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The Economic Case for Investing in Early Childhood Education

Case Western Reserve University
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American Society is Becoming Polarized and Less Productive

American Society is Becoming Polarized and Less Productive

In the past 30 years, American society has polarized.

A greater percentage of children attending and graduating college.

At the same time, a greater percentage dropping out of secondary school producing a growing underclass, neither working nor going to school.

American Society is Becoming Polarized and Less Productive

75% of American youth who apply to the military are ineligible to serve because of low cognitive capacities, criminal records, or obesity.

20% of the U.S. work force has such a low rate of literacy that it cannot understand the instructions on a vial of pills.

The slowdown in the growth of the skills of the workforce is reducing U.S. productivity and competitiveness.

American Society is Becoming Polarized and Less Productive

These problems are usually discussed separately, in a piecemeal fashion.

Analysts blame the public schools, rising tuition costs, or the failure of a number of other social institutions.

This has produced an array of competing proposals that lack coherence or a firm grounding in science and social science.

American Society is Becoming Polarized and Less Productive

Today, I want to articulate a coherent approach to addressing these problems that is rooted in the economics, psychology, and biology of human development.

There is a strong economic case for investing in early childhood.

The Argument

The Argument

Many major economic and social problems such as crime, teenage pregnancy, obesity, high school dropout rates, and adverse health conditions can be traced to low levels of skill and ability in society.

In analyzing ability, society needs to recognize its multiple facets.

The Argument

Current public policy discussions focus on promoting and measuring cognitive ability through IQ and achievement tests.

For example, in the U.S. the accountability standards in the *No Child Left Behind Act* concentrate attention on achievement test scores, not evaluating a range of other factors that promote success in school and life.

Cognitive abilities are important determinants of socioeconomic success.

The Argument

So are socioemotional abilities, physical and mental health, perseverance, attention, motivation, and self confidence.

They contribute to performance in society at large and even help determine scores on the very tests that are used to monitor cognitive achievement.

Ability gaps between the advantaged and disadvantaged open up early in the lives of children.

The Argument

Family environments of young children are major predictors of cognitive and socioemotional abilities, as well as crime, health and obesity.

More than genetics is at work.

The evidence that documents a powerful role of early family influence is a source of concern because family environments in the U.S. and many other countries around the world have deteriorated over the past 40 years.

The Argument

Experimental evidence on the effectiveness of early interventions in disadvantaged families is consistent with a large body of non-experimental evidence that adverse family environments, especially adverse parenting, substantially impair child outcomes.

If society intervenes early enough, it can raise the cognitive and socioemotional abilities and the health of disadvantaged children.

The Argument

Early interventions reduce inequality by promoting schooling, reducing crime, and reducing teenage pregnancy.

They also foster workforce productivity.

These interventions have high benefit-cost ratios and rates of return.

The Argument

Early interventions have much higher economic returns than later interventions such as reduced pupil-teacher ratios, public job training, convict rehabilitation programs, adult literacy programs, tuition subsidies or expenditure on police, or a variety of programs recently funded under ARRA.

The Argument

Life cycle skill formation is dynamic in nature. Skill begets skill; motivation begets motivation.

If a child is not motivated and stimulated to learn and engage early on in life, the more likely it is that when the child becomes an adult, it will fail in social and economic life.

The longer society waits to intervene in the life cycle of a disadvantaged child, the more costly it is to remediate disadvantage.

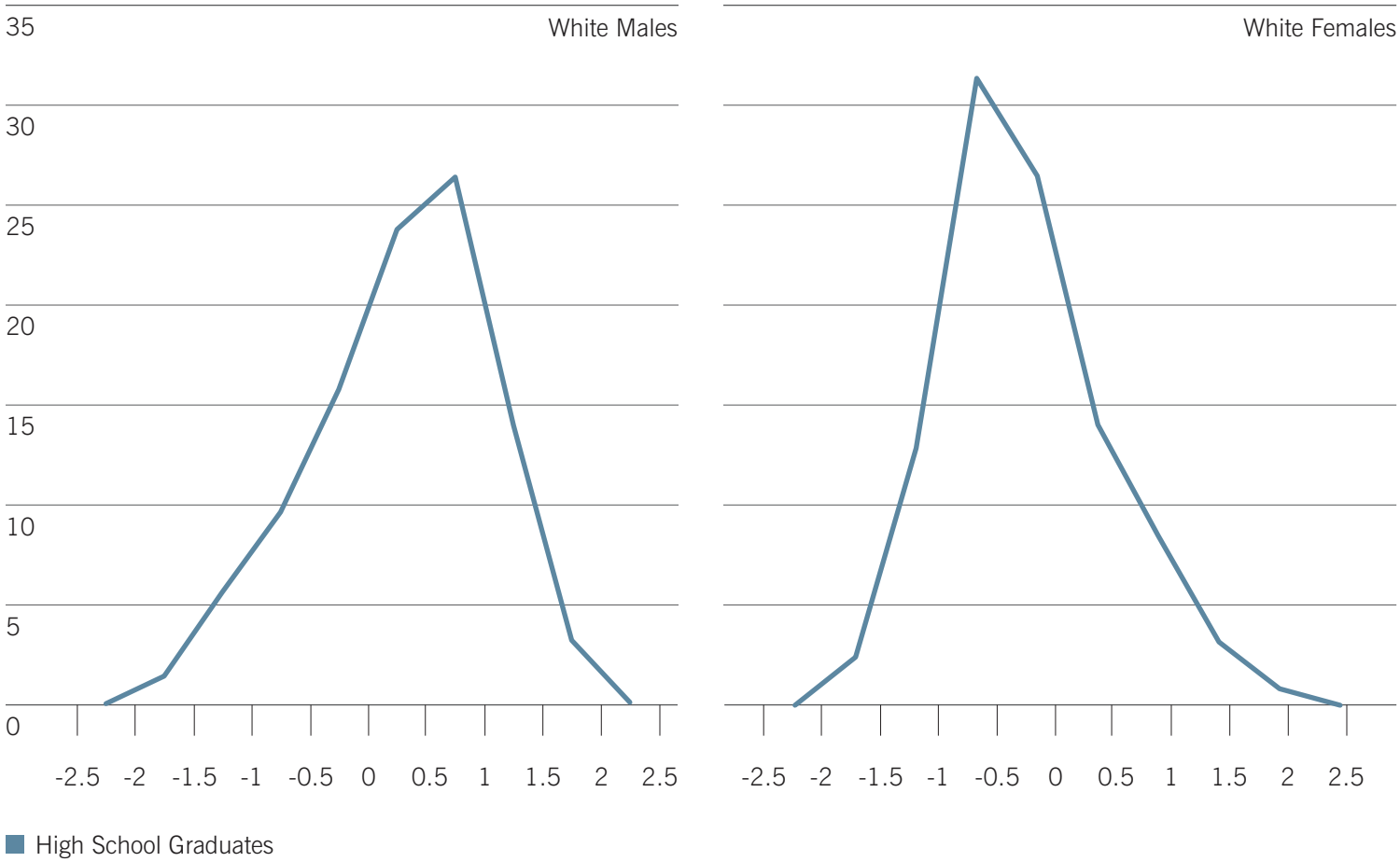
The Argument

Similar dynamics appear to be at work in creating child health and mental health.

A major refocus of policy is required to understand the life cycle of skill and health formation and the importance of the early years in creating inequality and opportunity, and in producing skills for the workforce.

The Importance of Cognitive and Noncognitive Skills

Density of Age Adjusted AFQT Scores, GED Recipients and High School Graduates with Twelve Years of Schooling



Source: Heckman, Hsee and Rubinstein (2001)

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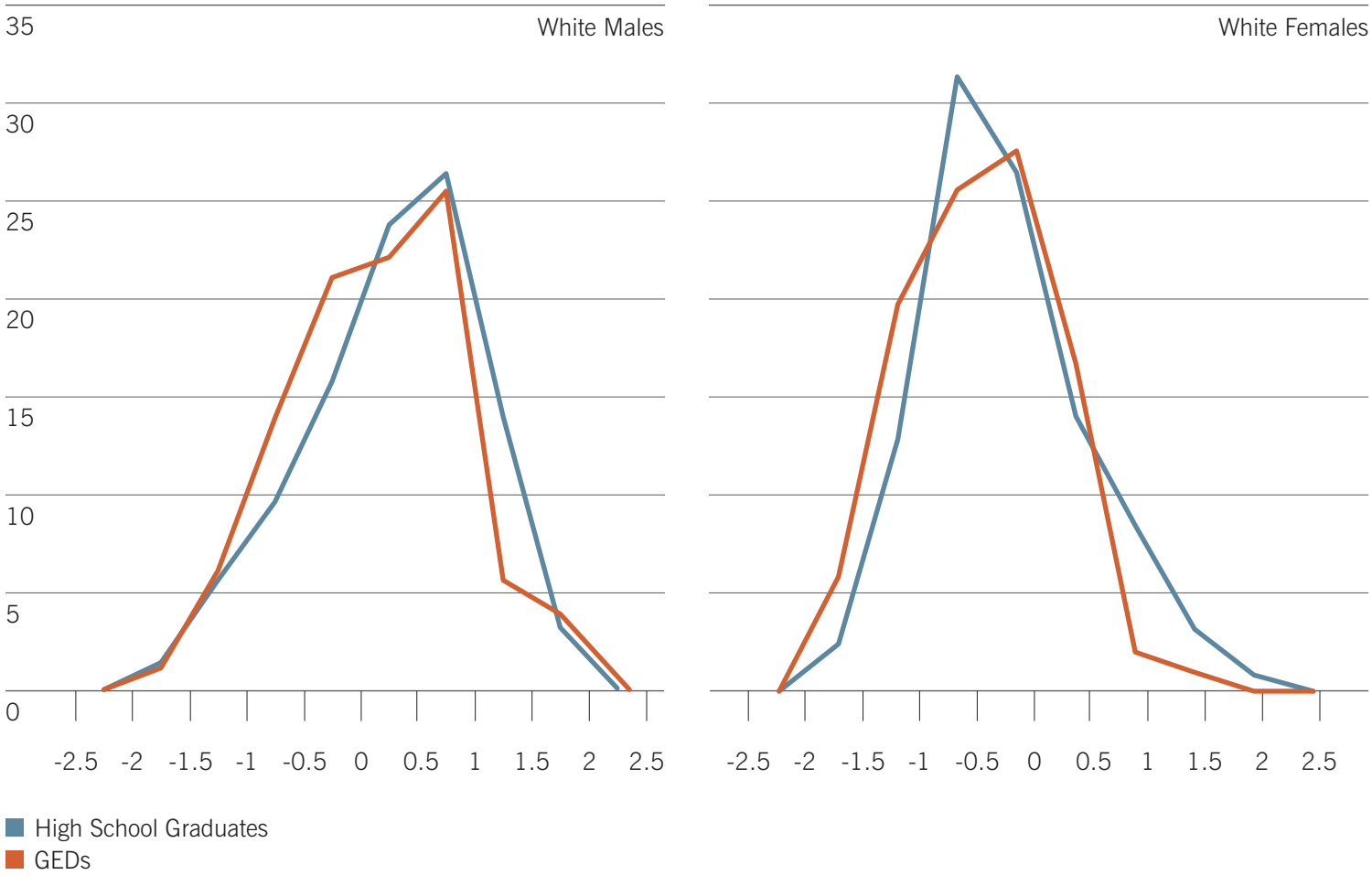


Source: Heckman, Hsee and Rubinstein (2001)

The Importance of Cognitive and Noncognitive Skills

GEDs earn at the rate of high school dropouts.

GEDs are as “smart” as high school graduates who complete education by classtime and not by taking tests.

They lack noncognitive skills.

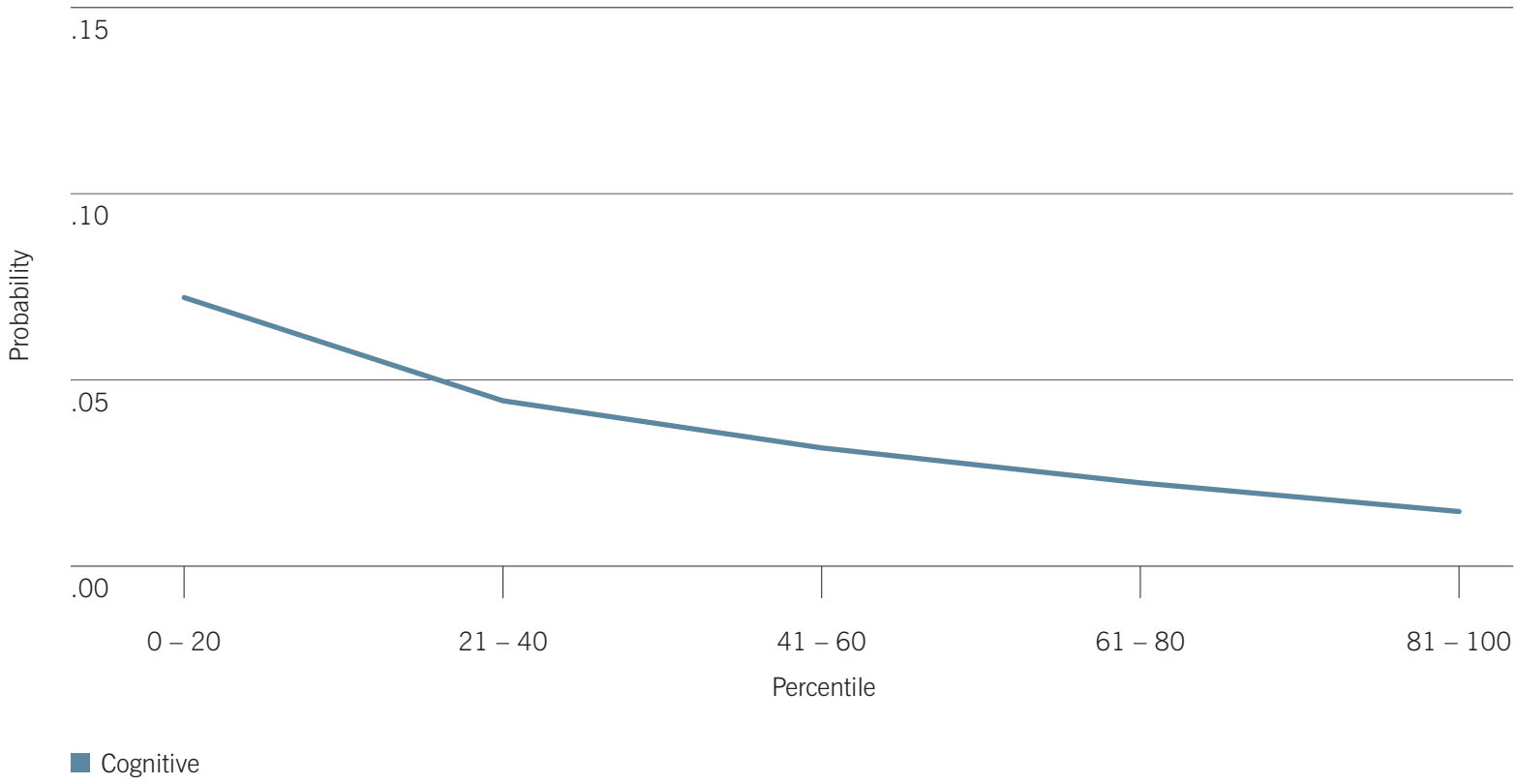
The Importance of Cognitive and Noncognitive Skills

The GEDs are the wise guys who can't finish anything.

Most branches of the U.S. military recognize this in their recruiting strategies.

GEDs too violent and undisciplined to be in the Marines.

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).

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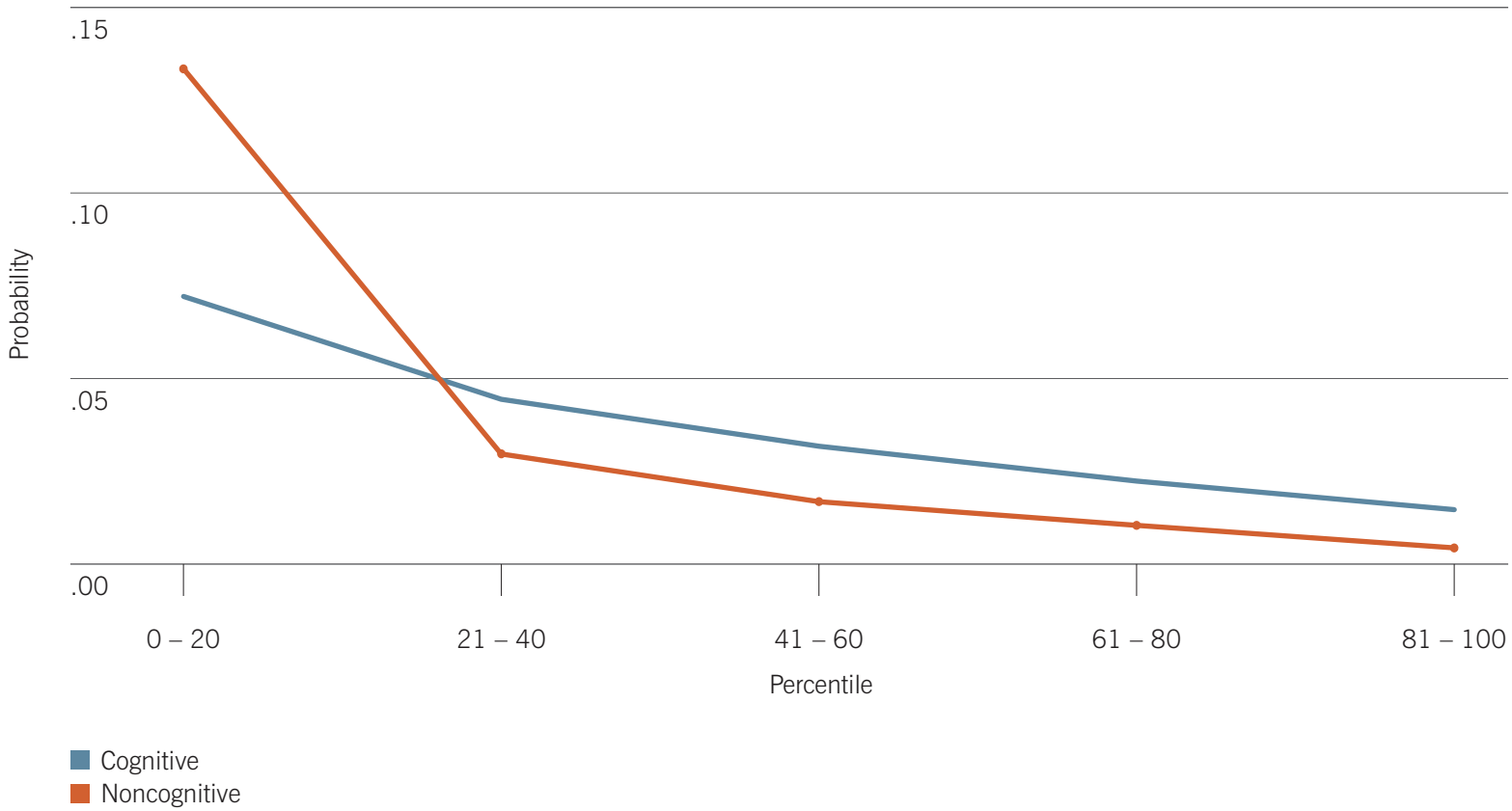

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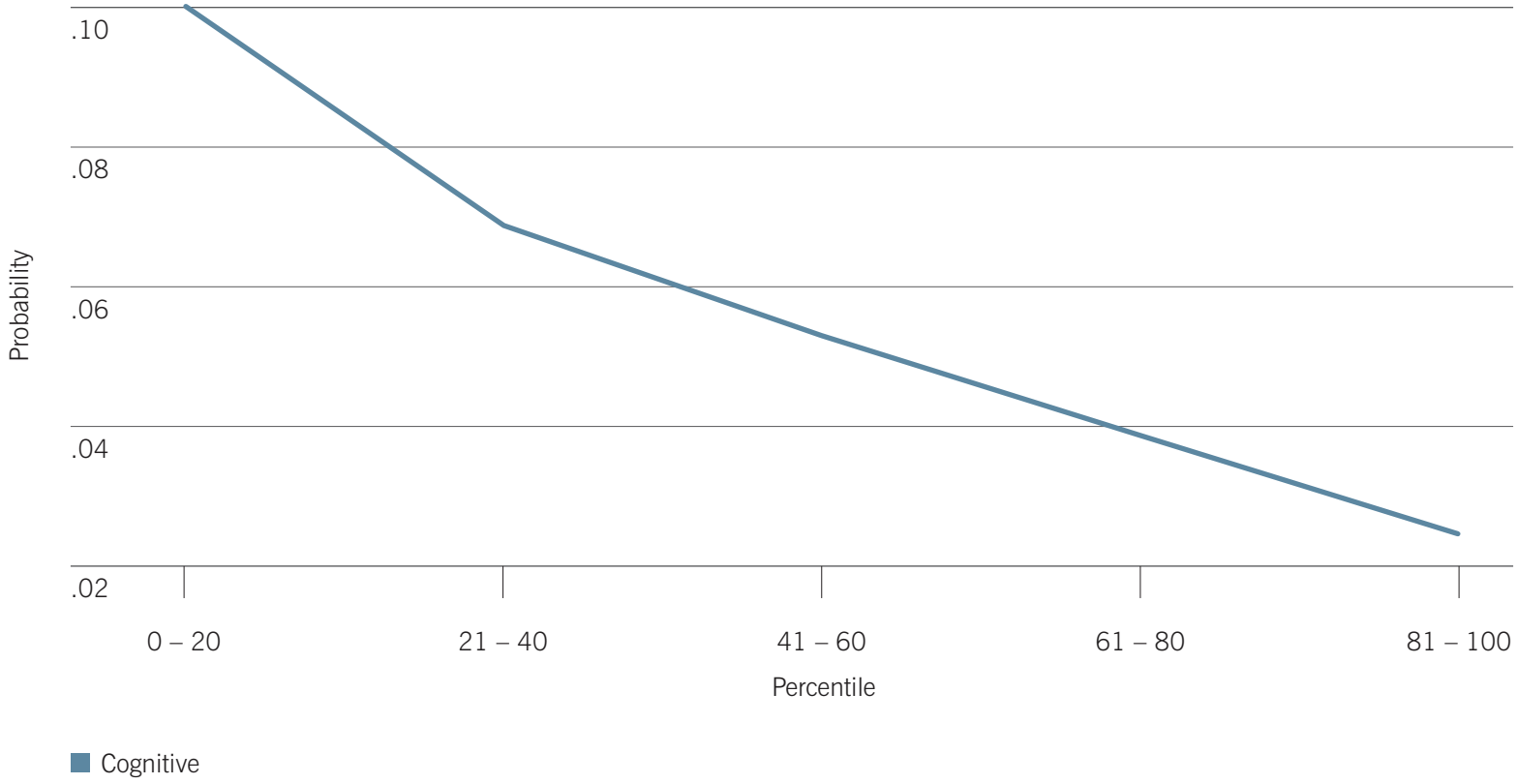
Probability of Being Single With Children (Females)



