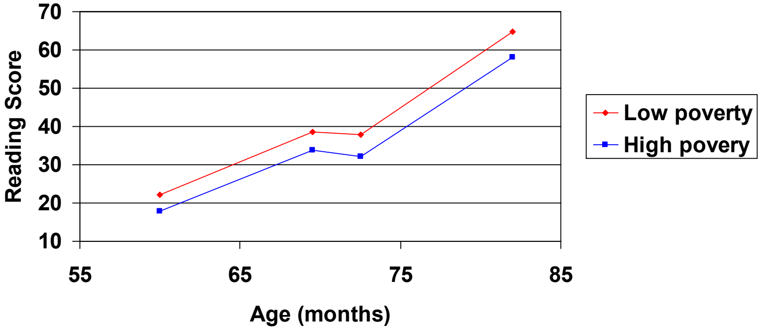


Figure D4b. Adjusted average anti-social behavior score percentile, by race



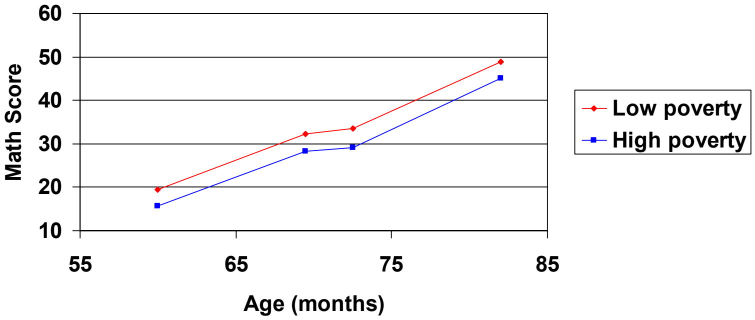
*** Residualized on maternal education, maternal AFQT (corrected for the effect of schooling) and broken home at each age**

Figure D5a. Early Childhood Longitudinal Study (ECLS) Reading



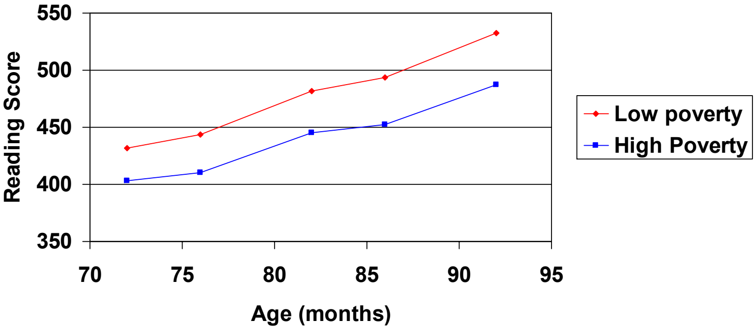
Source: Raudenbush (2006)

Figure D5b. Mean trajectories, high and low priority schools (ECLS) Math



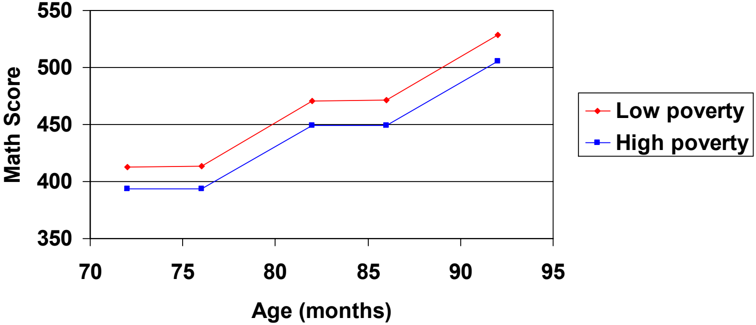
Source: Raudenbush (2006)

Figure D6a. Average Trajectories, Grades 1–3, high and low poverty schools (Sustaining Effects Study)
Reading



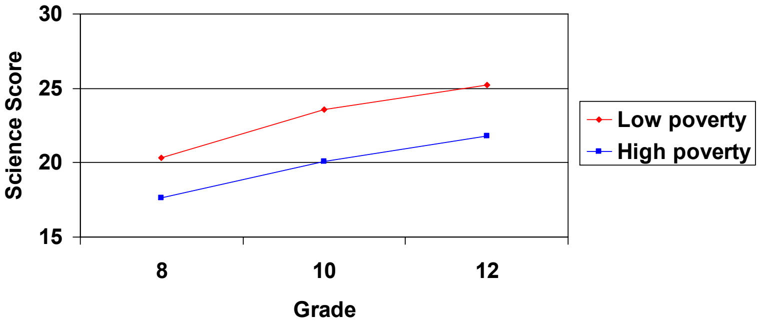
Source: Raudenbush (2006)

Figure D6b. Average Trajectories, Grades 1–3, high and low poverty schools (Sustaining Effects Study)
Math



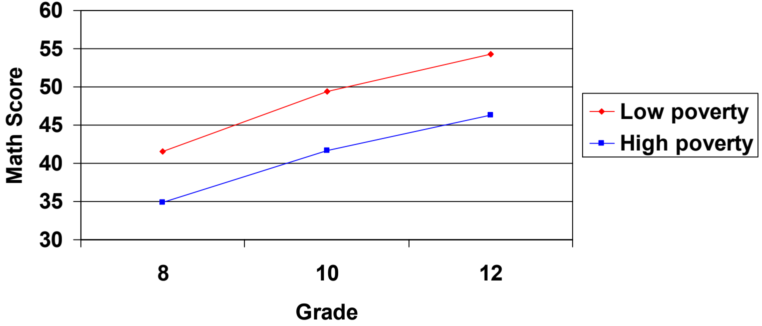
Source: Raudenbush (2006)

Figure D7a. Average achievement trajectories, grades 8–12, (NELS 88) Science



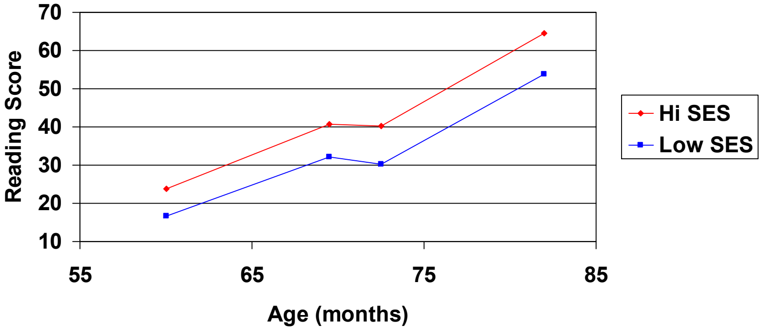
Source: Raudenbush (2006)

Figure D7b. Average achievement trajectories, grades 8–12, (NELS 88) Math



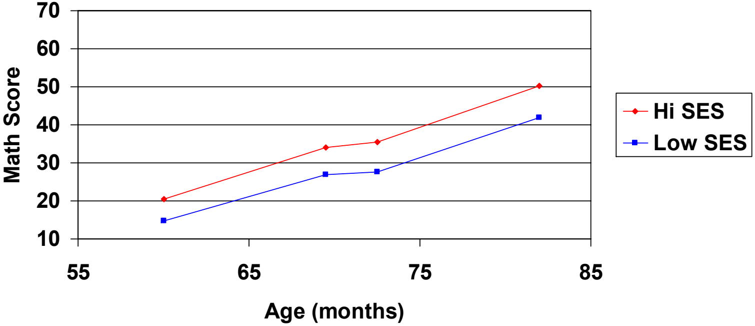
Source: Raudenbush (2006)

Figure D8a. Growth as a function of student social background: ECLS Reading



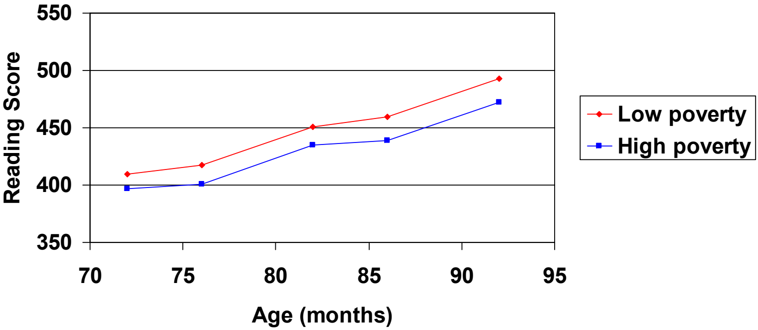
Source: Raudenbush (2006)

Figure D8b. Growth as a function of student social background: ECLS Math



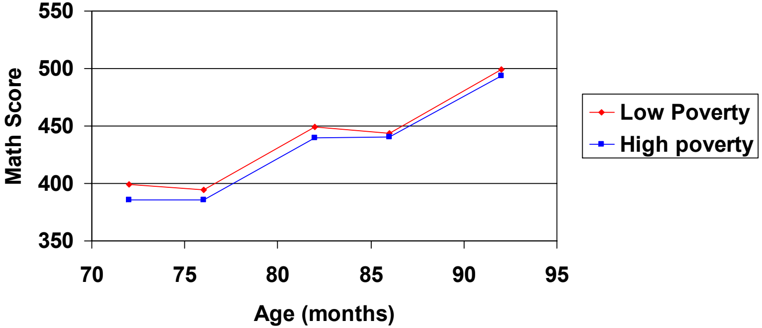
Source: Raudenbush (2006)