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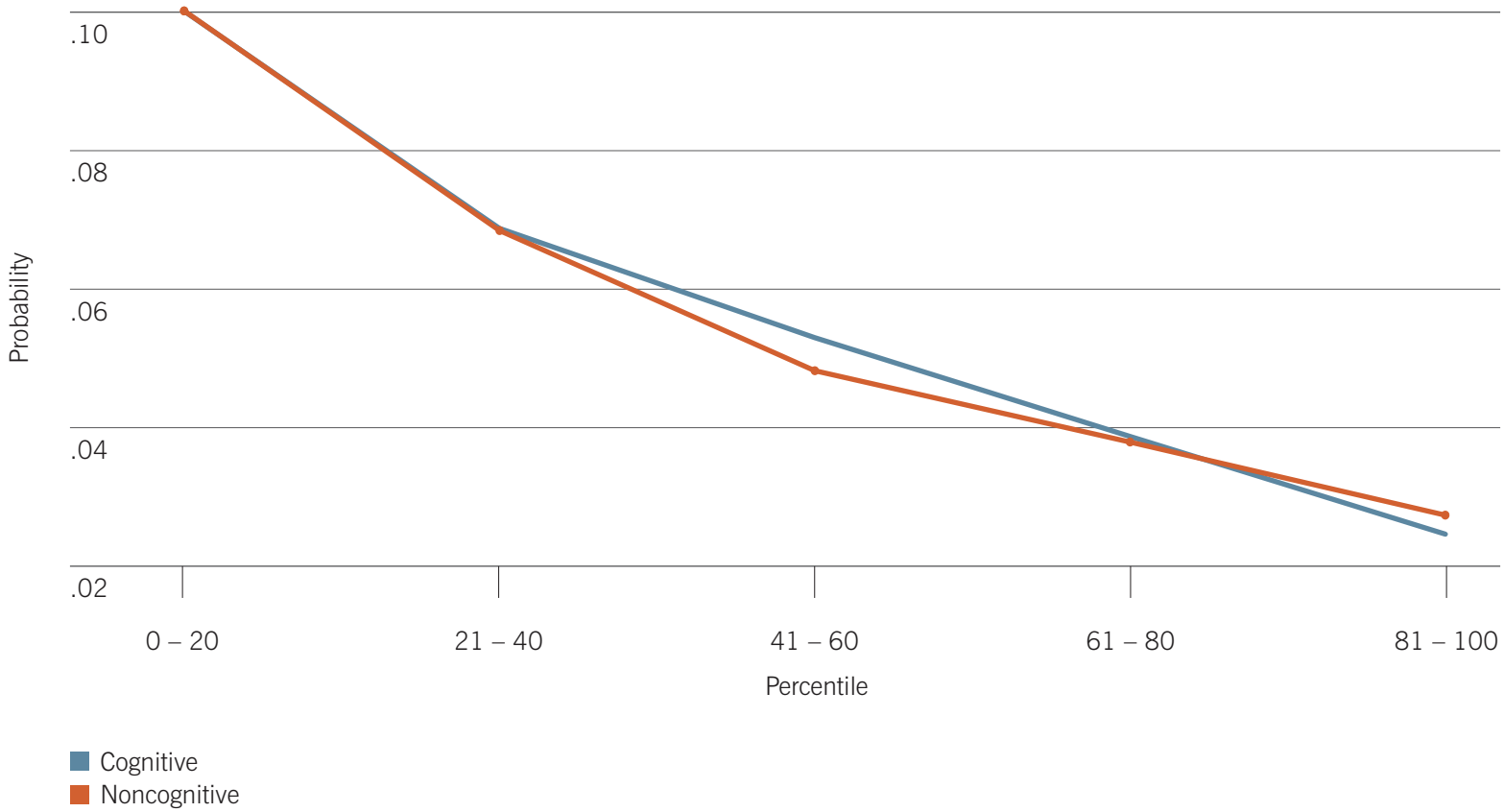

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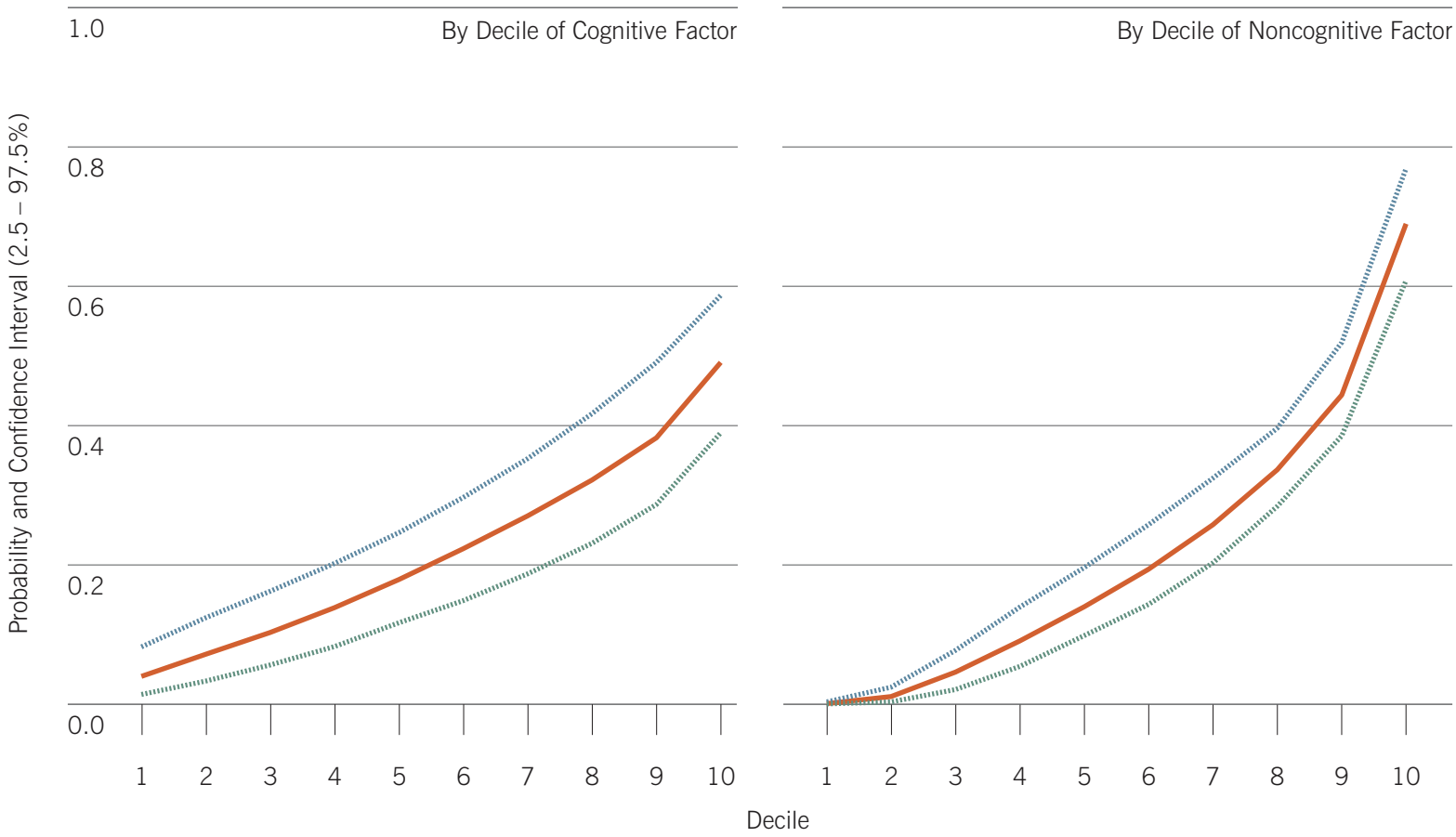
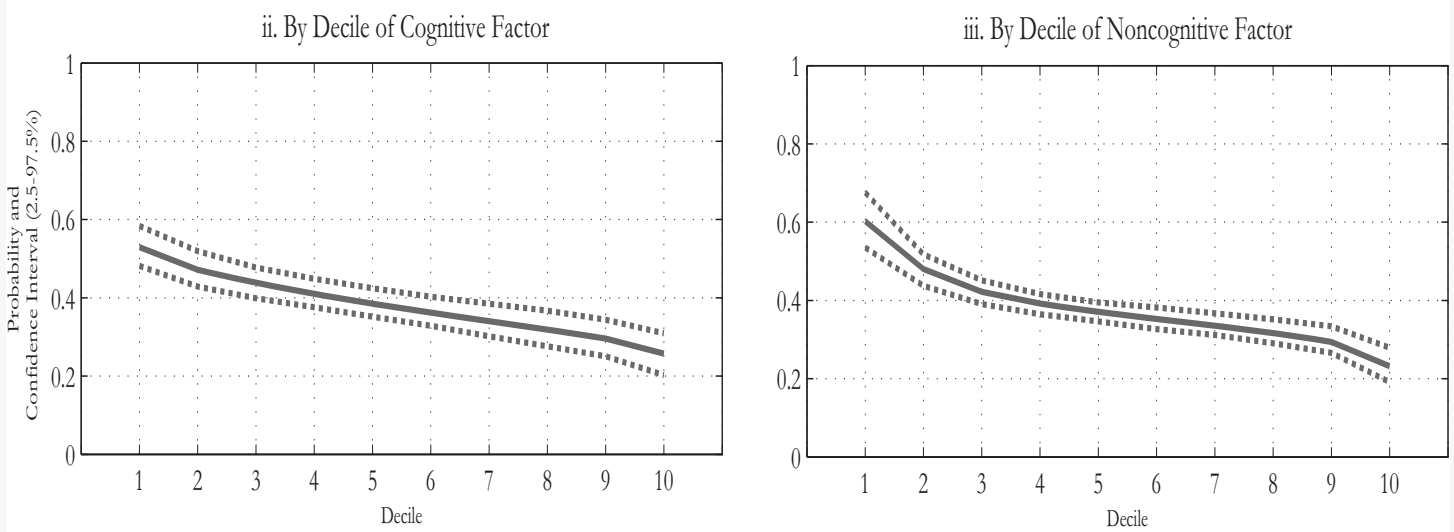
Probability of Being a 4-year College Graduate by Age 30 (Males)



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 (200 draws).

Probability of Daily Smoking by Age 18 (Males)



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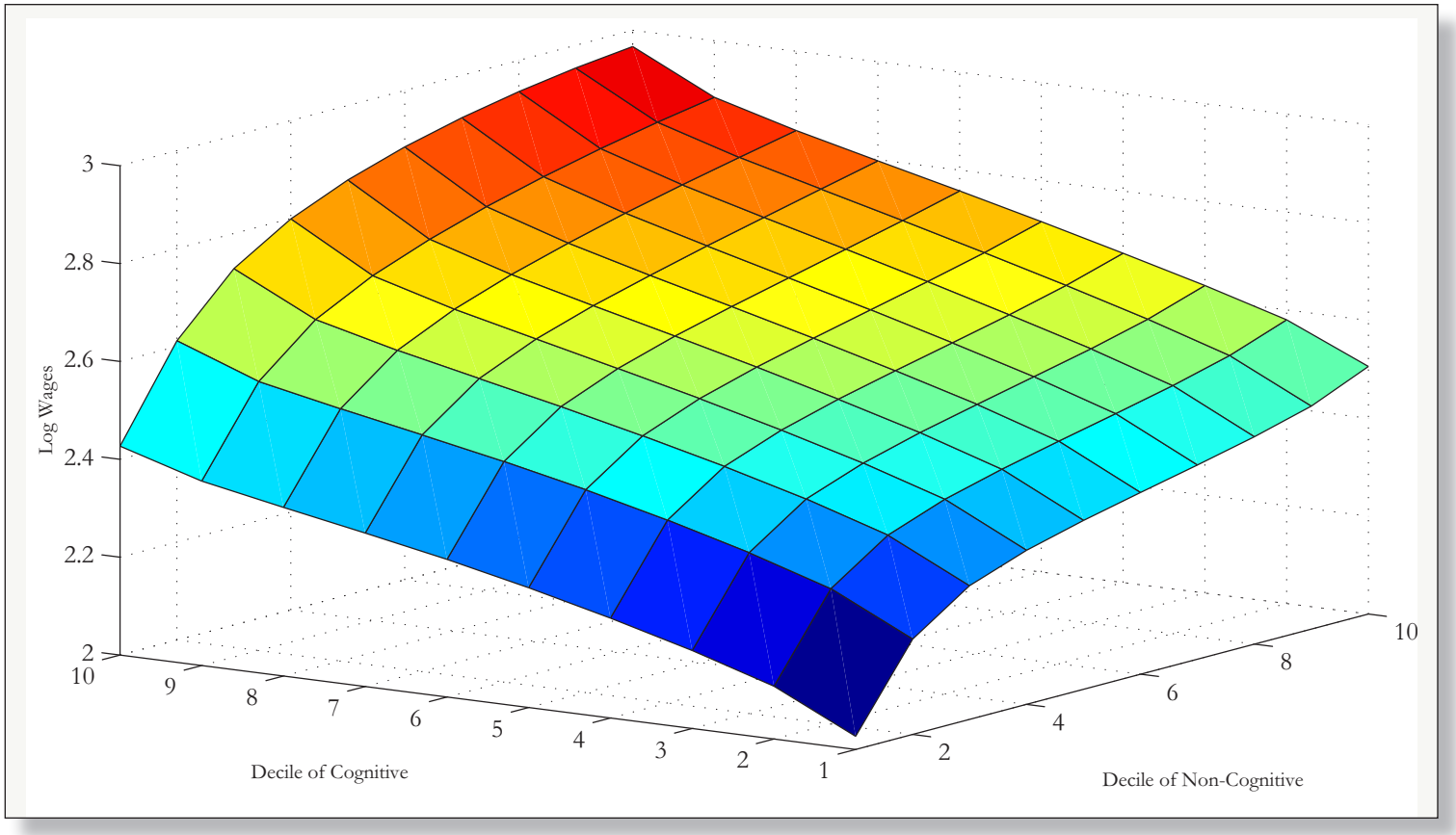
Mean Log Wages by Age 30 (Males)



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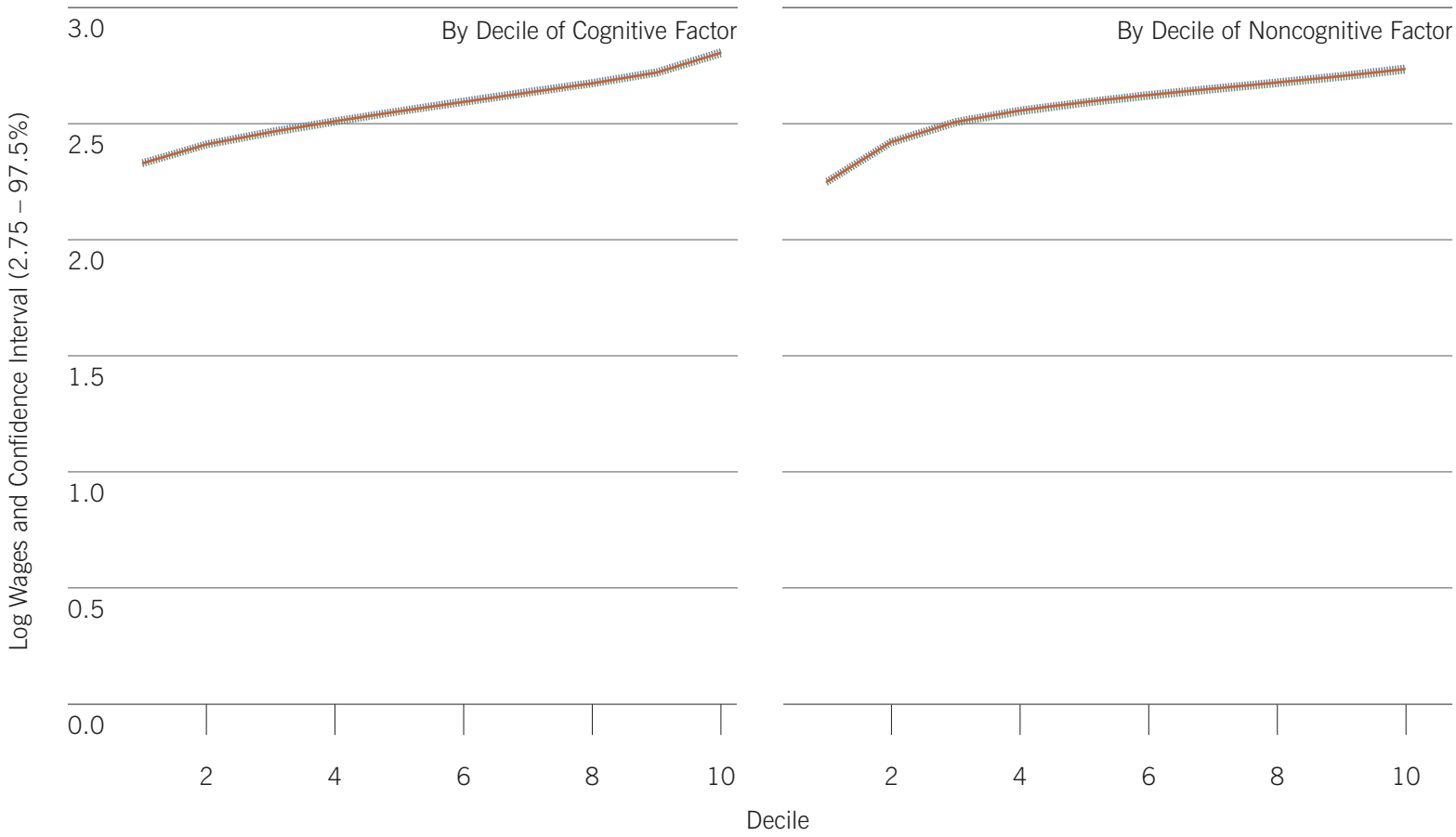

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The Importance of Cognitive and Noncognitive Skills

Controlling for ability measured at the school-going age, in the U.S. minorities are *more likely* to attend college than others despite their lower family incomes (Cameron and Heckman, 2001).

Deficits in college going across minority and majority groups are not caused by high tuition costs or family income at the age children are deciding to go to college.

Can ability differences explain racial-ethnic schooling gaps?

High School Completion Gap		
	White-Black Gap	White-Hispanic Gap
Actual White-Minority Gap	.06 (.01)	.14 (.02)
Ability Adjusted Gap	-.14 (.03)	-.12 (.04)

Source: Cameron and Heckman (2001)

Can ability differences explain racial-ethnic schooling gaps?

College Entry Probabilities Given High School Completion

	White-Black Gap	White-Hispanic Gap
Actual White-Minority Gap	.11 (.02)	.07 (.02)
Ability Adjusted Gap	-.14 (.02)	-.14 (.04)

Source: Cameron and Heckman (2001)

Can ability differences explain racial-ethnic schooling gaps?

Population College Entry Gap (Not Conditioning on HS Completion)		
	White-Black Gap	White-Hispanic Gap
Actual White-Minority Gap	.12 (.02)	.14 (.02)
Ability Adjusted Gap	-.16 (.03)	-.15 (.04)

Source: Cameron and Heckman (2001)

The Importance of Cognitive and Noncognitive Skills

Gaps in the abilities that play such an important role in determining diverse adult labor market and health outcomes open up early across socioeconomic groups.

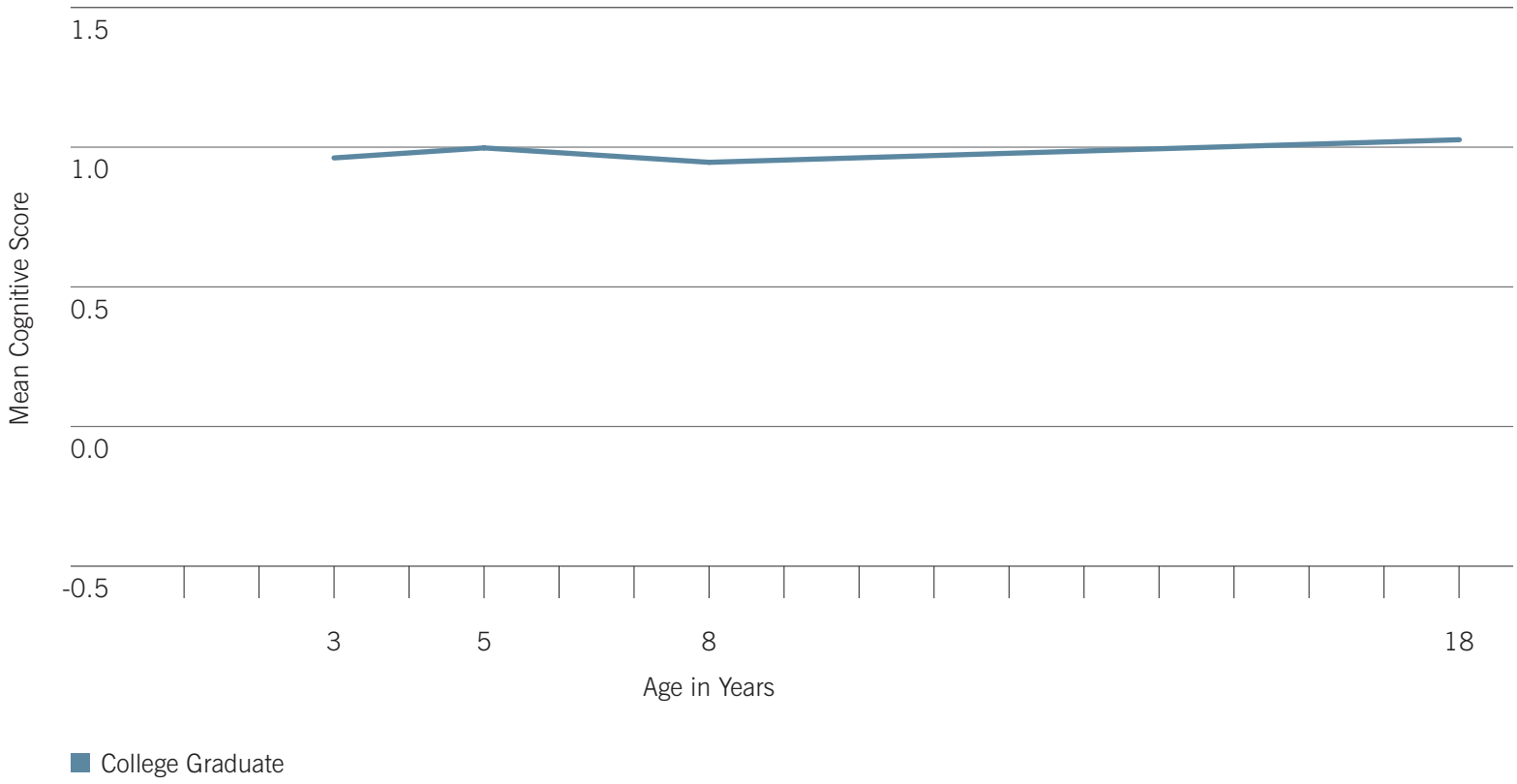
Schooling after the second grade plays only a minor role in alleviating these gaps.

The Importance of Cognitive and Noncognitive Skills

Measures of schooling quality (teacher/pupil ratios and teacher salaries) that receive so much attention in public forums play only minor roles in creating or eliminating the gaps after the first few years of schooling.

Schooling quality and school resources have relatively small effects on ability deficits and only marginally account for any divergence by age in test scores across children from different socioeconomic groups.

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).

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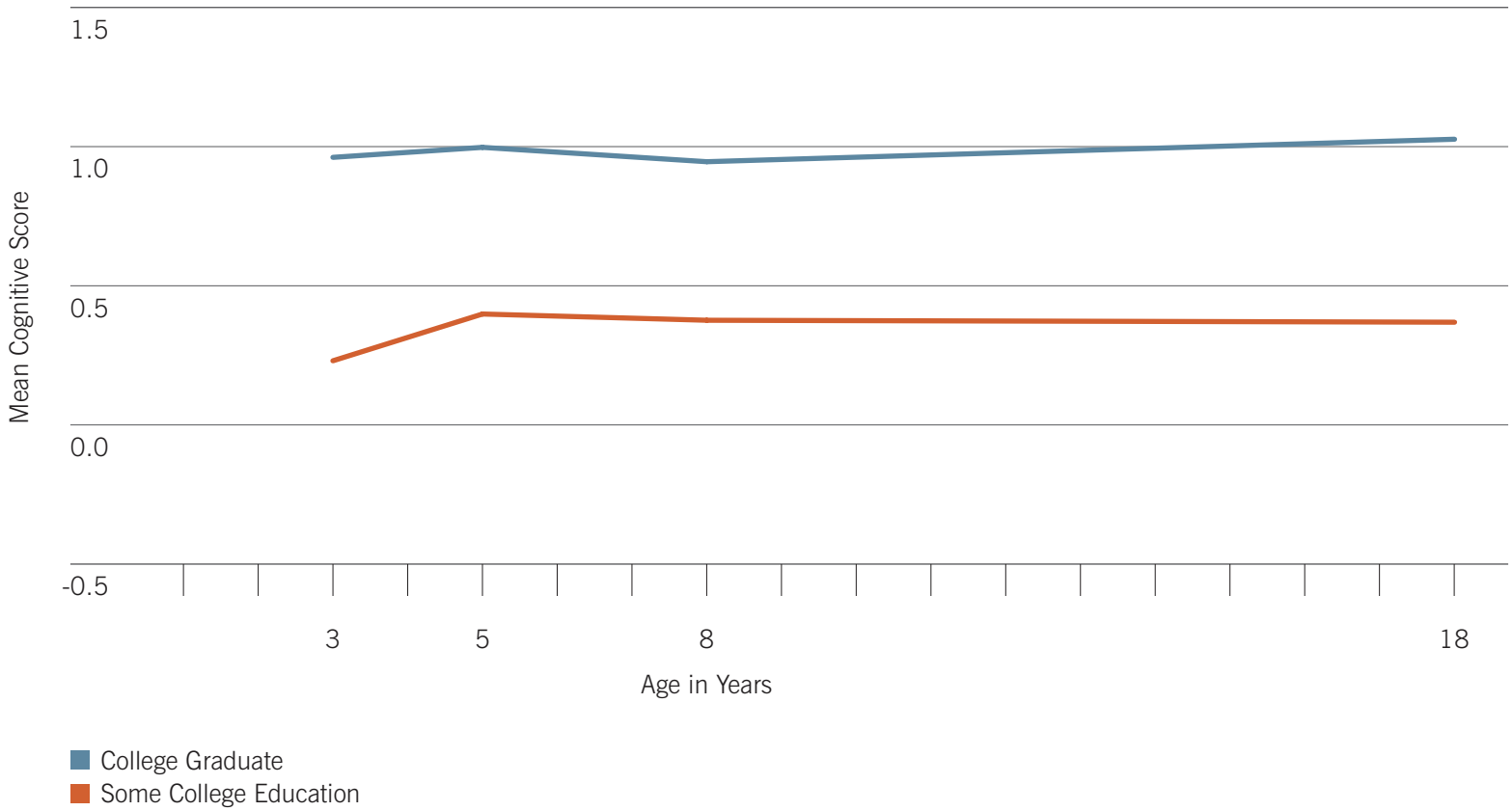

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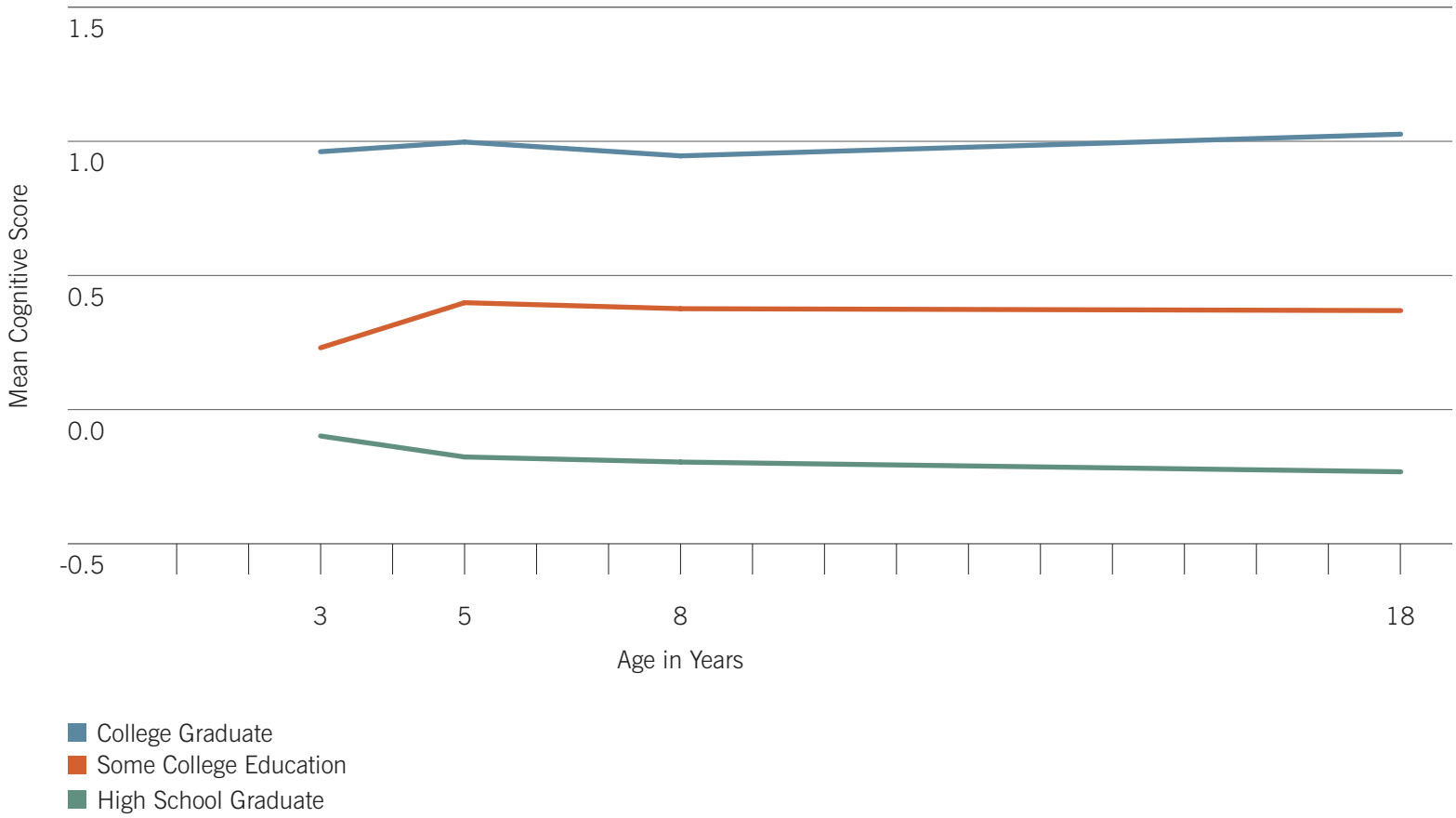

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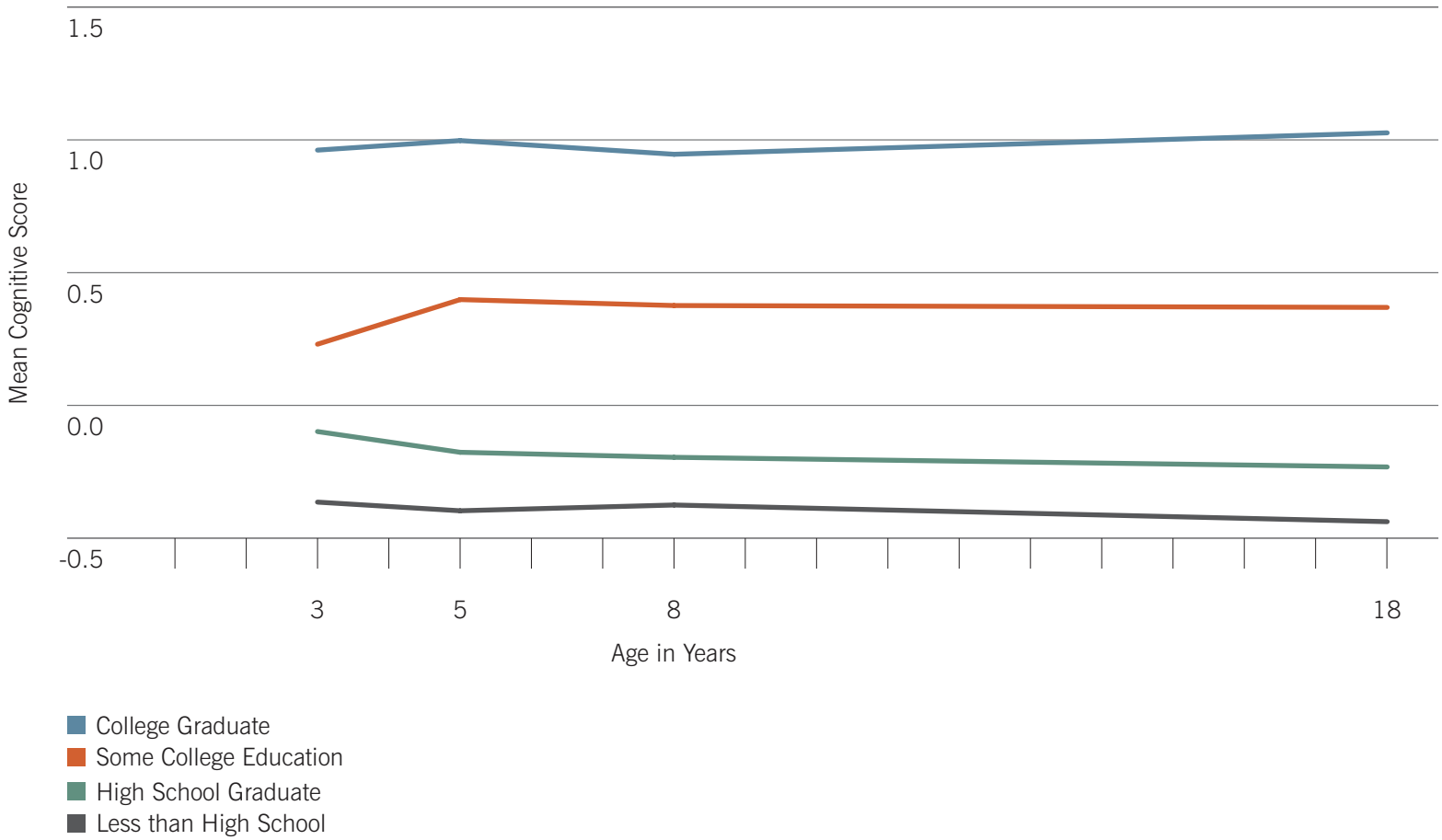

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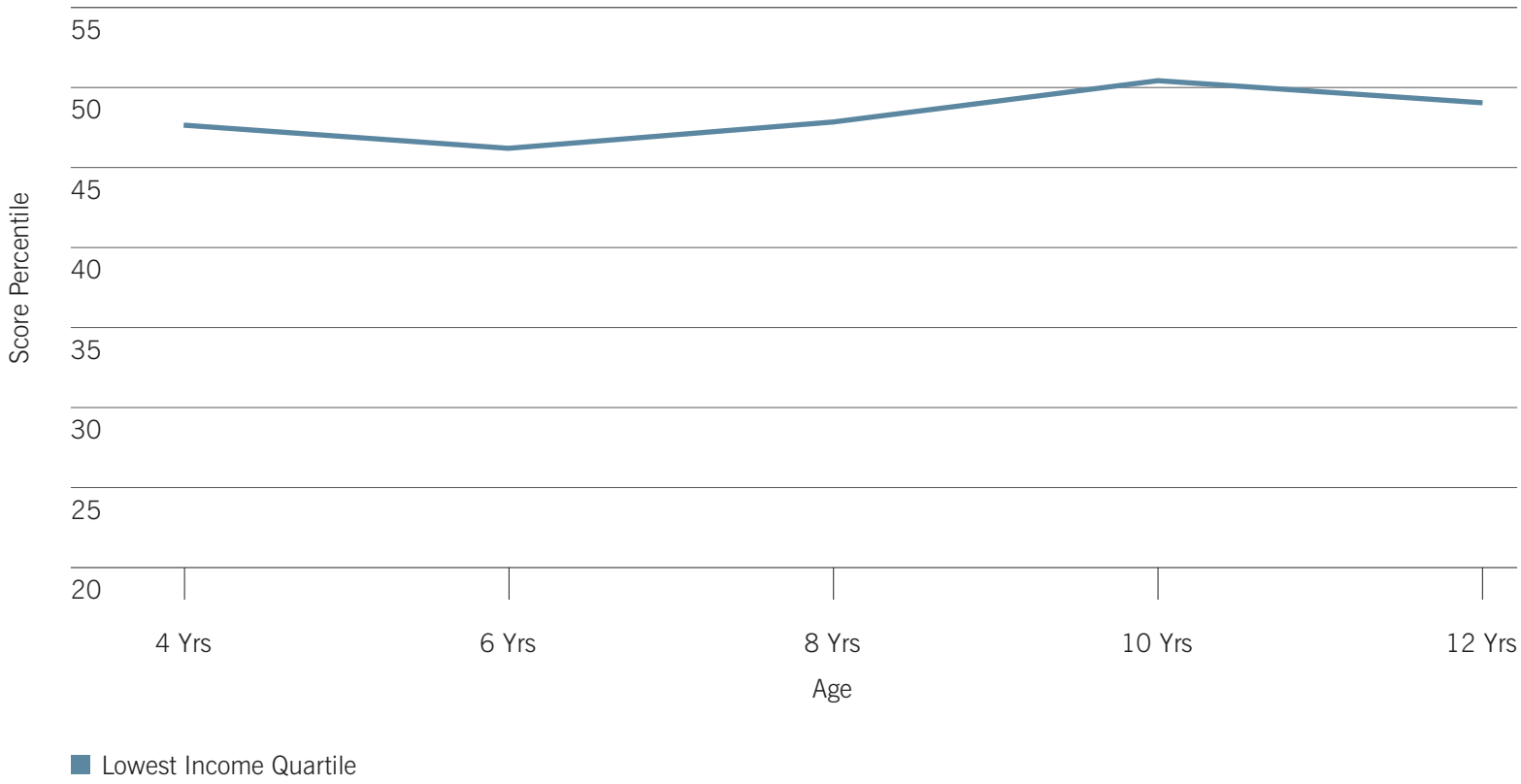
Average Percentile Rank on Anti-Social Behavior Score, by Income Quartile



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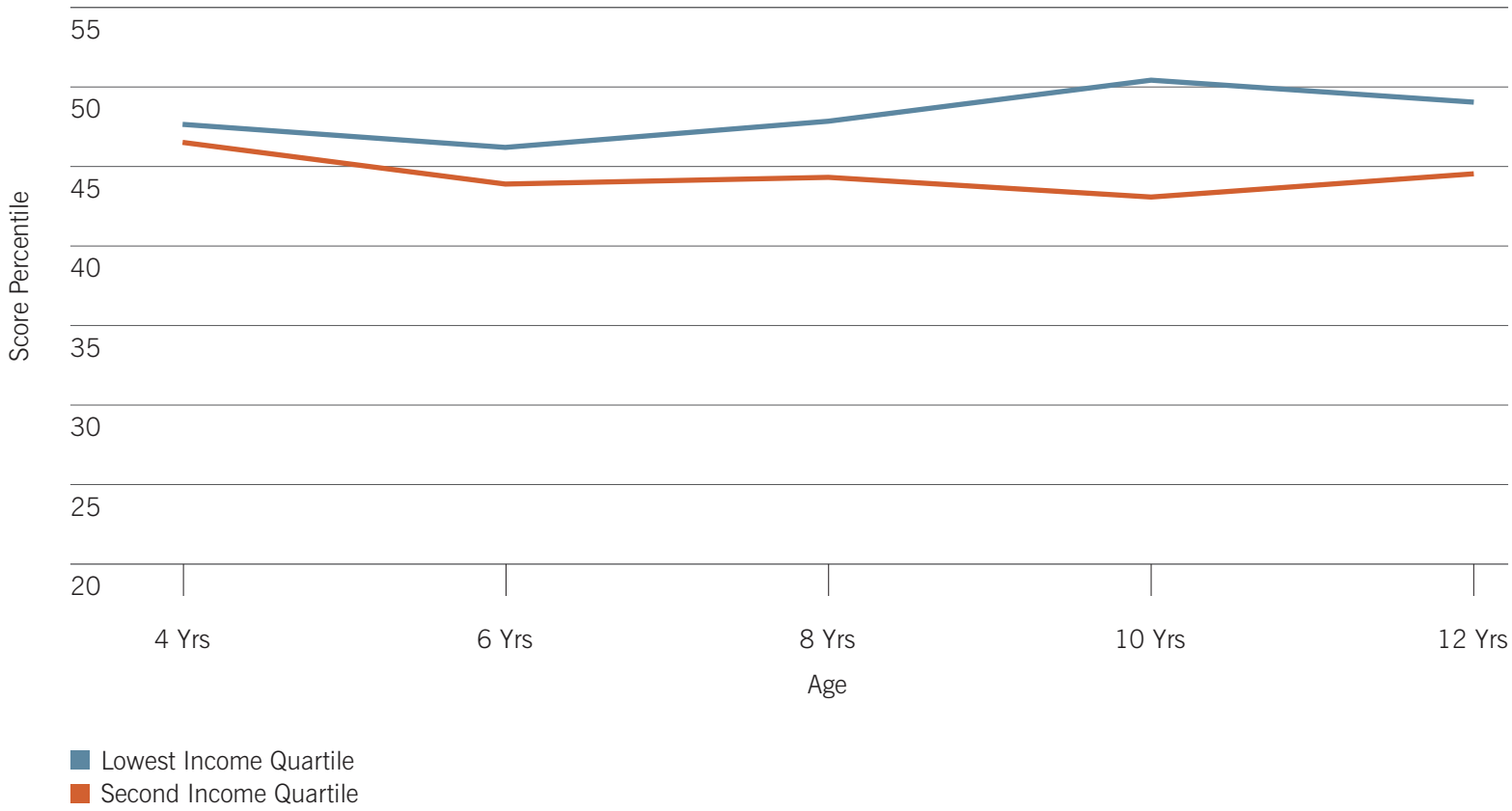

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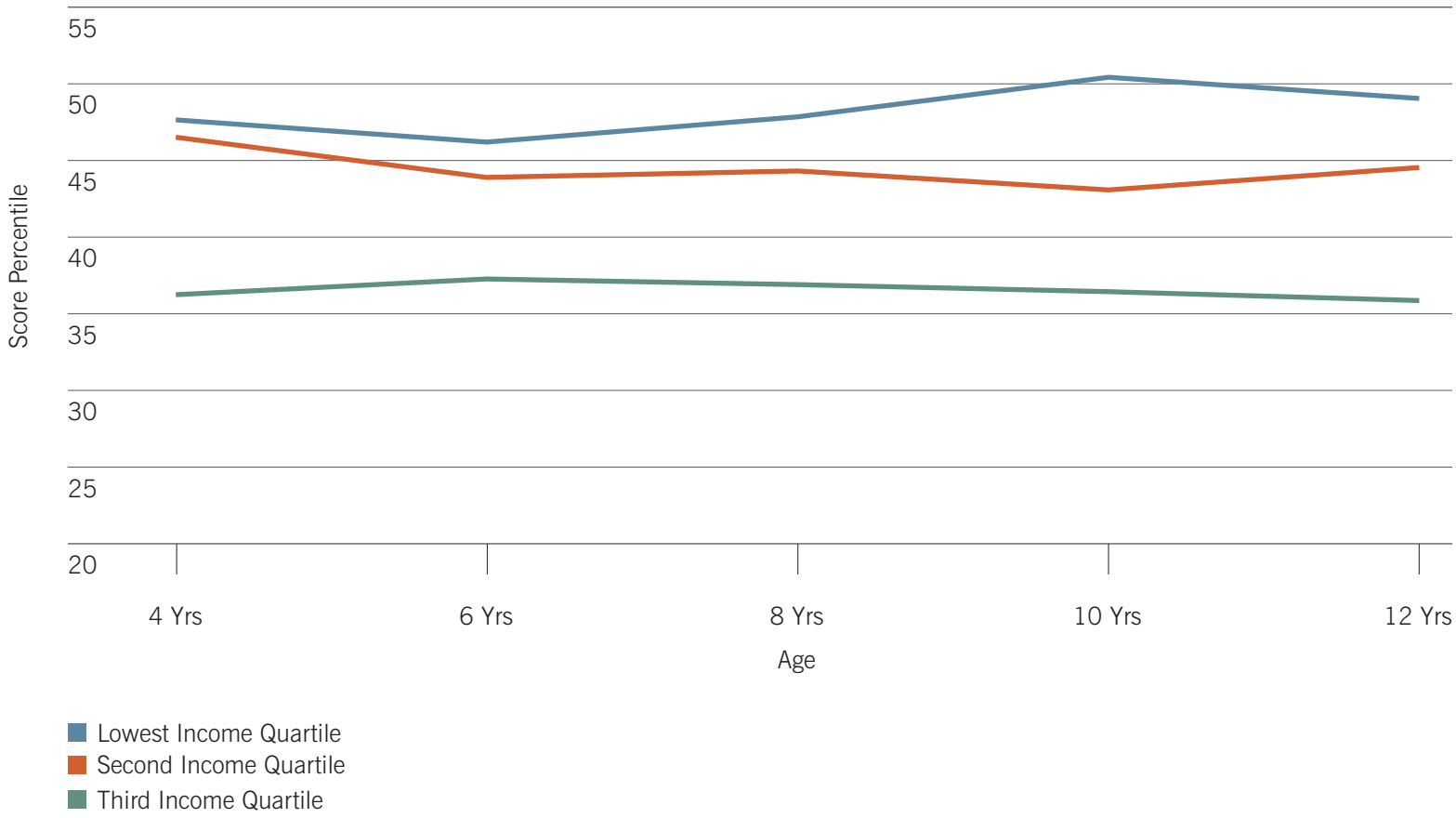