Figure D9a. Growth as a function of school poverty for poor children: sustaining effects data
Reading



Source: Raudenbush (2006)

Figure D9b. Growth as a function of school poverty for poor children: sustaining effects data
Math

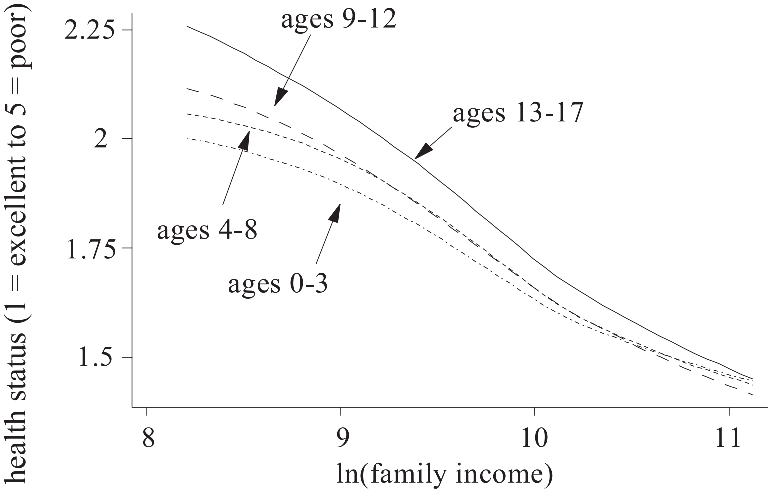


Source: Raudenbush (2006)

- Schooling quality and school resources have relatively small effects on ability deficits and only marginally account for any divergence by age across children from different socioeconomic groups in test scores.
- See Heckman, Larenas et al. (2004) and Raudenbush (2006).

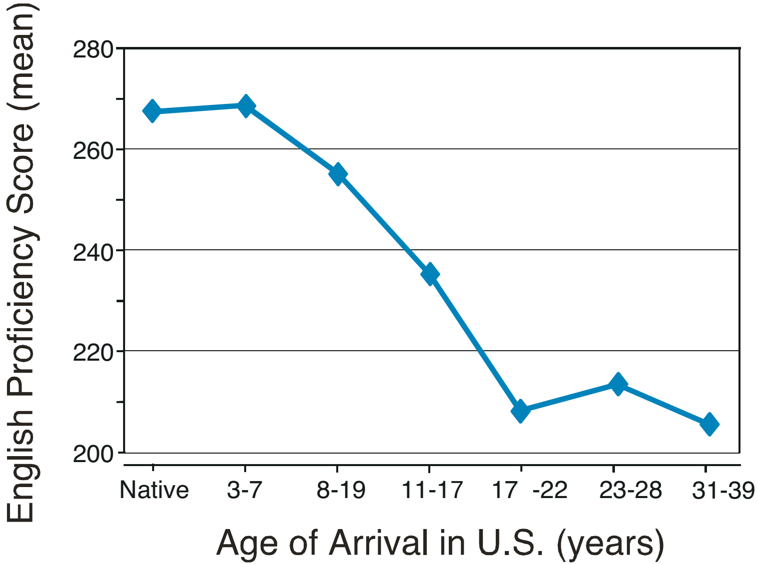
Gaps also emerge in health. These appear to be divergent with age, at least in the U.S.

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.



- Second, *in both animal and human species, there is compelling evidence of critical and sensitive periods in the development of the child*.

Second language learning



- The later remediation is given to a disadvantaged child, the less effective it is.
- A substantial body of evidence suggests that returns to adolescent education for the most disadvantaged and less able are lower than the returns for the more advantaged.

- The economic returns to adolescent interventions — job training, high school graduation, and college attendance — are lower for less able persons.

Table 1. Return to one year of college for individuals at different percentiles of the math test score distribution White males from high school and beyond

	5%	25%	50%	75%	95%
Average return in the population	0.1121	0.1374	0.1606	0.1831	0.2101
	(0.0400)	(0.0328)	(0.0357)	(0.0458)	(0.0622)
Return for those who attend college	0.1640	0.1893	0.2125	0.2350	0.2621
	(0.0503)	(0.0582)	(0.0676)	(0.0801)	(0.0962)
Return for those who do not attend college	0.0702	0.0954	0.1187	0.1411	0.1682
	(0.0536)	(0.0385)	(0.0298)	(0.0305)	(0.0425)
Return for those at the margin	0.1203	0.1456	0.1689	0.1913	0.2184
	(0.0364)	(0.0300)	(0.0345)	(0.0453)	(0.0631)

Source: Carneiro and Heckman (2003)

- Third, *despite the low returns to interventions targeted toward disadvantaged adolescents, the empirical literature shows high economic returns for remedial investments in young disadvantaged children*.