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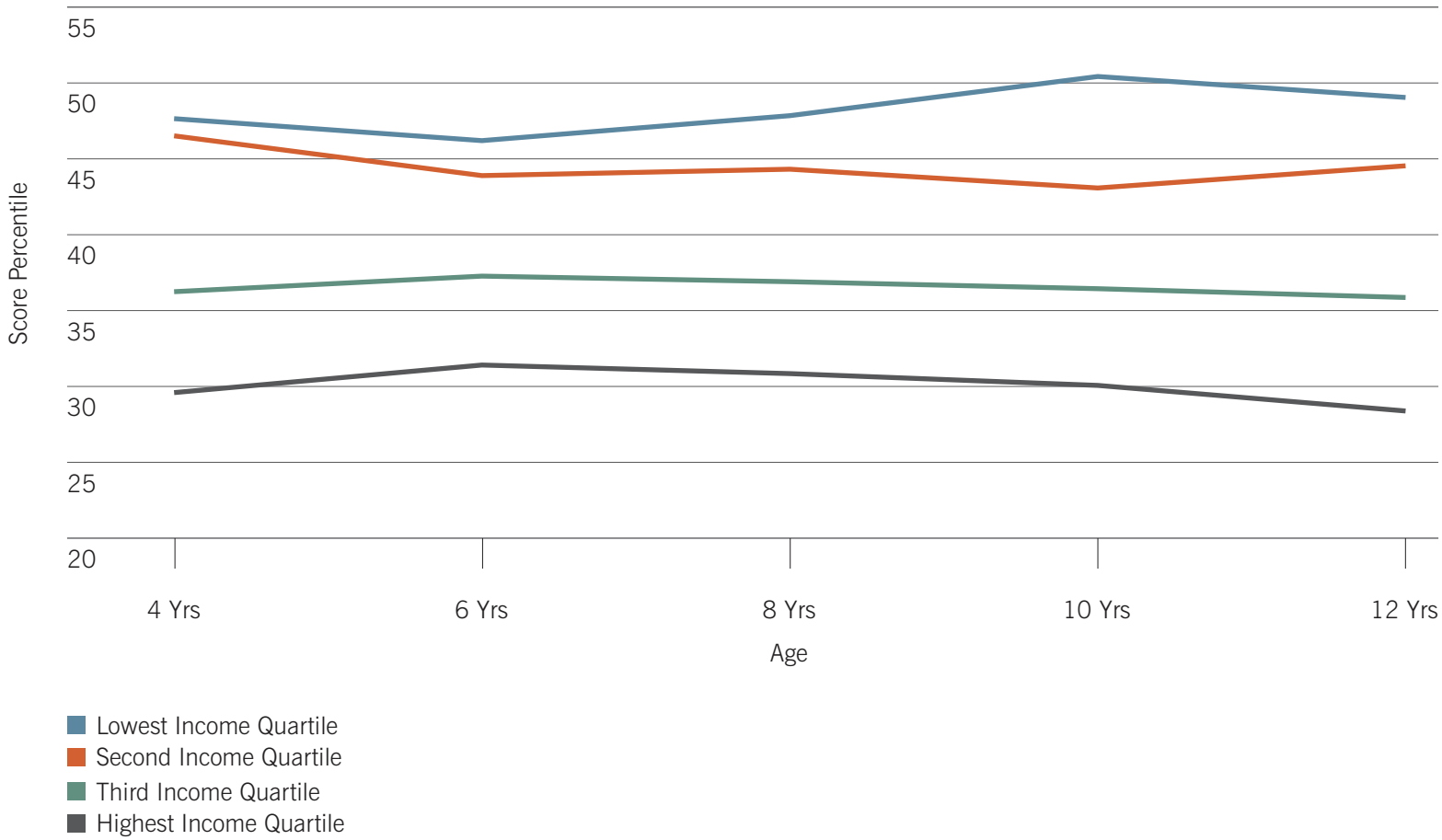
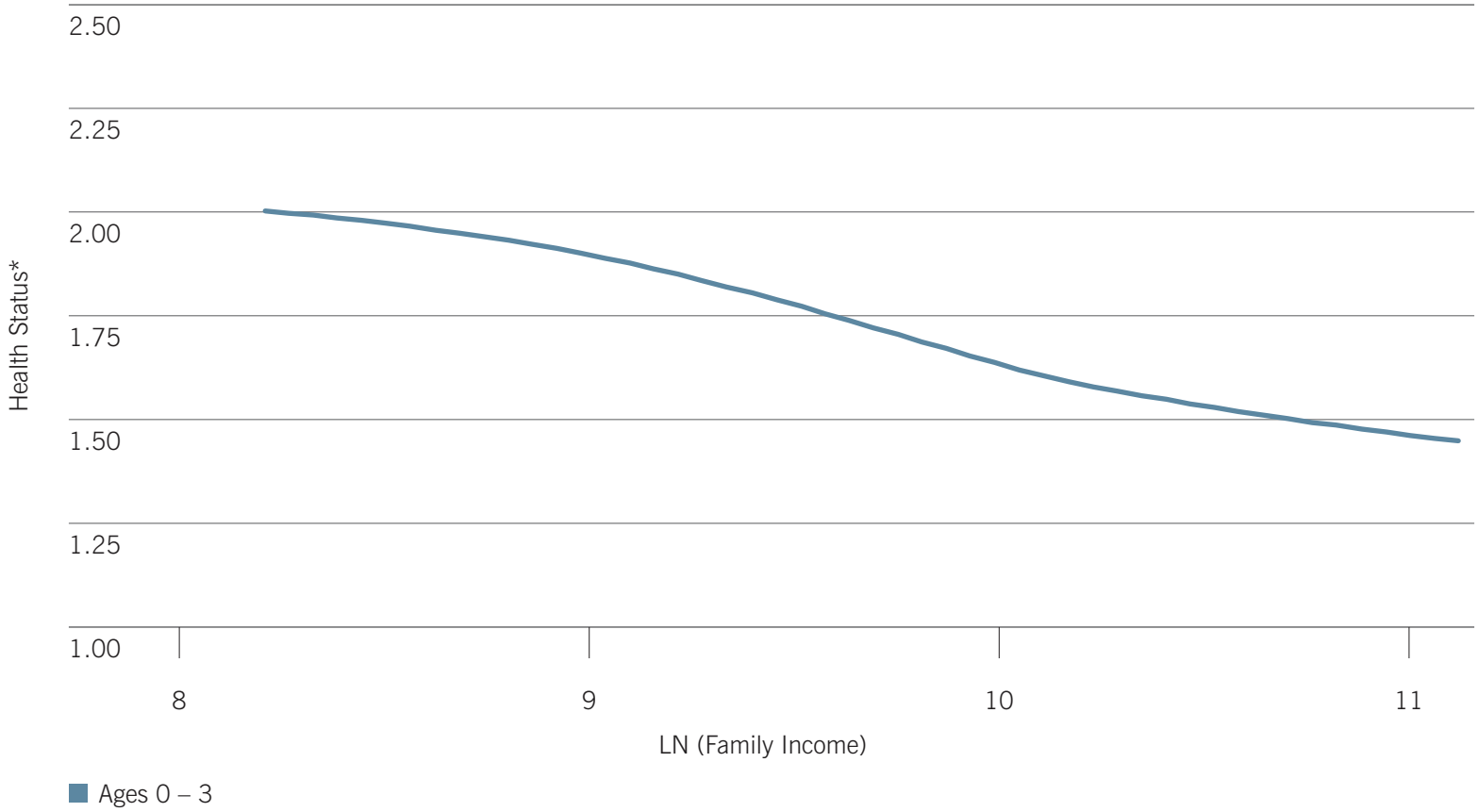


Gaps Also Emerge in Health. They *Diverge* with Age.

*Health and Income For Children and Adults, U.S. National Health Interview Survey 1986 – 1995**



(Scale ranges from 1 = Excellent to 5 = Poor)

** From Case, A., Lubotsky, D. & Paxson, C. (2002), American Economic Review, Vol. 92, 1308 – 1334.*

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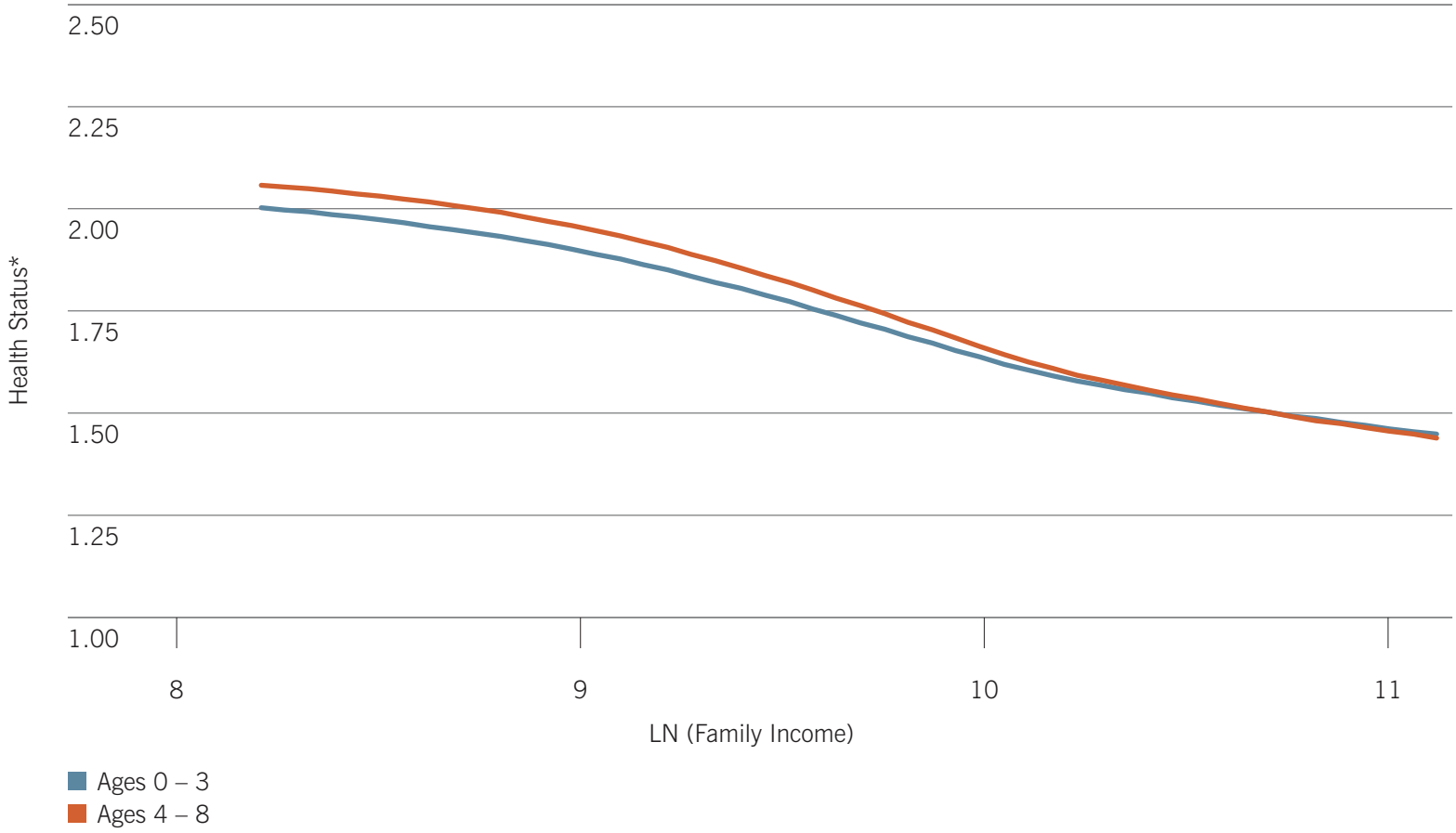

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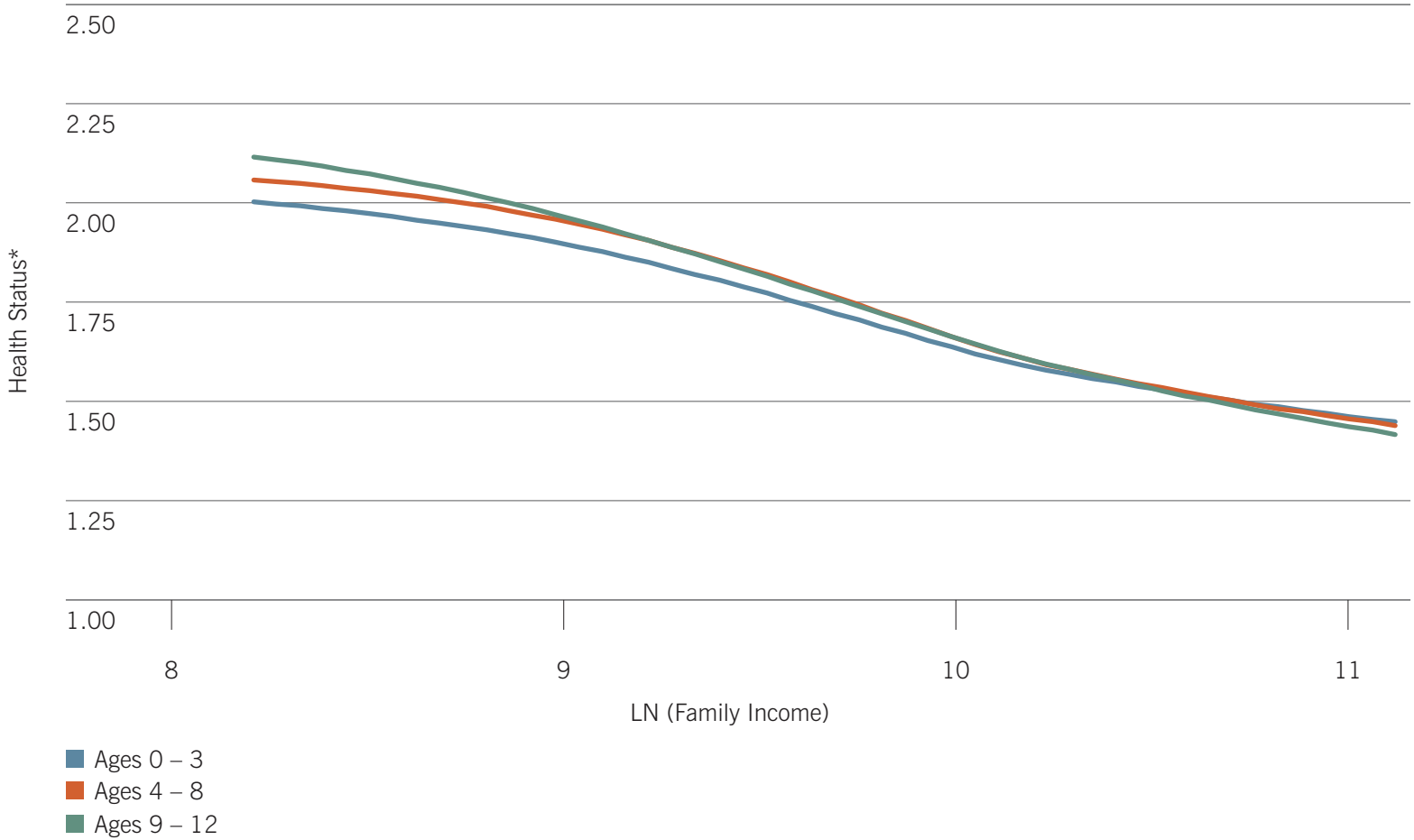

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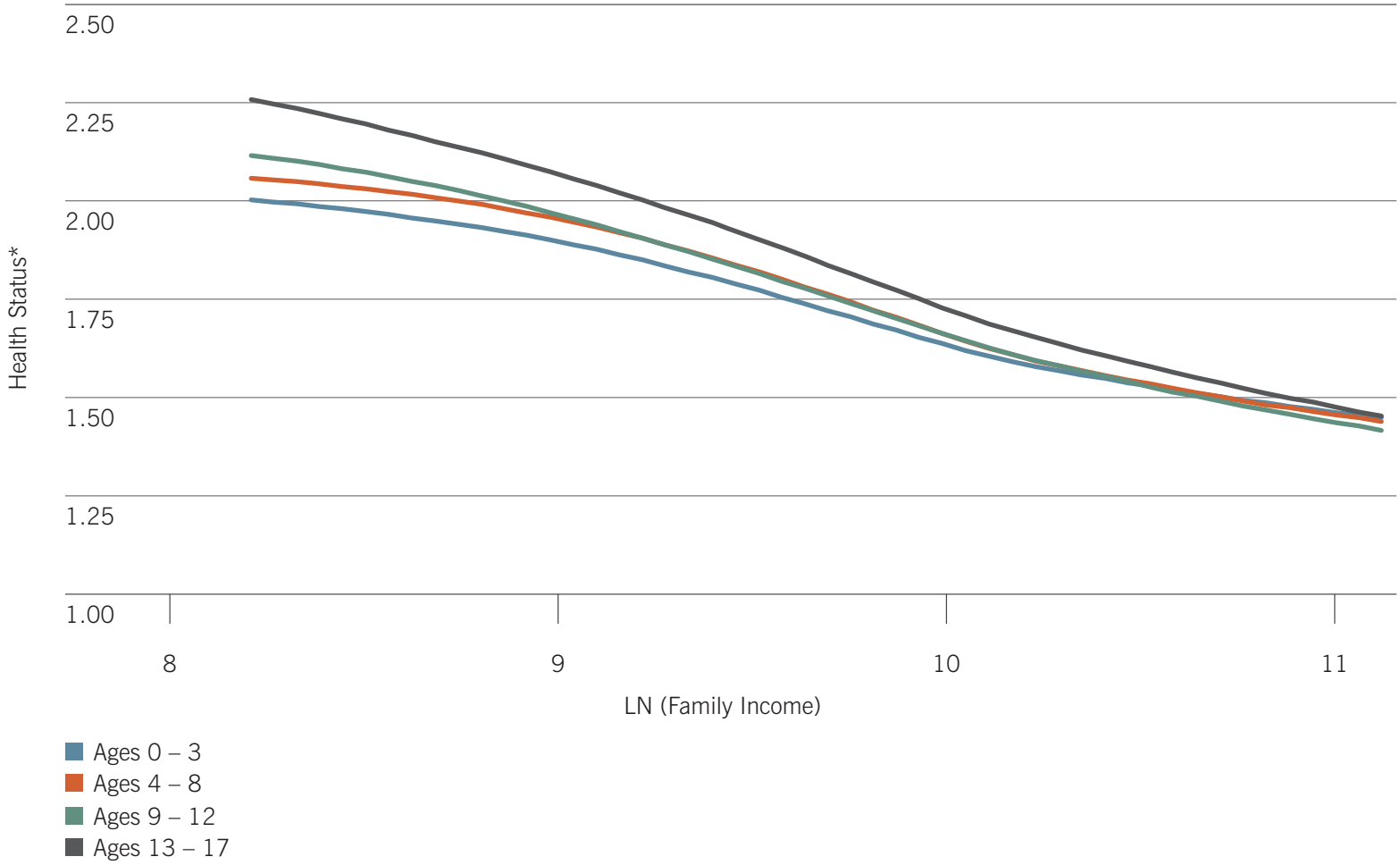

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Gaps Also Emerge in Health. They Diverge with Age.

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?

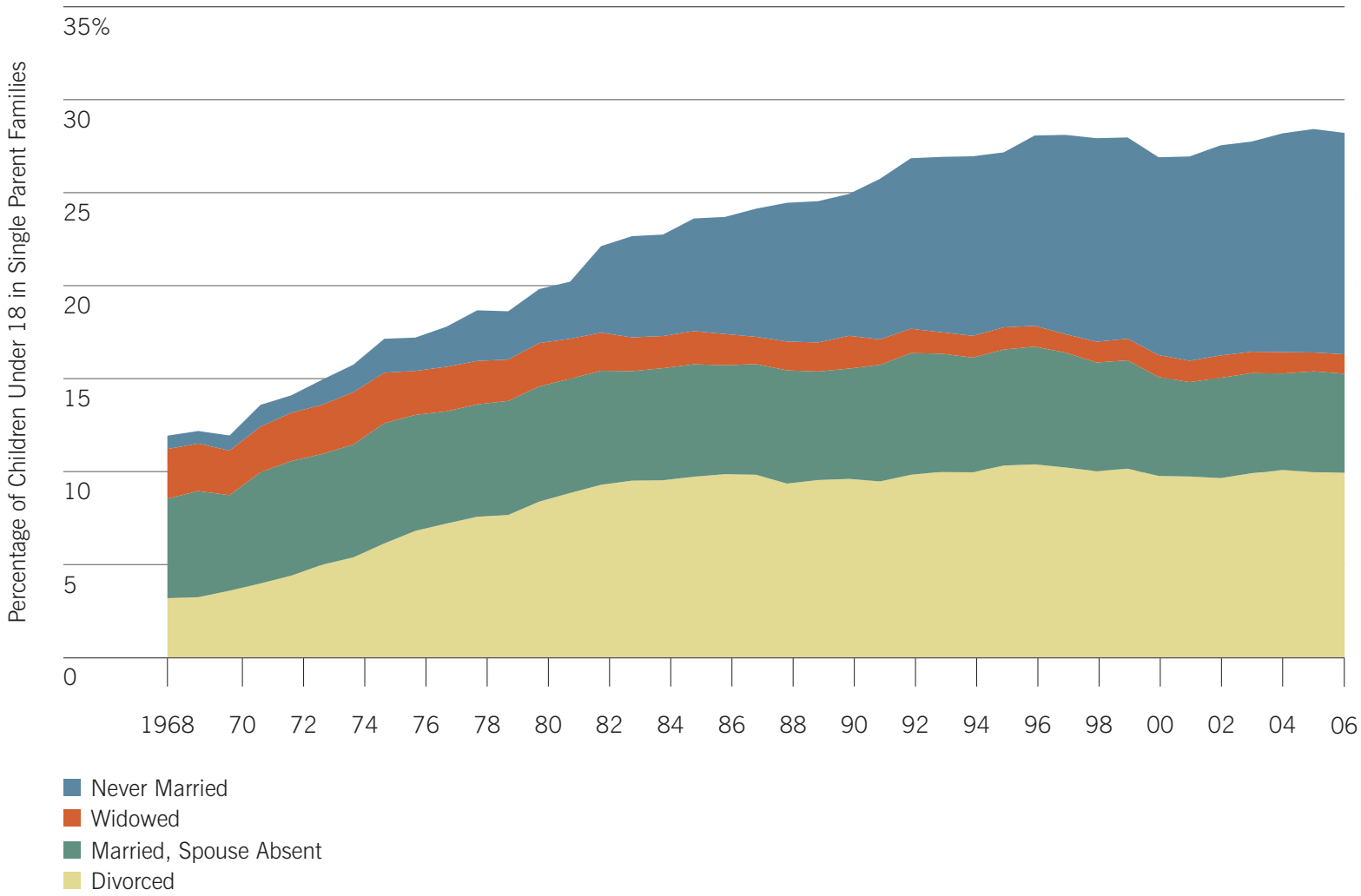
Family investment decisions?

Gaps Also Emerge in Health. They Diverge with Age.

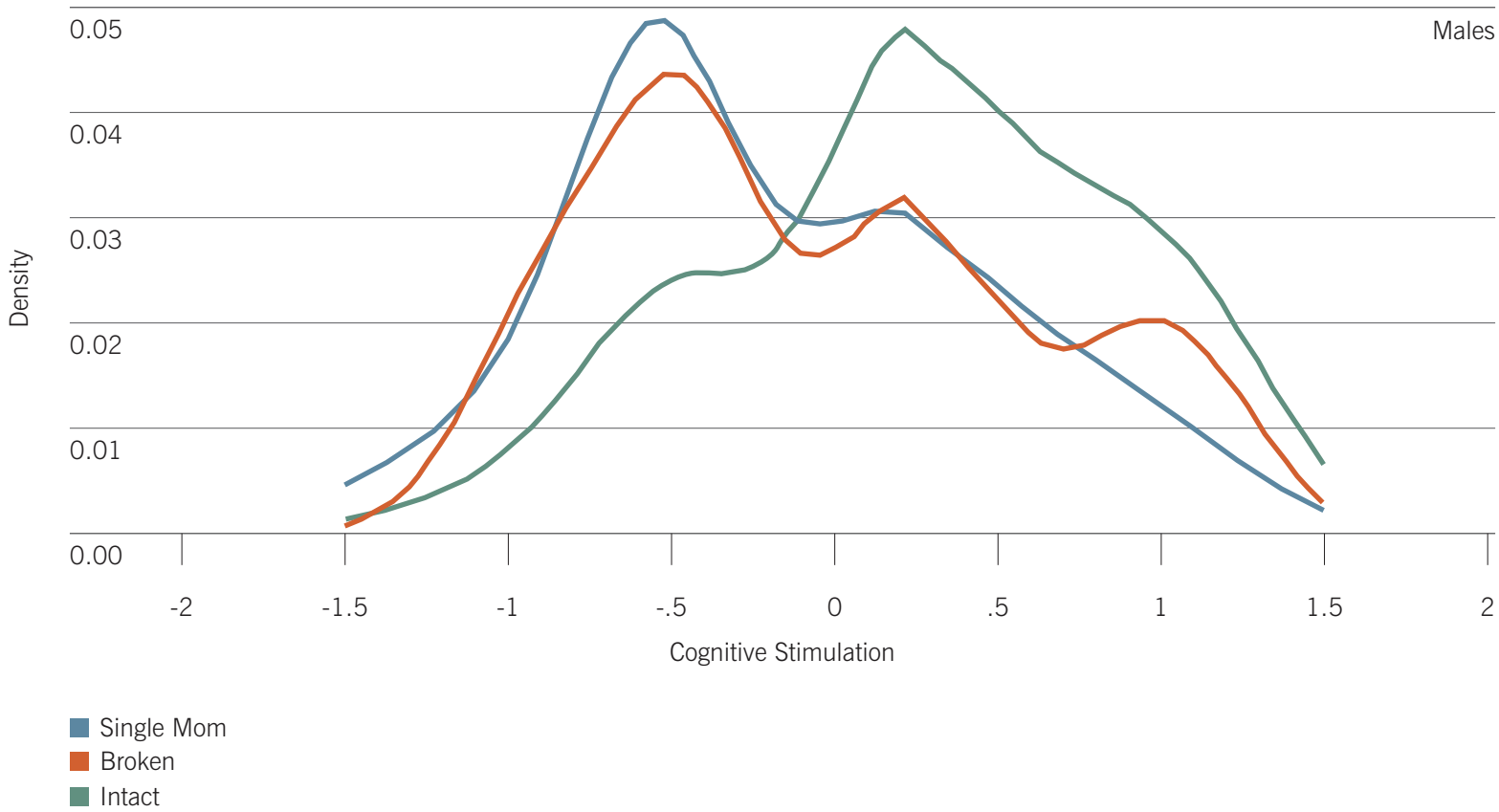
The evidence from the intervention studies suggests an important role for investments and family environments in determining adult capacities above and beyond genes, and also in interactions with the genes.

Family Environments

Percent of Children Under 18 Living with One Parent, By Marital Status of Single Parent

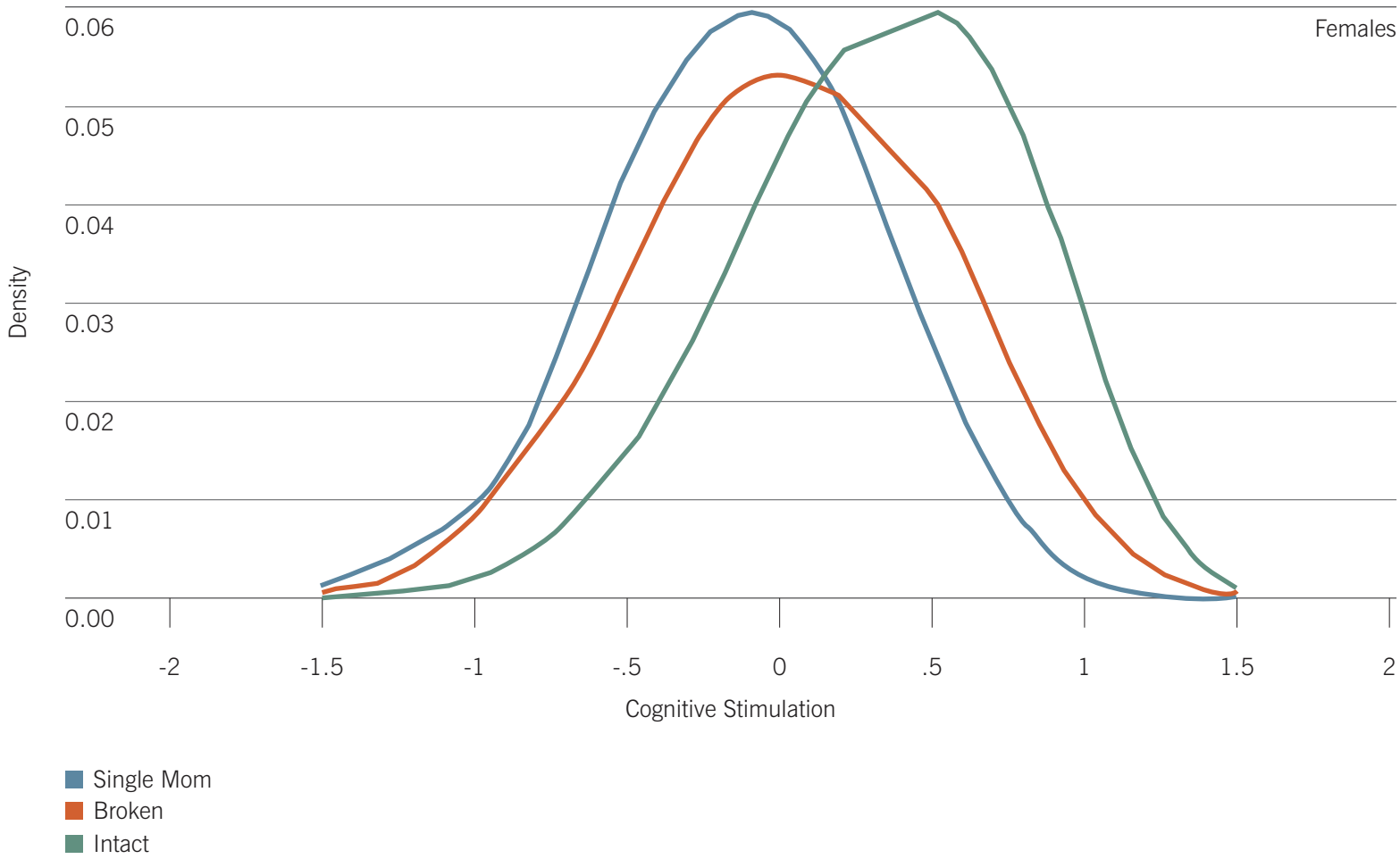


Cognitive Stimulation: Age 0 – 2, White, by Family Type



Source: Seong Hyeok Moon (2008) analysis of CNLSY data

Cognitive Stimulation: Age 10 – 11, White, by Family Type



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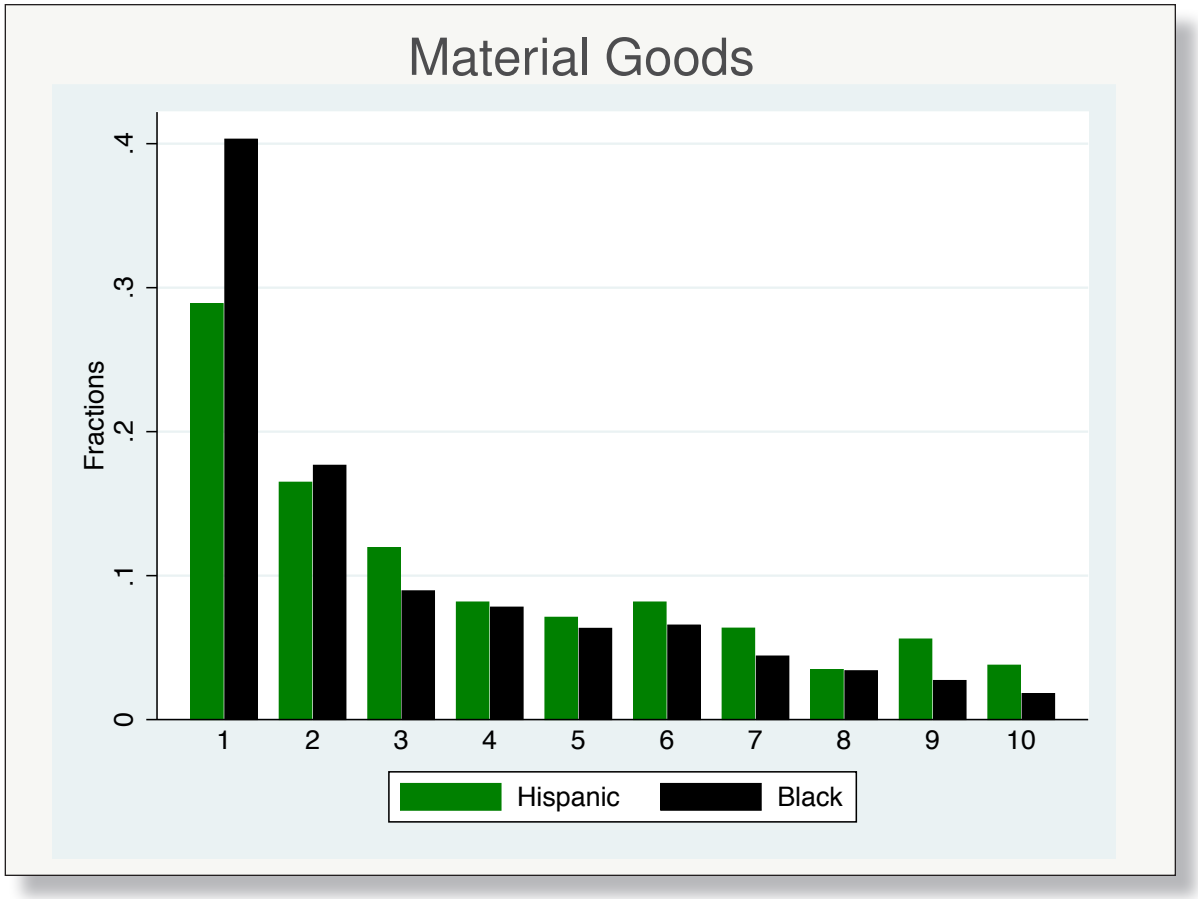
There are Substantial Differences in Family Investment Across Income and Ethnic Groups

Hispanic and Black PI in White Distribution: Full Sample, Age 0 – 3



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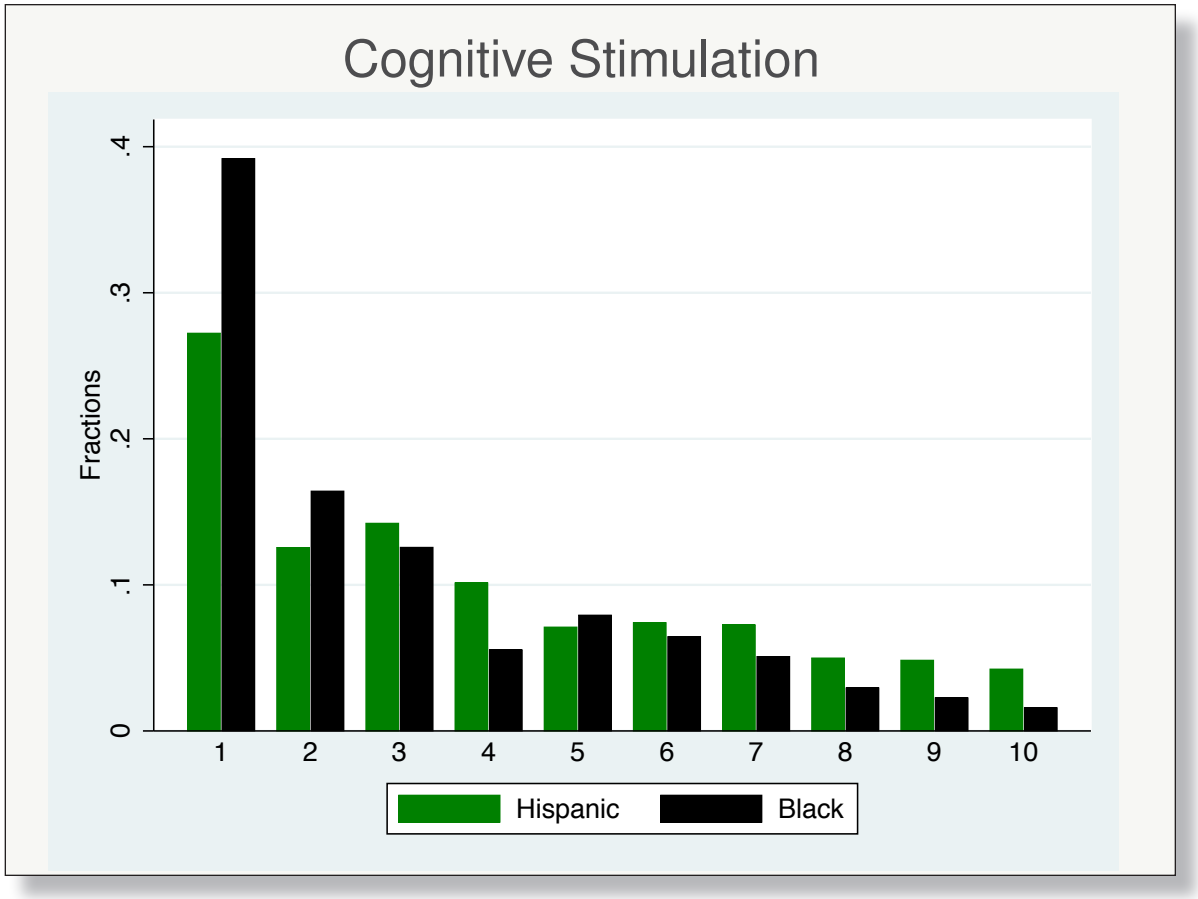

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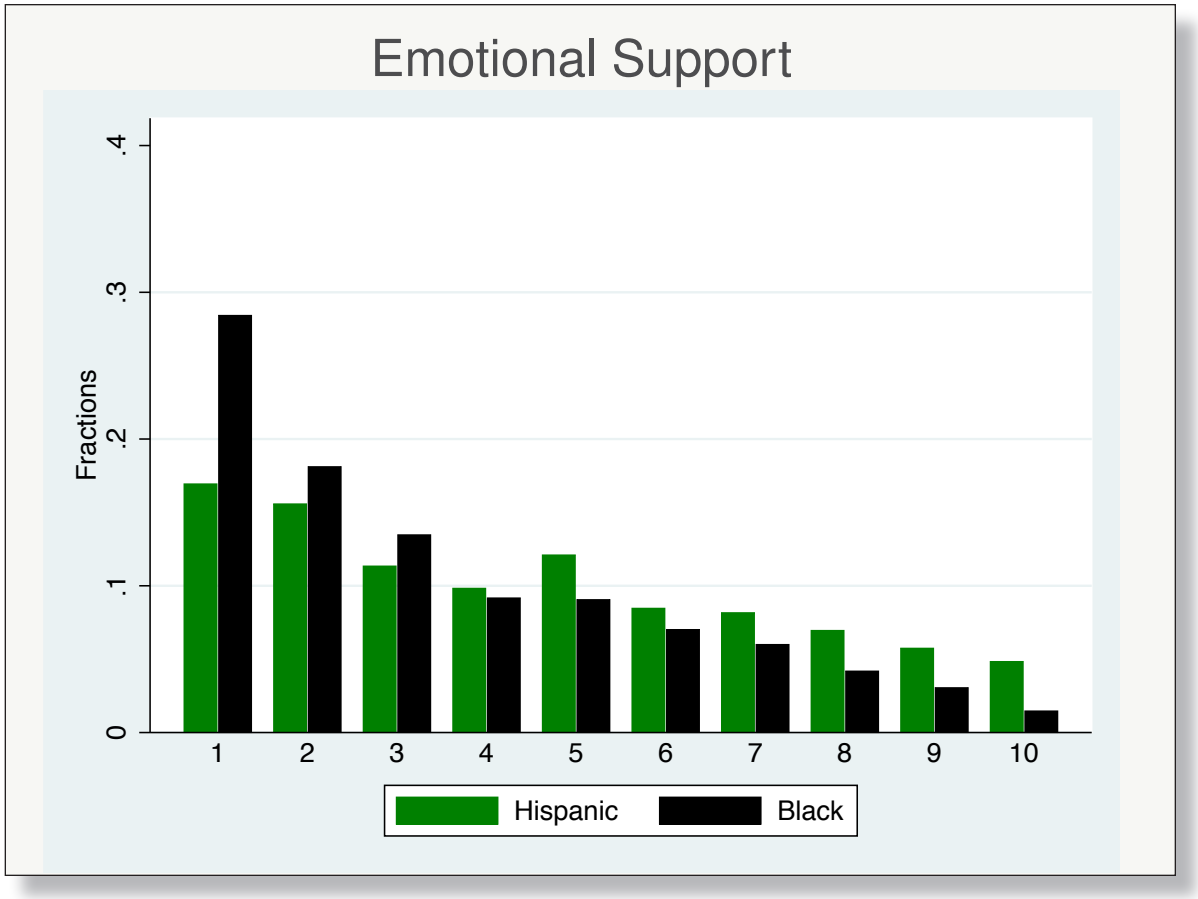
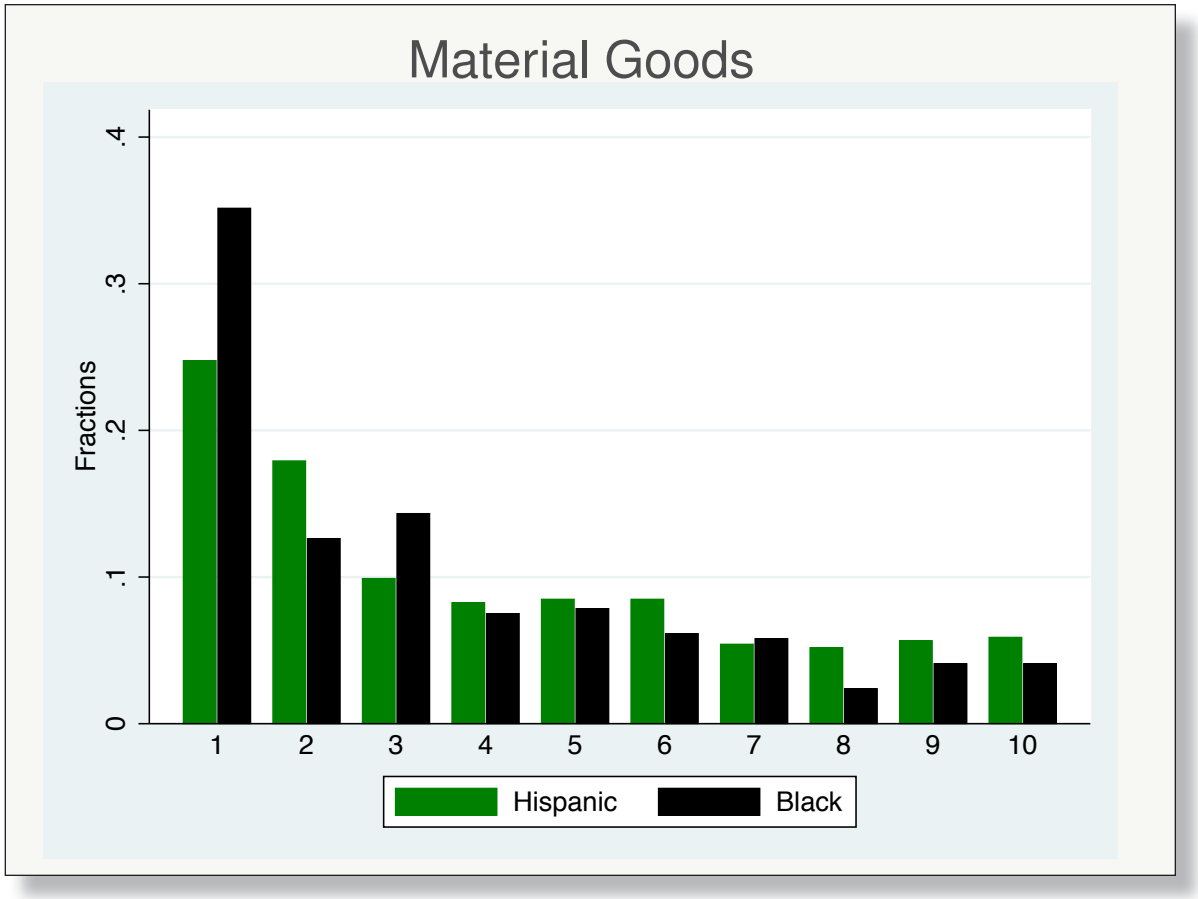


Source: Moon (2010)

Hispanic and Black PI in White Distribution: Intact Family, Adjusted For Mother's Education Age 0 – 3



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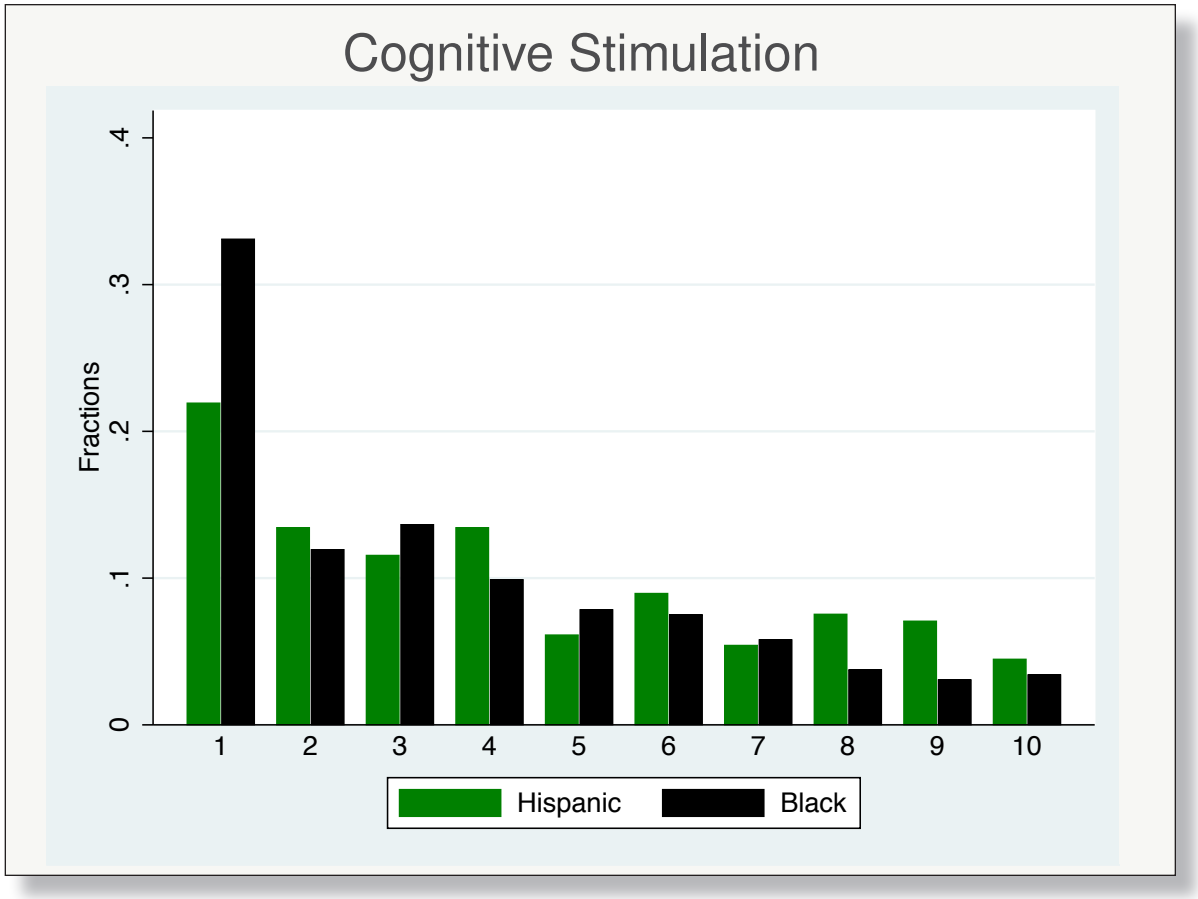