- Fourth, *if early investment in disadvantaged children is not followed up by later investment, its effect tends to weaken at later ages.*
- Currie and Thomas (1995) document a decline in the performance of minority Head Start participants after they leave the program.

- Fifth, *the effects of credit constraints on the child's adult outcomes depend on the age at which they bind for the child's family*.
- Controlling for cognitive ability, under meritocratic policies currently in place in American society, family income during the child's college-going years plays only a minor role in determining child college participation.
- Holding ability fixed, minorities are *more likely* to attend college than others despite their lower family incomes.

- Carneiro and Heckman present evidence for the United States that only a small fraction (at most 8%) of the families of adolescents are credit constrained in making their college decisions.
- This evidence is supported in research by Cameron and Taber (2004) and Stinebrickner and Stinebrickner (2006).
- Recent research by Lochner & Caucutt (2019) and Hai & Heckman (2016) suggests that the "constrained" are of two categories of families.
    - (i) Low income throughout life
    - (ii) Rising income profiles – families unable to fully access future income, but with high and rising profiles (associated with more educated families).

- The empirically important market failures in the life cycle of skill formation in contemporary American society are the inability of children to buy their parents or the lifetime resources that parents provide.

- Sixth, *socioemotional (noncognitive) skills foster cognitive skills and are an important product of successful families and successful interventions in disadvantaged families.*
- The Perry Preschool Program, which was evaluated by random assignment, did not boost participant adult IQ but enhanced performance of participants in a number of dimensions, including elevated scores on achievement tests, employment and reduced participation in a variety of social pathologies.

Figure D10a. Perry Preschool Program: IQ, by age and treatment group

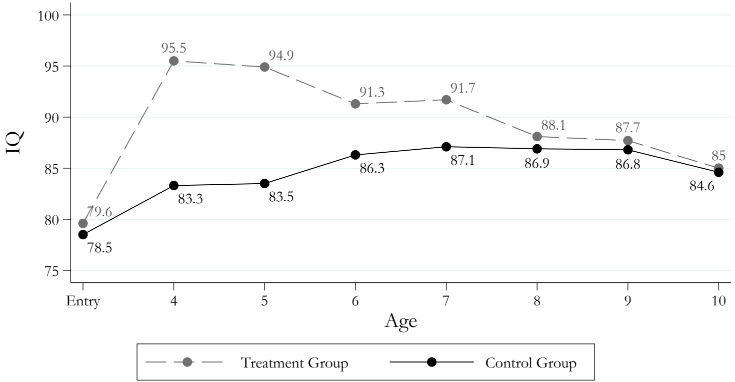
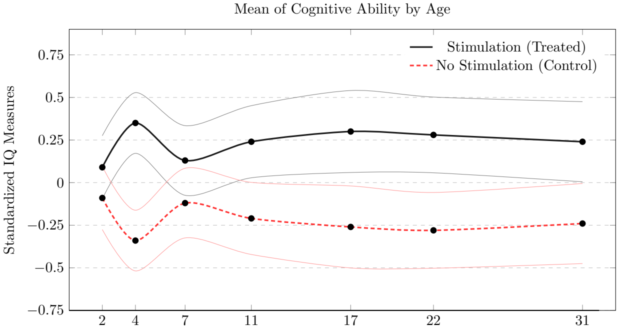


Figure 1: Mean of Cognitive Ability by Age



Effect	**0.18**	**0.69*****	**0.25***	**0.45*****	**0.56*****	**0.56*****	**0.48****
Std.Err.	0.185	0.178	0.204	0.211	0.240	0.222	0.235
p-value	0.14	0.00	0.09	0.01	0.00	0.00	0.01
Sample	127	127	122	116	103	105	95

Note: This figure presents the mean of the cognitive measures for the Jamaican study participants by age. Data consists of seven variables: the standardized Griffiths developmental quotient measured at ages 2 and 4; the standardized Stanford Binet IQ surveyed at age 7; the standardized WISC Full Scale full scale IQ at age 11; and standardized the WAIS Full scale IQ measured at ages 17, 22 and 31. The thick solid line presents the conditional estimates for the mean of the cognitive measures for stimulation arms of the intervention controlled by age variation. The thick dashed line presents the respective estimates for the non-stimulation arms of the intervention. The boundaries denote estimated standard errors of each mean. The bottom of the figure displays four rows. The first one presents the treatment effect estimate controlled for age variation. The second row presents the estimated standard error. The third row presents the one-sided single hypothesis p-value associated with the null hypothesis of no treatment effect. The last row presents the sample size.