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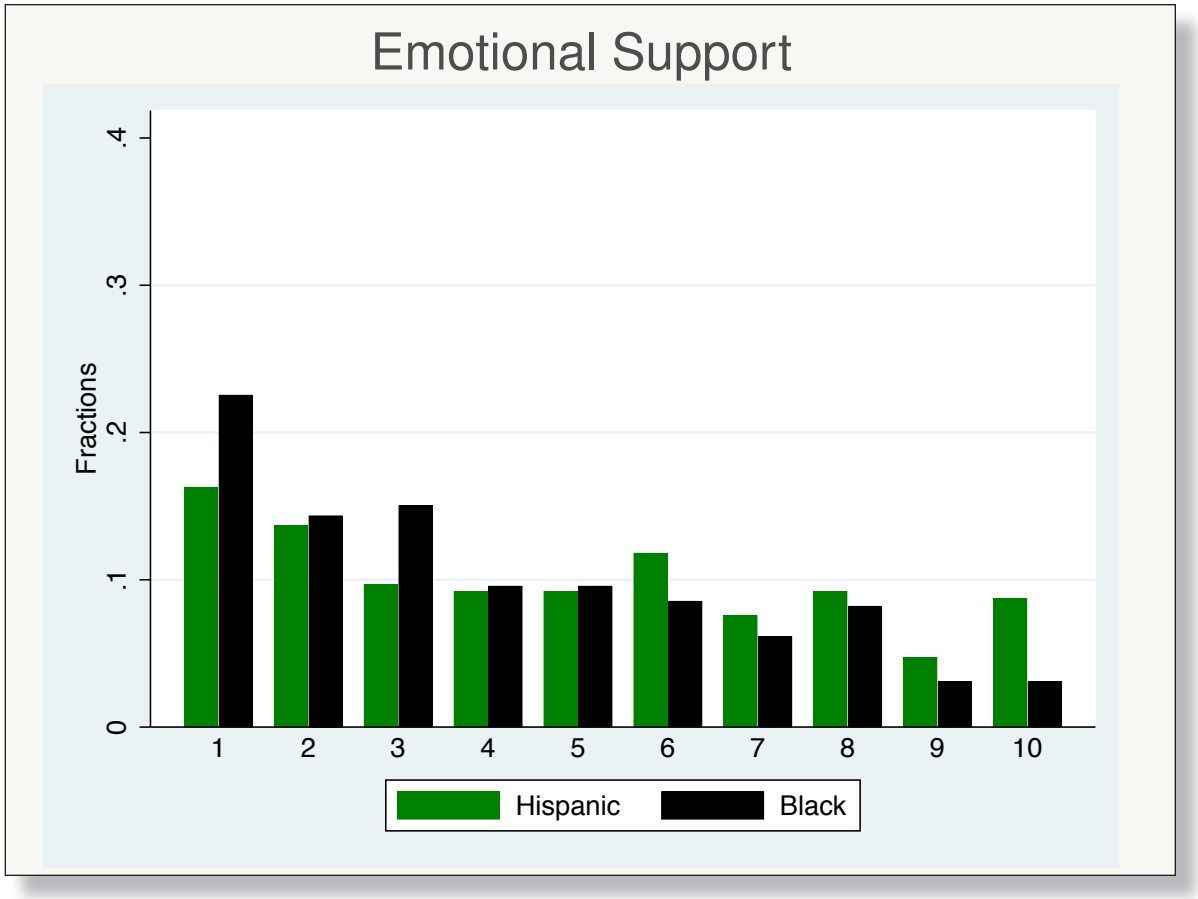


Source: Moon (2010)

Evidence

Experience Gets Embodied in the Biology of the Organism

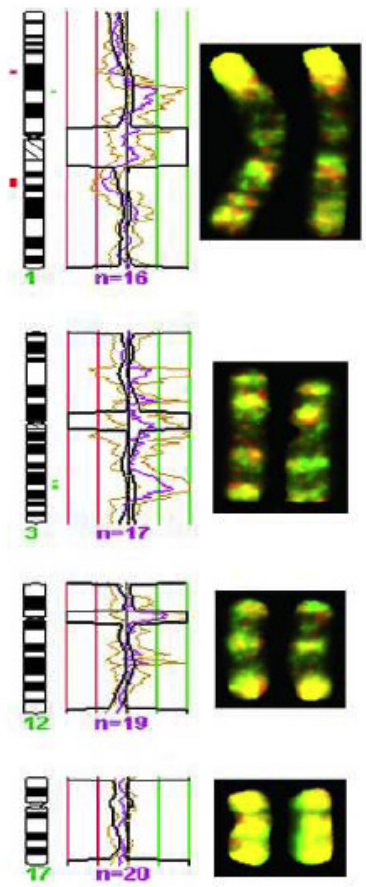
Experience Gets Embodied in the Biology of the Organism

Evidence of gene-environment interactions:

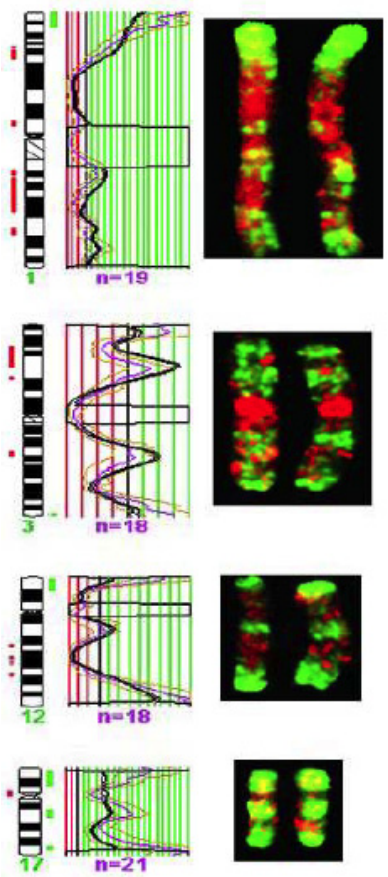
– How experience gets under and stays under the skin.

Methylation Patterns In Young and Old Twins

3-year-old twins



50-year-old twins



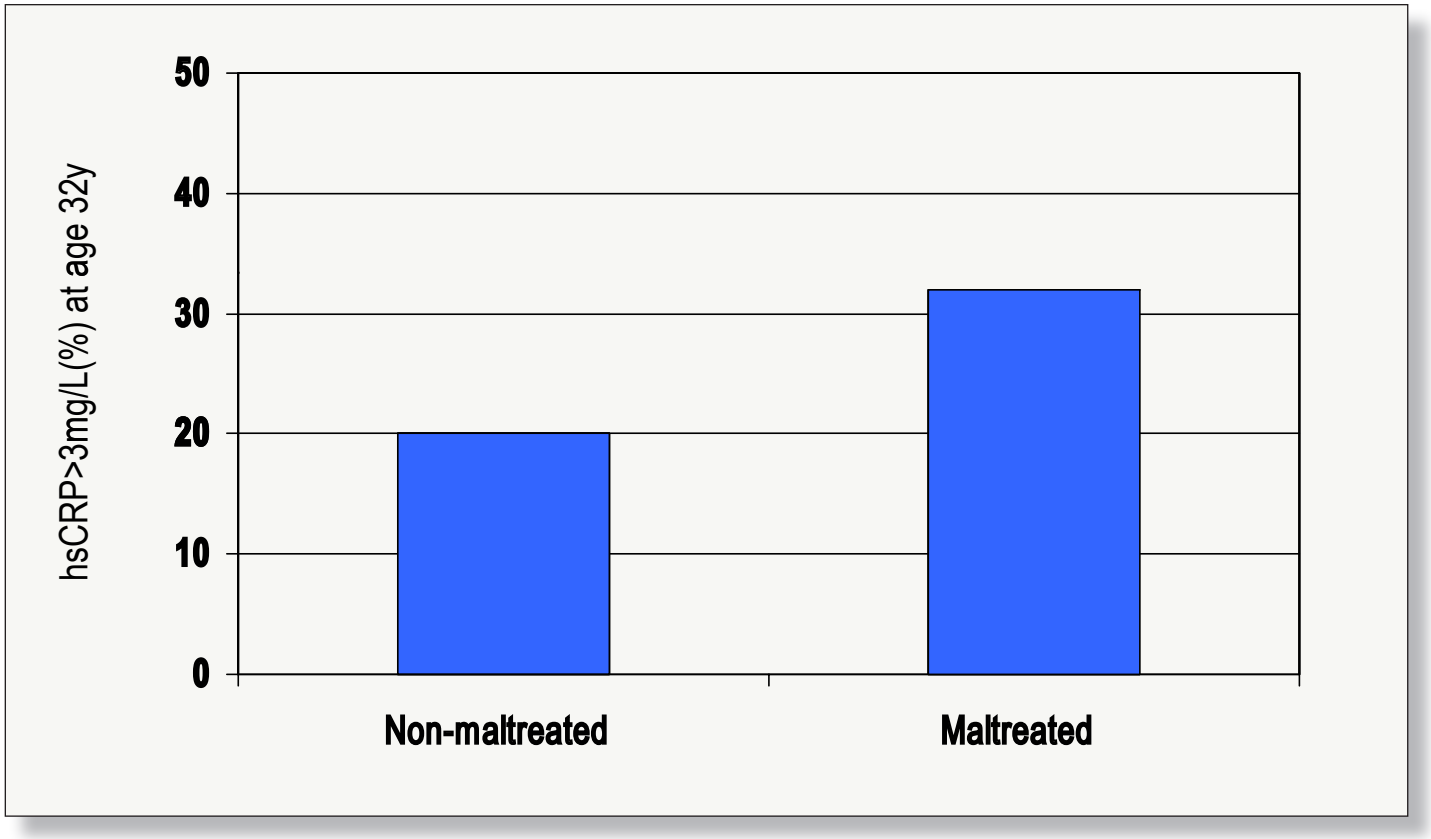
Source: Fraga, Ballestar et. al. (2005)

Childhood Maltreatment: Age 3 –11 in Dunedin Cohort

Maternal Rejection	(14%)
Harsh Discipline	(10%)
Caregiver Changes	(6%)
Physical Abuse	(4%)
Sexual Abuse	(12%)

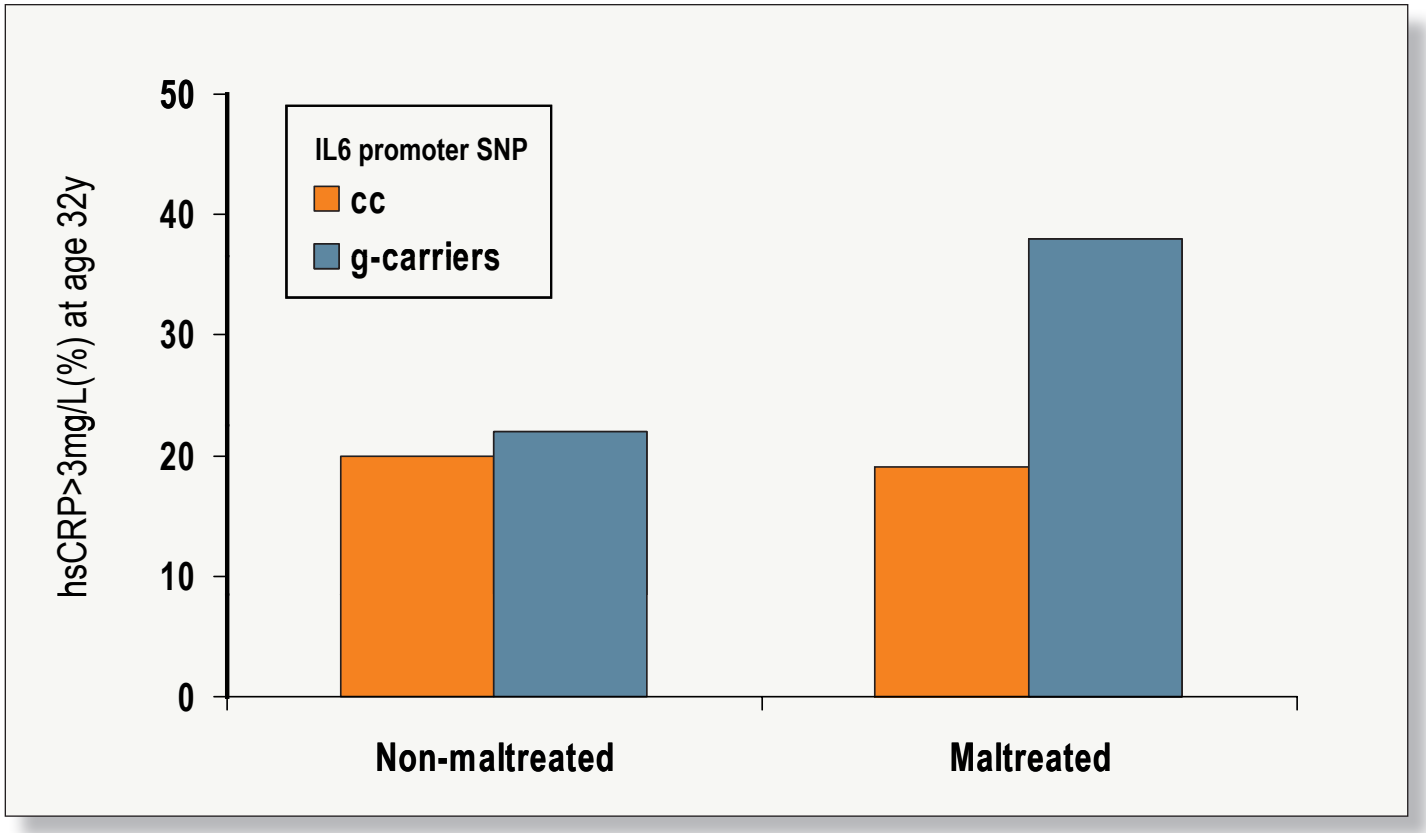
Source: Moffitt, "Gene-Environment Interaction in Problematic and Successful Aging," NIA Meeting Feb 12, 2008.

Childhood Maltreatment and Adult Inflammation



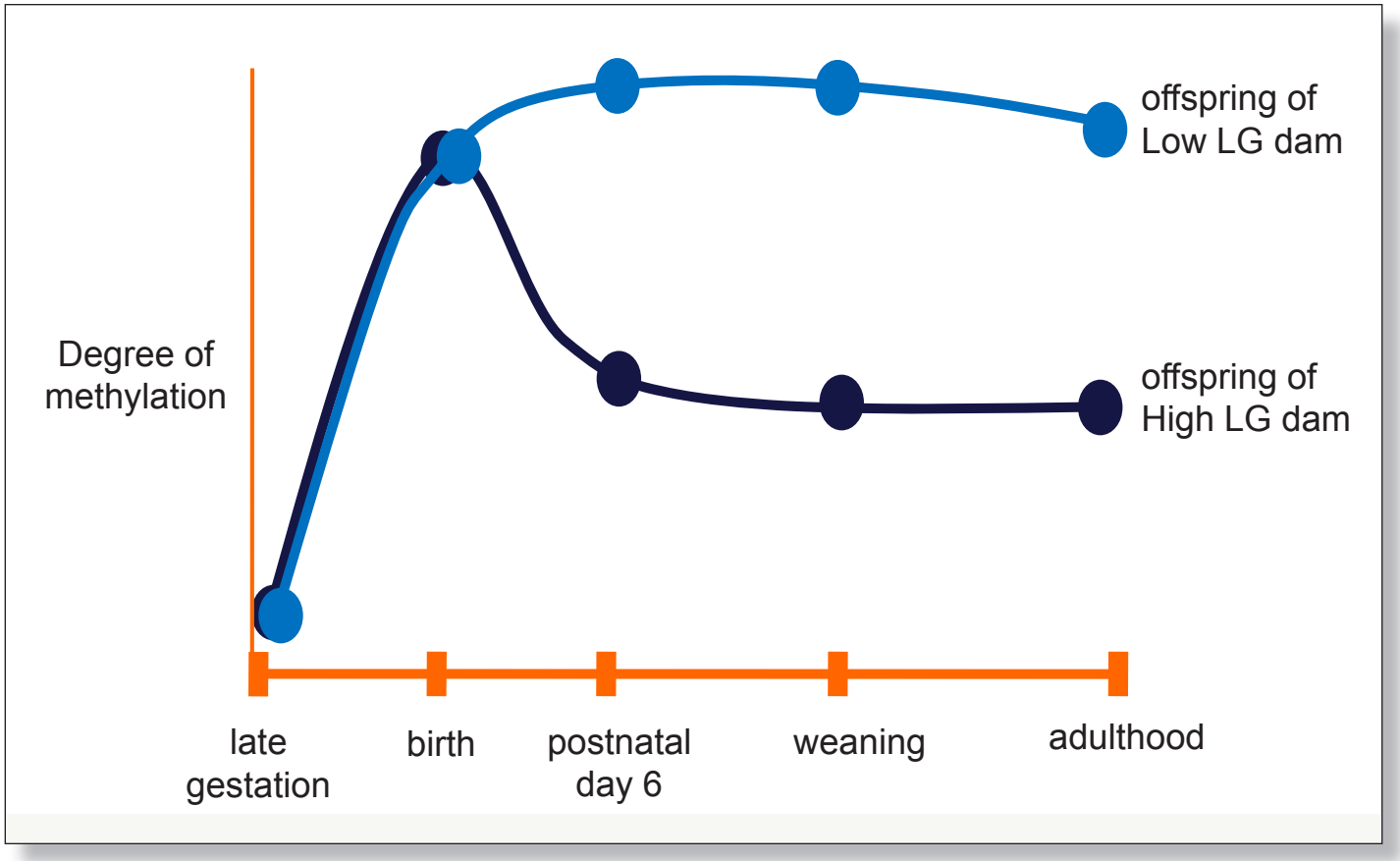
Danese et al. 2007 (PNAS)

IL6 Genotype x Maltreatment > Adult Inflammation: Gene x Environment Interaction



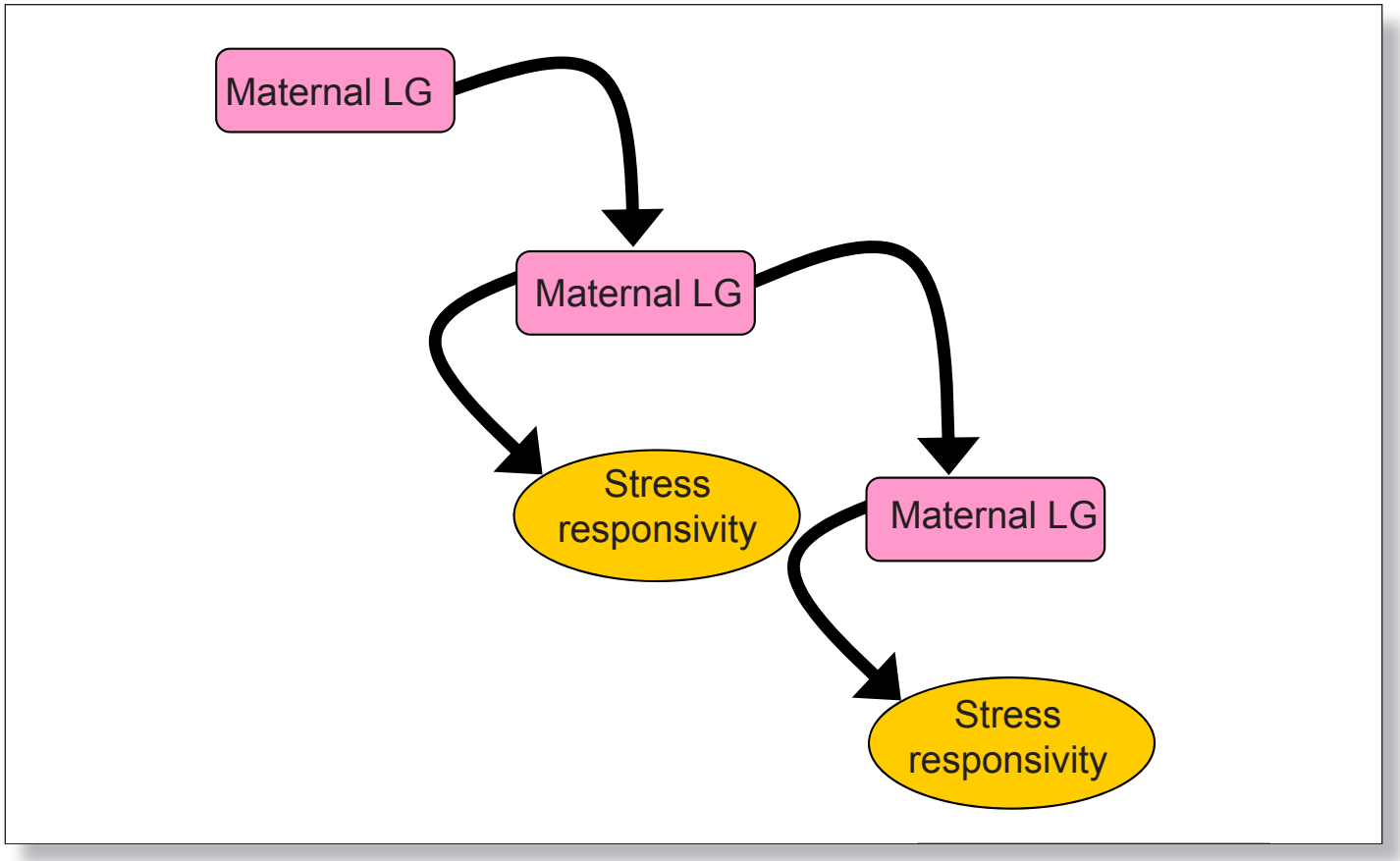
Danese et al. (in preparation)

Changes in Methylation Over Time



Source: Champagne (2008)

Transmission of Maternal Care and Stress Responsivity Across Generations



Champagne & Curley, Current Opinion in Neurobiology, 2005

Evidence of Environmental Role on Gene Expression in Monkey Studies

Evidence of Environmental Role on Gene Expression in Monkey Studies

Remodeling of the basal leukocyte gene expression profile in 4 month-old rhesus monkeys *(Macaca mulatta)* reared under adverse social conditions.

Evidence of Environmental Role on Gene Expression in Monkey Studies

Disadvantaged (peer-reared; surrogate-reared) monkeys exhibit leukocytes showing enhanced expression of genes involved in:

- Inflammation
- T lymphocyte activation
- Cell proliferation
- Suppression of genes involved in Type I interferon antiviral response and immunoglobulin production of B lymphocytes

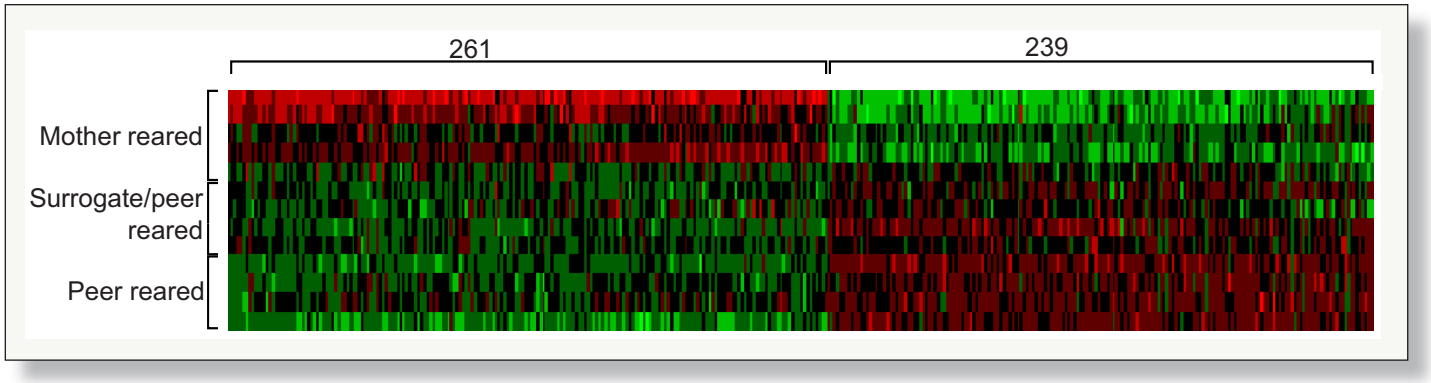
Evidence of Environmental Role on Gene Expression in Monkey Studies

Surrogate mothers partly reverse some of the adverse effects.

Social conditions become embedded in basal transcriptional stance of primate immune systems.

Sympathetic nervous system-linked signal transduction and transcriptional control pathways are candidate mediators of these effects.

Distribution of Leukocyte Gene Expression in Surrogate/Peer-Reared Macaques on the 500-Gene Expression Vector Discriminating Mother-Reared from Peer-Reared Animals



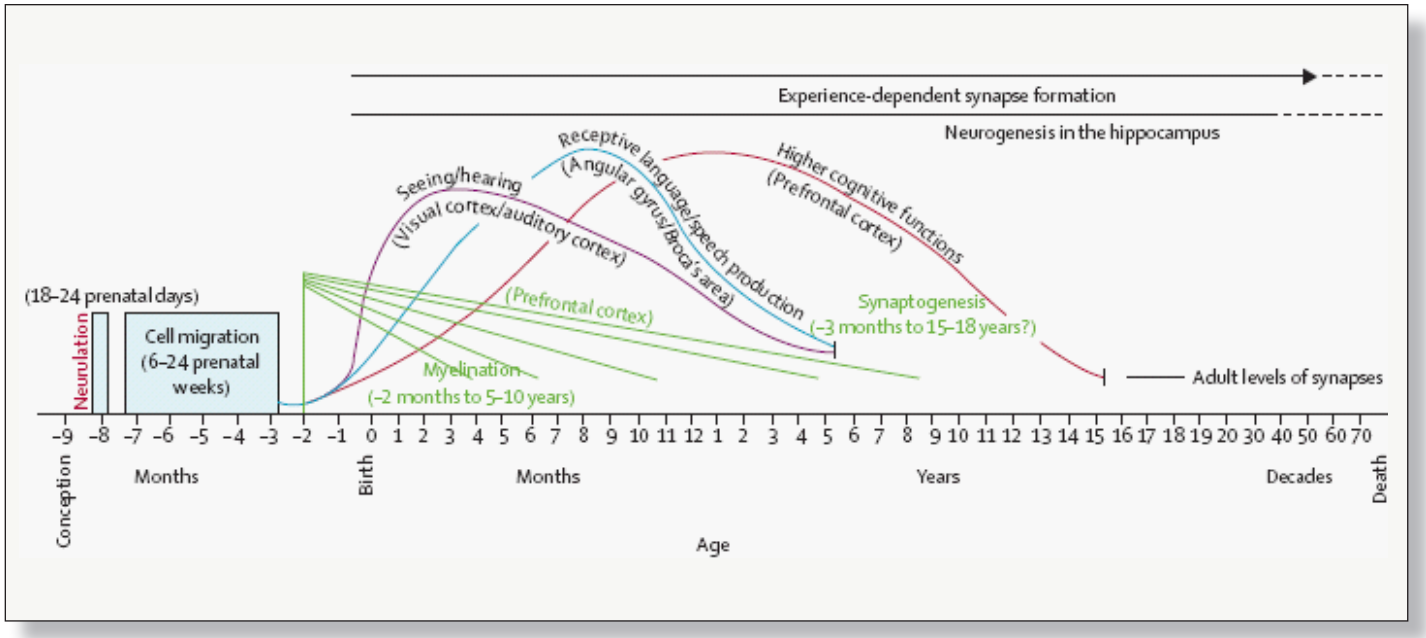
Source: Cole, Arevalo, Ruggiero, Heckman, and Suomi (2009)

Evidence of Environmental Role on Gene Expression in Monkey Studies

Meaney, Suomi and Szyf (2009) show that early peer rearing affects methylation in 22% of rhesus monkey genes.

Critical and Sensitive Periods

Human Brain Development



Source: Thompson and Nelson (2001)

Key Policy Issues

Key Policy Issues

From the point of view of social policy, the key question is how easy is it to remediate the effect of early disadvantage?

How costly is delay in addressing early disadvantage?

How critical are the early years and for what traits?

What is the optimal time for intervention in different capacities?

Environment

Environment

Enriched early environments can compensate in part for risk features of disadvantaged environments.

Early Intervention Programs for Disadvantaged Children

Early Intervention Programs for Disadvantaged Children

The Perry Program is the best studied of all of these intervention programs.

The Perry Program was an intensive preschool program that was administered to 58 disadvantaged, black children in Ypsilanti, Michigan between 1962 and 1967.

Early Intervention Programs for Disadvantaged Children

The treatment consisted of a daily 2.5 hour classroom session on weekday mornings and a weekly 90 minute home visit by the teacher on weekday afternoons. The length of each preschool year was 30 weeks.

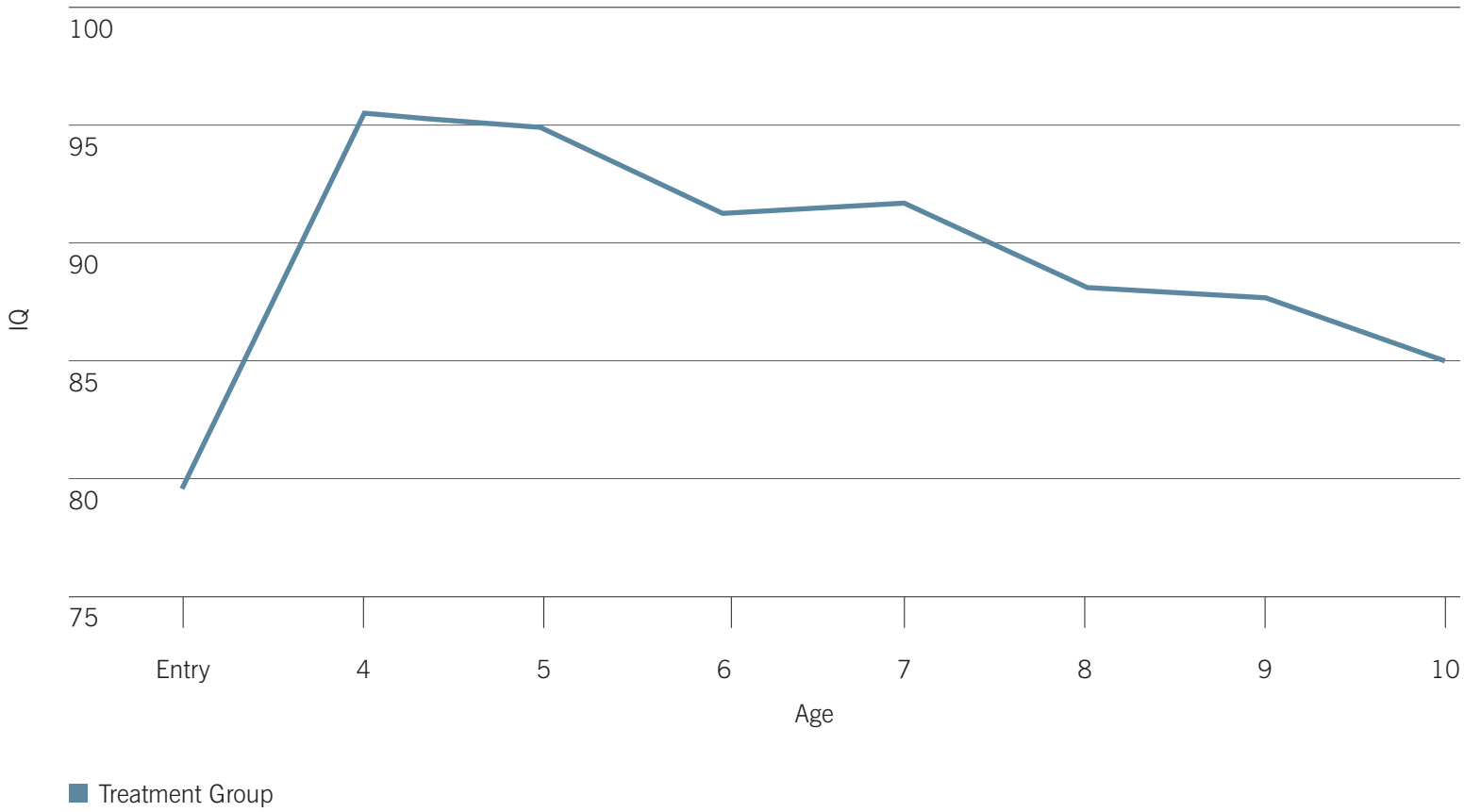
The control and treatment groups have been followed through age 40.

Early Intervention Programs for Disadvantaged Children

Perry did not raise IQ.

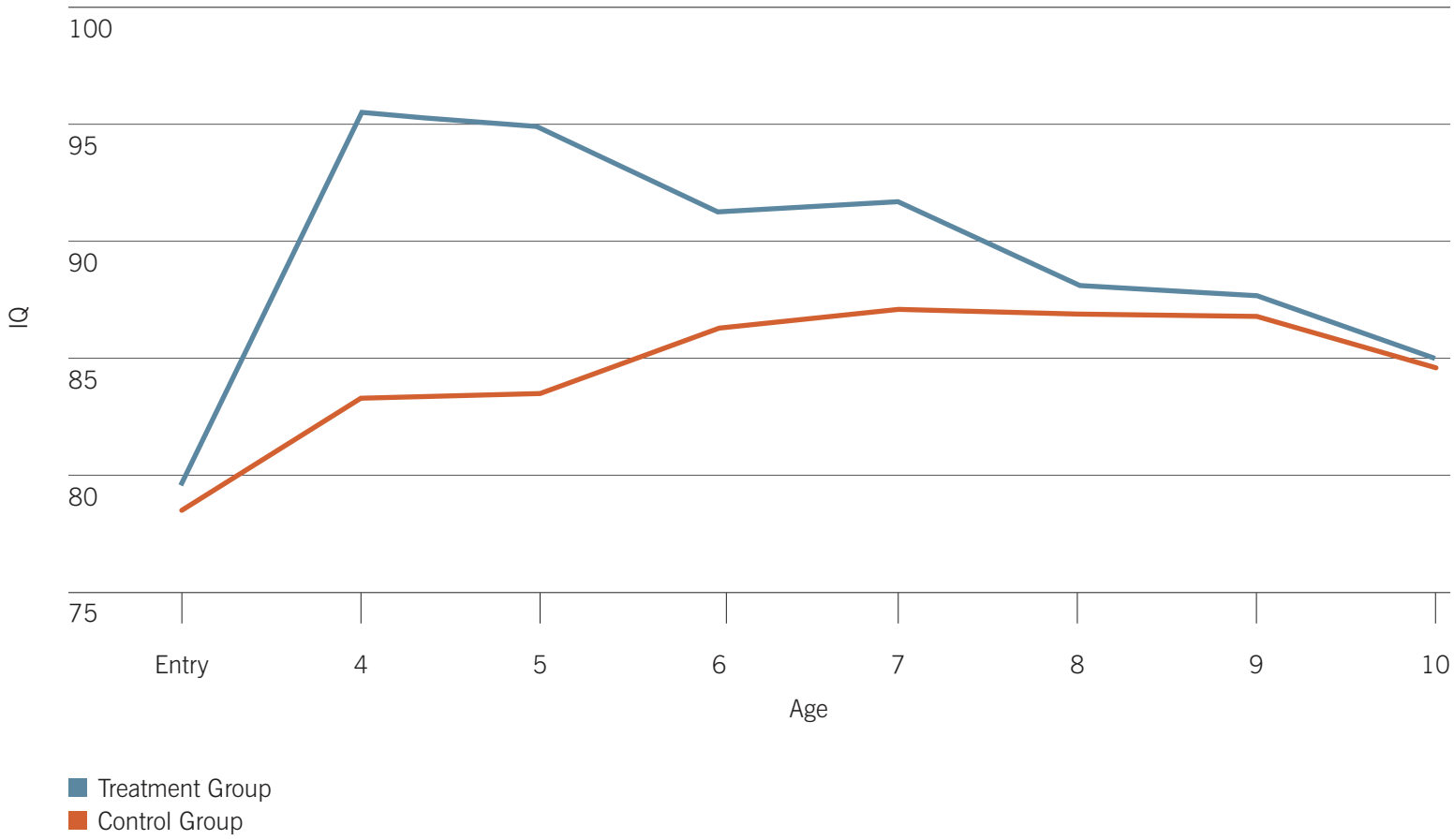
It raised noncognitive skills.

Perry Preschool Program: IQ, by Age and Treatment Group



Source: Perry Preschool Program. IQ measured on the Stanford Binet Intelligence Scale (Terman & Merrill, 1960). Test was administered at program entry and each of the ages indicated.

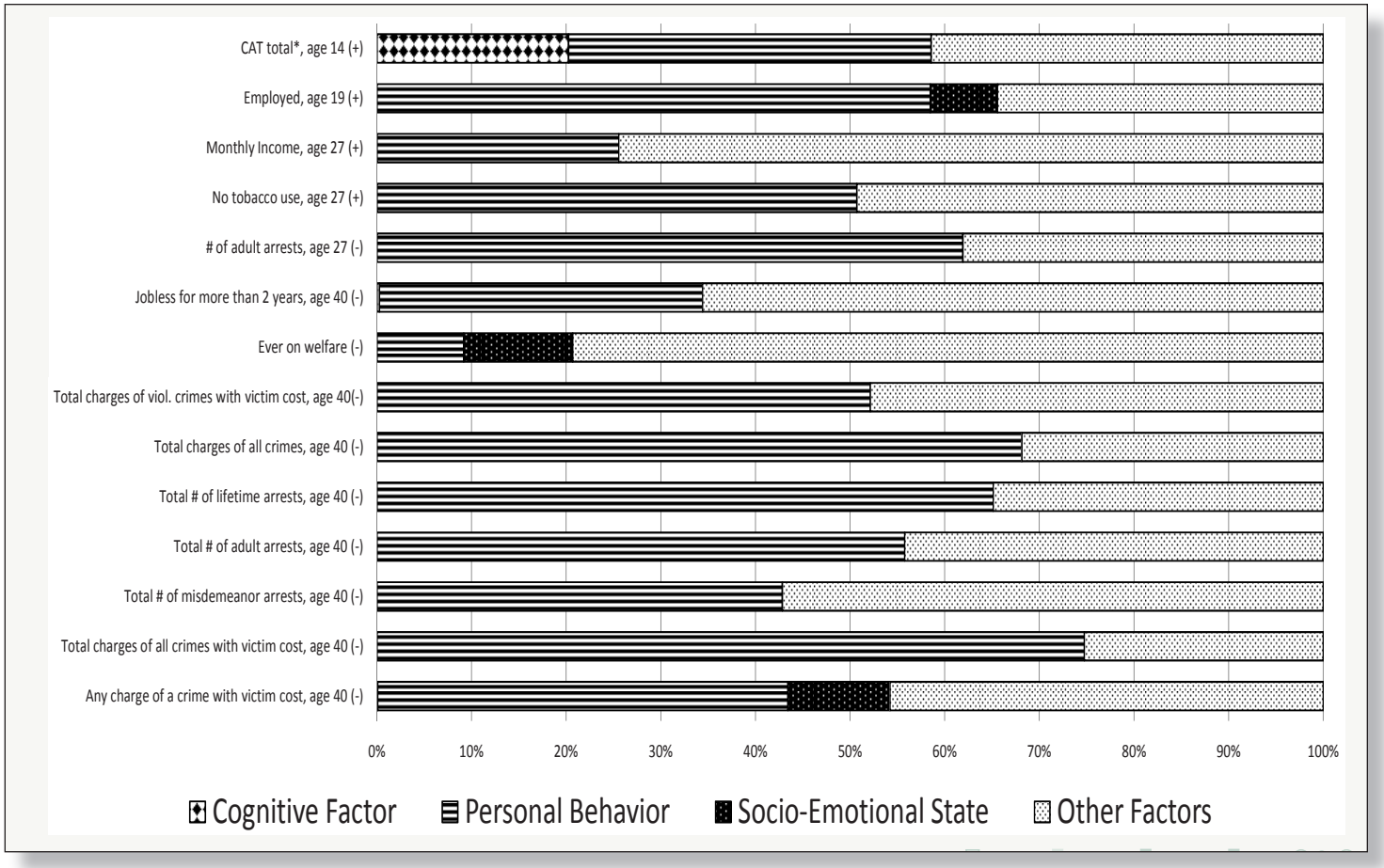
Perry Preschool Program: IQ, by Age and Treatment Group



Source: Perry Preschool Program. IQ measured on the Stanford Binet Intelligence Scale (Terman & Merrill, 1960). Test was administered at program entry and each of the ages indicated.

Contribution of Noncognitive Capacities to Perry Treatment

Figure 1: Decompositions of Treatment Effects, Males



A Developmental Focus: Capacities

A Developmental Focus: Capacities

Capacities at stage *t* of the lifecycle

$$\theta_t = (\theta_{C,t}, \theta_{N,t}, \theta_{H,t})$$

↑ cognition

A Developmental Focus: Capacities

Capacities at stage *t* of the lifecycle

$$\theta_t = (\theta_{C,t}, \theta_{N,t}, \theta_{H,t})$$

↑ personality

A Developmental Focus: Capacities

Capacities at stage *t* of the lifecycle

$$\theta_t = (\theta_{C,t}, \theta_{N,t}, \theta_{H,t})$$

↑ health

A Developmental Focus: Capacities

Expression of Capacities: Behavior at stage *t*

$$Y_{j,t} = \psi_j(\theta_t, R_t)$$

↑ capacities

A Developmental Focus: Capacities

Expression of Capacities: Behavior at stage *t*

$$Y_{j,t} = \psi_j(\theta_t, R_t)$$

↑ incentives to use capacities

A Developmental Focus: Capacities

Capacities can be produced. Technology of capacity formation:

$$\theta_{t+1} = f_t(\theta_t, I_t, \theta_{t,P})$$

↑ capacities

A Developmental Focus: Capacities

Capacities can be produced. The technology of capacity formation:

$$\theta_{t+1} = f_t(\theta_t, I_t, \theta_{t,P})$$

↑ investment (parenting, schools)

A Developmental Focus: Capacities

Capacities can be produced. The technology of capacity formation:

$$\theta_{t+1} = f_t(\theta_t, I_t, \theta_{t,P})$$

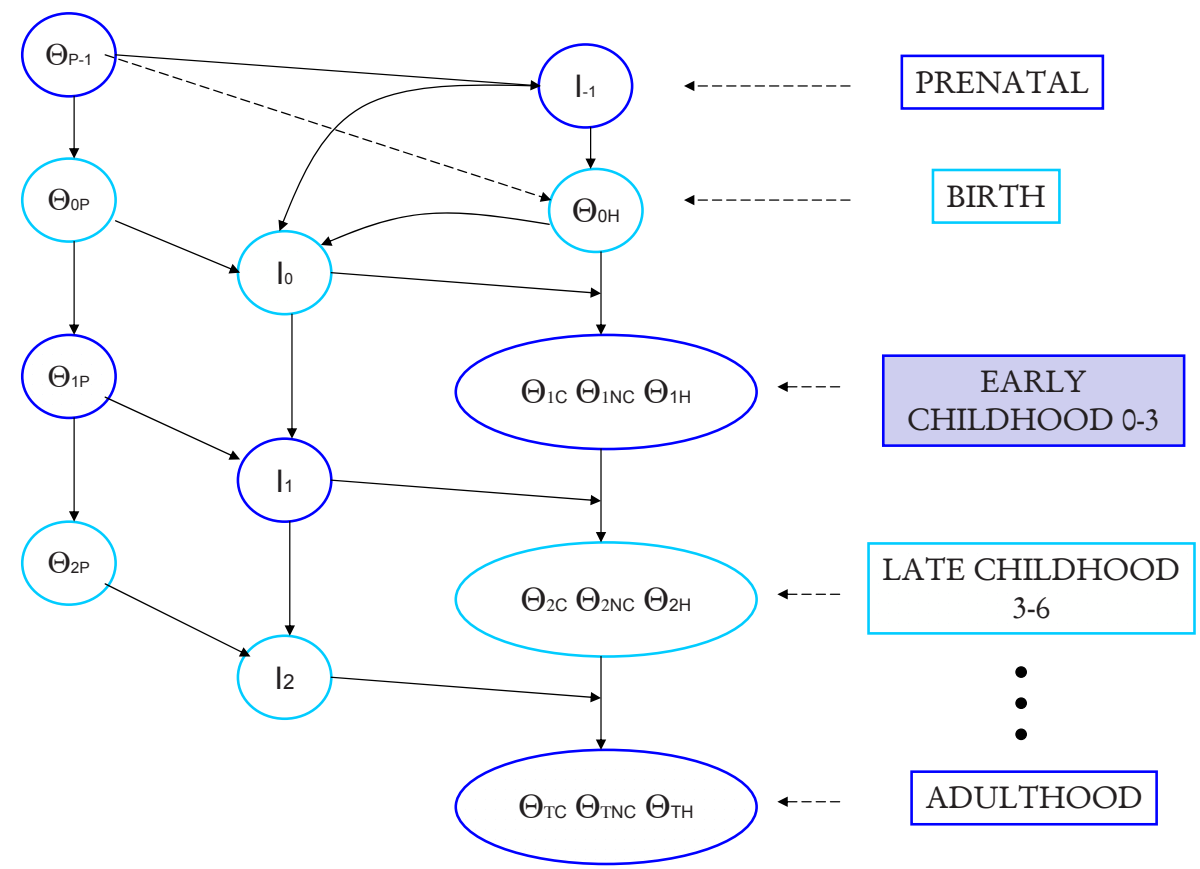
↑ parental and social environmental influences (traits of parents; values and motivations)

A Developmental Focus: Capacities

A central question for public policy is what is the most effective way to promote high achievement in outcomes and reduce inequality that recognizes the way capacities are expressed and produced over the life cycle?

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
$\theta_{t+1} = f_t(\theta_t, I_t, \theta_{t,P})$



A Developmental Focus: Capacities

Cunha and Heckman (2008) and Cunha, Heckman, and Schennach (2007) estimate technologies of skill formation to understand how the skills of the children evolve in response to:

– the stock of skills children have already accumulated;

– the investments made by their parents; and

– the stock of skills accumulated by the parents themselves.

Two Polar Cases Summarize the Literature

Two Polar Cases Summarize the Literature (Example One)

Let h be adult human capital:

$$h = \gamma I_1 + (1 - \gamma) I_2$$

I_1 is early investment; I_2 is late investment.

Two Polar Cases Summarize the Literature (Example One)

This extreme case states that remediation is always possible. (However, it may not be cost effective.)

This is at odds with the evidence from Neuroscience and Developmental Psychology.

It is the standard model in economics.

The Technology in an Intuitive Framework

The Technology in an Intuitive Framework

This technology suggests that the timing of investment is not an important issue. As a consequence, remediation is possible.

However, even though it may be feasible to remediate, it may be very costly (especially if γ is close to 1).

Even if it is technologically feasible to remediate, it is not necessarily economically feasible.

The Technology in an Intuitive Framework

If: $\frac{\gamma}{1+r} < 1-\gamma$ invest later

$\frac{\gamma}{1+r} > 1-\gamma$ invest earlier

E.g., if $\gamma = 1/2$, invest later.

All depends on γ.

May be more efficient to give the child a bank account to finance its schooling.

Polar Opposite Case

Polar Opposite Case (Example Two)

Let h be adult human capital:

$$h = \min \{ I_1 , I_2 \}$$

In this case, if investments in period one are very low, no remediation is possible.

For early investment to work, later investments must be made.

The empirical truth is in-between.

Capability Formation Process

Capability Formation Process

The capability formation process is governed by a multistage technology.

Each stage corresponds to a period in the life cycle of a child.

The *technology of capability formation* (Cunha and Heckman, 2007; Heckman, 2007) captures essential features of development.

Capability Formation Process

It expresses the stock of period $t + 1$ capabilities (θ_{t+1}) in terms of period t capabilities, (θ_t), investments, (I_t), and parental environments (θ_t^P):

$$(1) \quad \theta_{t+1} = f_t(\theta_t, I_t, \theta_{tP}).$$

θ_0 is the vector of initial endowments determined at birth or at conception.

Capability Formation Process

The framework allows analysts:

– To organize the evidence on outcomes and interventions from diverse literatures within a common framework;

– Identify synergies among capabilities: how health, cognition and personality traits produce outcomes and interact in the production of capabilities; and

– Recognize gaps in the literature and the possibilities for a variety of interventions to promote health.

Estimates

Estimates

These technologies have been estimated.

The major findings from analyses based on them are:

– Self-productivity becomes stronger as children become older, for both cognitive and noncognitive capability formation.

– It is much more difficult to compensate for the effects of adverse environments on cognitive endowments in adolescence than it is at very young ages.

Estimates

- This helps to explain the large body of evidence on ineffective cognitive remediation strategies for disadvantaged adolescents.
- The productivity of investment is much greater at younger ages than at older ages for all types of investments. This is due to the plasticity of the young.

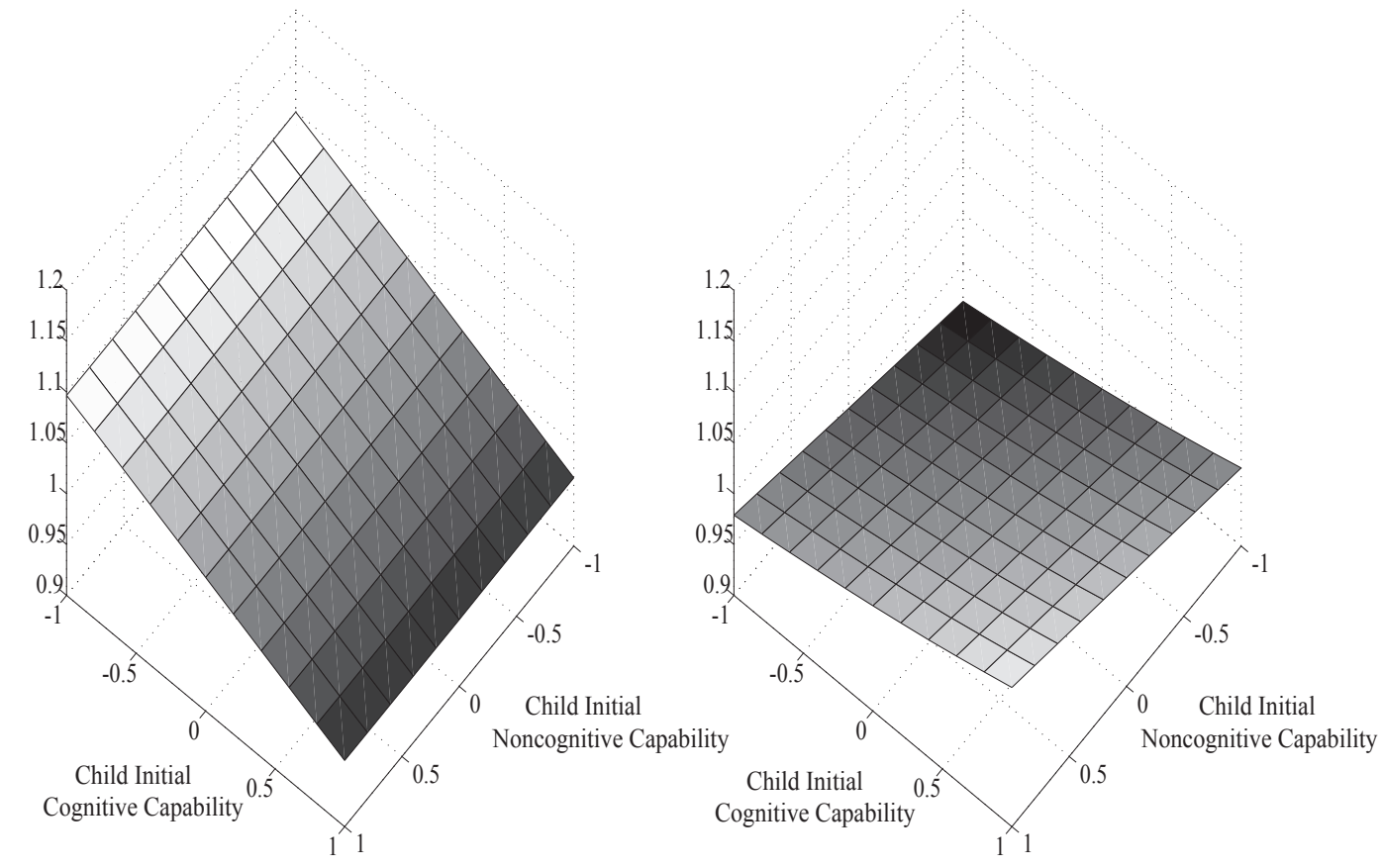
Estimates

– If society waits until adolescence to invest in children in disadvantaged environments, it is costly. At that stage of the life cycle, investments in noncognitive skills are more effective than investments in cognitive skills.

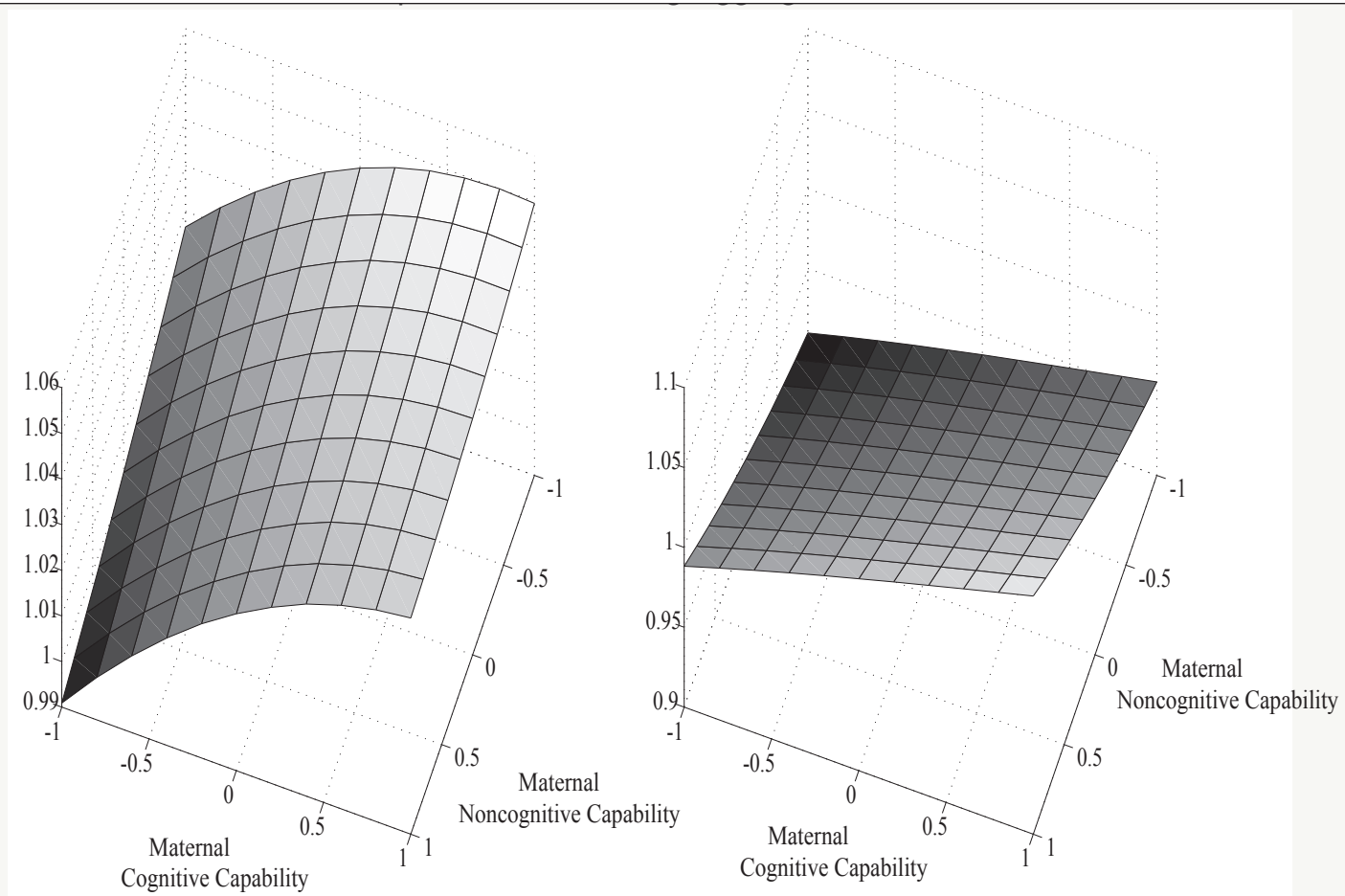
Estimates

The optimal policy toward disadvantaged children is to invest much more than we currently do in the early years of childhood.

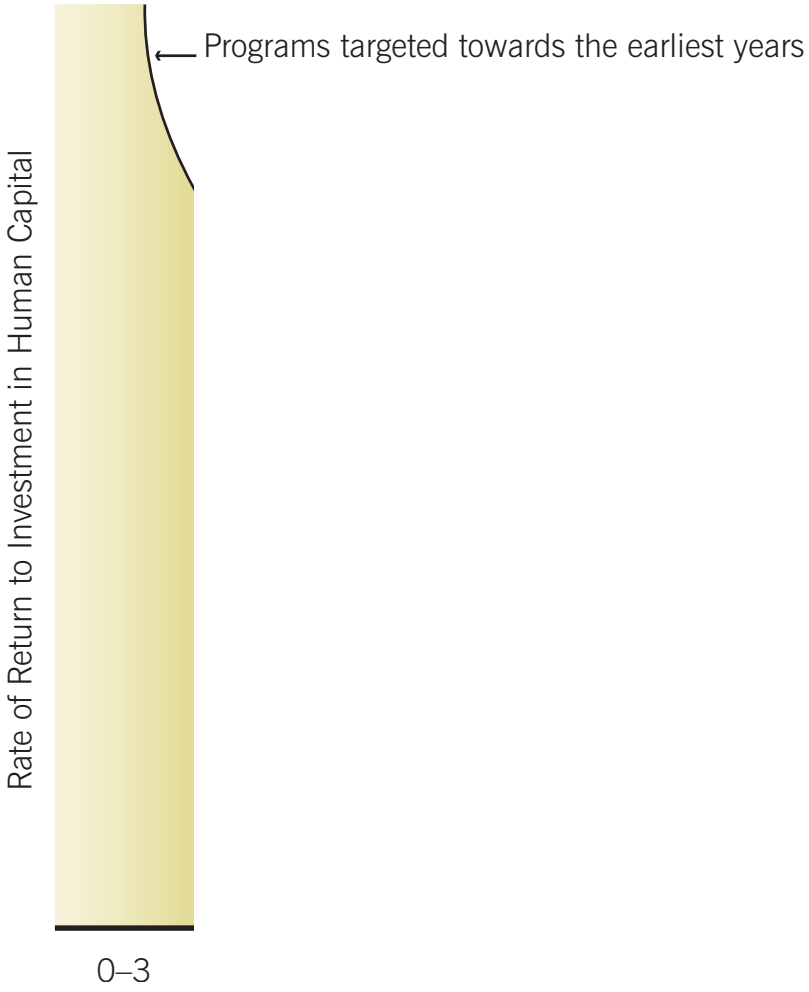
Optimal Early (L) and Late (R) Investments by Child Initial Conditions of Cognitive and Noncognitive Capacities Maximizing Aggregate Education



Optimal Early (L) and Late (R) Investments by Maternal Cognitive and Noncognitive Capacities Maximizing Aggregate Education

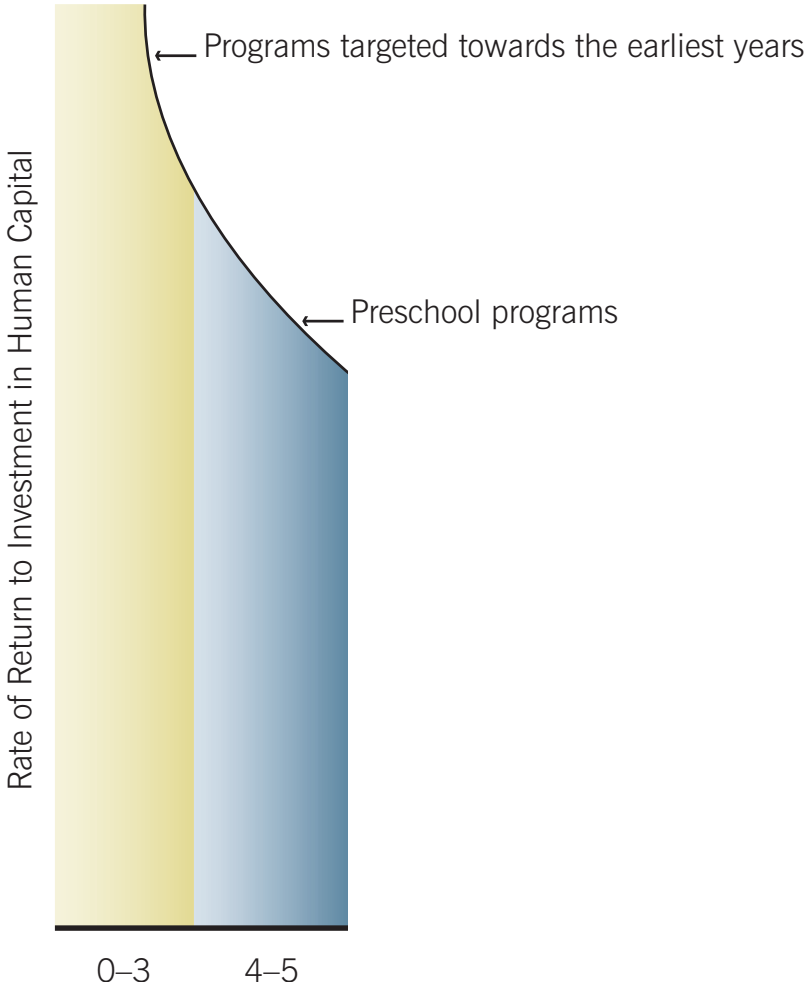


Returns to a Unit Dollar Invested



Source: Heckman and LaFontaine (2007).

Returns to a Unit Dollar Invested



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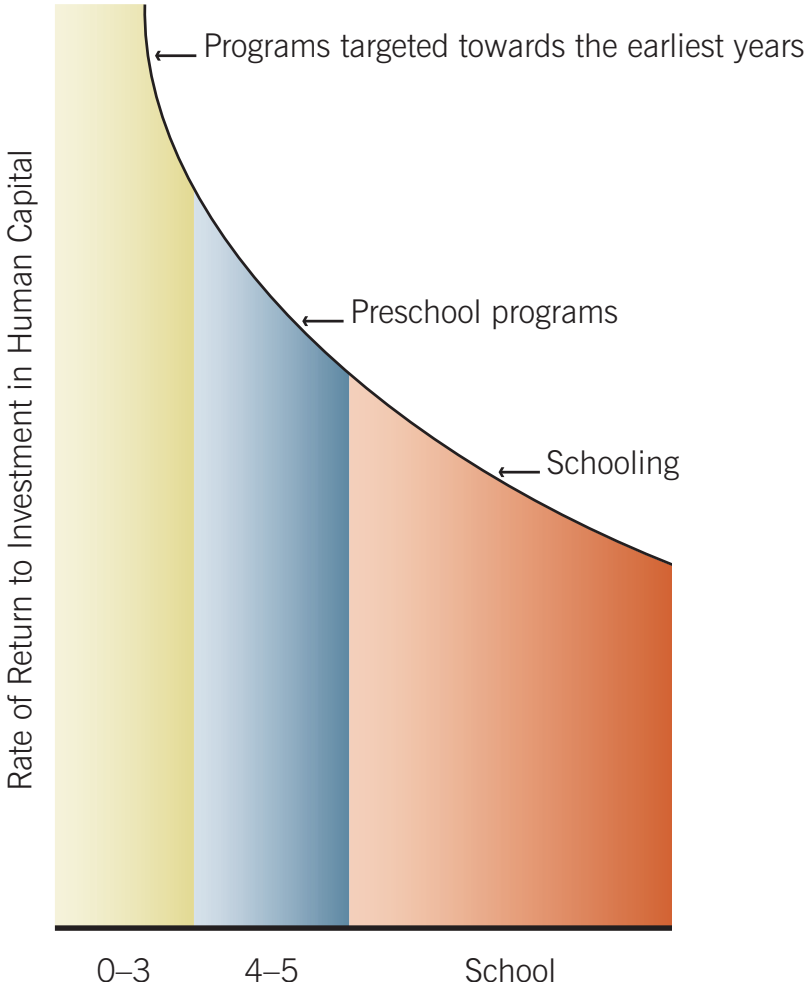
Returns to a Unit Dollar Invested



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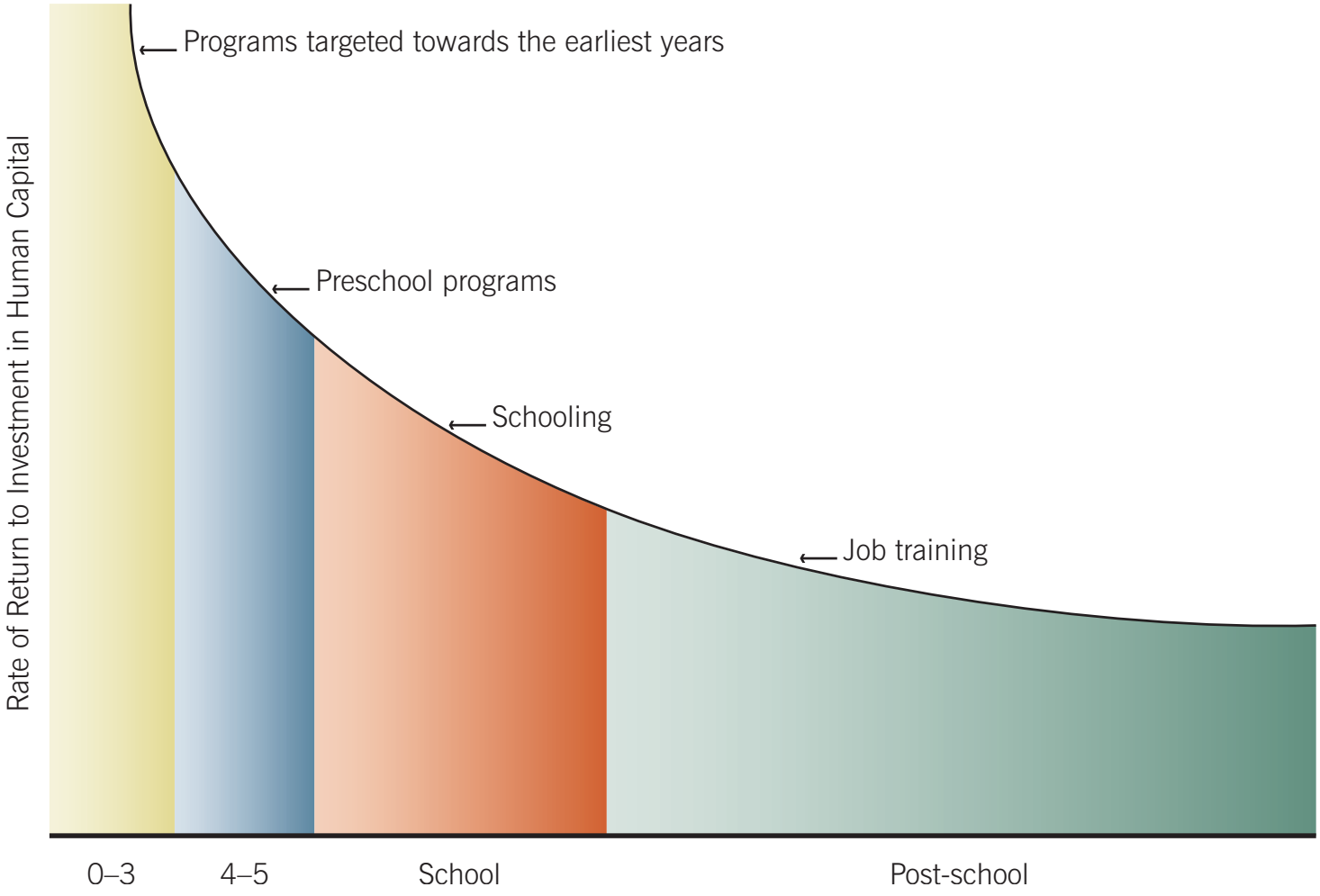
Returns to a Unit Dollar Invested



Source: Heckman and LaFontaine (2007).

Practical Issues

Practical Issues

Whom to Target?

With What Programs?

Who Should Provide the Programs?

Who Should Pay for Them?

Issues of Compliance

Practical Issues

Whom to Target?

– Returns higher to disadvantaged.
– What is the proper measure of disadvantage? Is it poverty? Measures of childhood home life?
– Evidence suggests quality of parenting is the key.
– Parenting is the scarce resource.
– Not always closely linked to family income or even parental education.
– Explains in part why certain culture groups produce successful children and others do not.

Practical Issues

With What Programs?

– Programs that target the early years seem to have the greatest promise.
– Nurse Family Partnership Program / Abecedarian / Perry.
– Home visits affect the lives of the parents, create a permanent change in the home environment.
– Programs that build character and motivation — not just cognition — are essential.

Practical Issues

Who Should Provide the Programs?

– Respect the sanctity of early family life.
– Respect cultural diversity.
– Create a base of common skills and traits but do so within a culturally diverse settings.
– Engage private industry and other social groups that:
  Draw in private resources.
  Create community support.

Practical Issues

Who Should Pay for Them?

– Can make it universal to avoid stigmatization.
– Offer a sliding fee schedule to avoid deadweight losses.
– Mobilize private resources to support the subsidy.

Practical Issues

Issues of Compliance

- Many successful programs change the values and motivation of the child.
- This may run counter to the values of parents (e.g., James Dobson).
- There may be serious tension between the need of the child and the acceptance of intervention by the parent.
- Then there is a basic conflict between values of society (as it seeks to develop the potential of the child) and the values of the family.

Summary

Summary

Many current social problems have their roots in deficits in abilities.

Ability deficits open up early in life and persist. They produce inequality and reduce productivity.

Evidence from human and animal studies shows critical and sensitive periods for development.

Summary

Critical and sensitive periods come earlier for cognitive traits; later for noncognitive traits.

Associated with slower development of the prefrontal cortex.

Noncognitive traits stimulate production of cognitive traits (cross complementarity) but not vice versa.

Accords with evidence from animal studies.

Summary

Later investment (associated with resilience) is possible but less efficient — consistent with the evidence from Neuroscience.

Later investment is more efficient if early investment is made.

Balanced portfolio weighted toward the early years is optimal.

Early investments create a base for enhancing the productivity of later investment.

Summary

Children from advantaged environments by and large receive substantial early investment.

Children from disadvantaged environments typically do not.

There is a strong case for public support for funding interventions in early childhood for disadvantaged children.

The measurement of disadvantage is the **quality of parenting,** not income per se.

Summary

The knowledge base needs to be expanded.
A fruitful symbiosis of science and policy.
Science guides policy and policy problems motivate scientific research.

Schools and tuition do not matter as much as is often thought.

Summary

Late remediation not very effective.

Remediation can work, but is costly.

Social policy should be directed toward the malleable early years, if we want to successfully reduce inequality and promote productivity in American society.

HeckmanEquation.org

Heckman
The economics of human potential.