Early Childhood Development: Learning, Behavior and Health

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Research for a Lifetime:
A Scientific Colloquium to Commemorate the NICHD's 50th Anniversary
Session on "Healthy Beginnings"
NIH Main Campus, Bethesda, Maryland
December 5, 2012

Questions Addressed

1. **What are the most important questions your field seeks to answer?**
2. **What are some of the seminal advances in your field over the past 50 years?**
3. **What research opportunities make you most enthusiastic for the future of your field?**

1. What are the most important questions your field seeks to answer?

- Understanding how to devise effective social policies to create successful, thriving people.
- Policies that reduce inequality, promote opportunity and foster social mobility.
- Policies that allow persons to realize their full potential.

2. What are some of the seminal advances in your field over the past 50 years?

- Understanding **Capabilities**.
- The capacities to function in society.
- Capabilities interact to produce life outcomes.
- Understanding how these capabilities shape life outcomes and produce opportunities and inequality.
- Recognizing and quantifying differences in capabilities across people.
- Capabilities are multiple in nature.
- More than just cognitive skills (IQ).
- A common core of cognitive, personality and health skills shape life outcomes.
- Different capabilities have different importance in different tasks in life where tasks are defined broadly.
- Shortfalls in some can be compensated in part by strengths in others.

- Capabilities are skills, not traits.
- Capabilities are **not** set in stone. Genes play an important role in shaping them but are far from being the whole story.
- Capabilities are fostered by families and social environments.
- Recently acquired understanding of the role of the family in shaping child and adult outcomes makes trends in American family life alarming.
- Family life is under challenge in the U.S. and around the world.
- As a result the creation of the capabilities of future generations is threatened.

- We have a deeper understanding of the life cycle of the production of capabilities of the child.
- Critical and sensitive periods for the development of capabilities.
- Periods in the life of the child where investment and intervention are most productive.
- These differ for different capabilities.
- This is useful knowledge because it provides guidance to policy to understand which policies targeted toward different capabilities for which ages are most effective in producing flourishing people.

Modern Understanding of Human Development

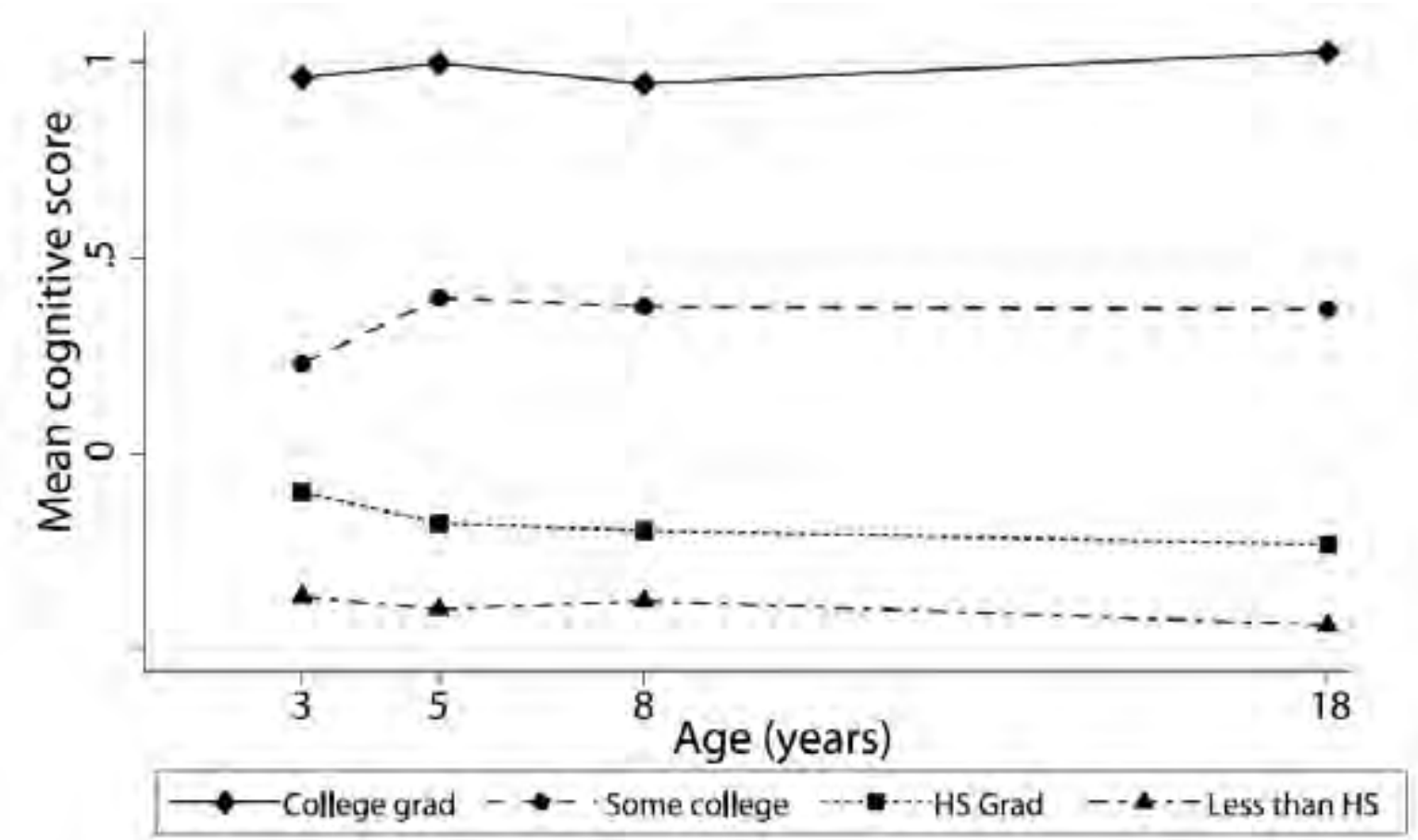
- The **powerful role of family life** and the early years in shaping adult capabilities.
- **Multiple capabilities** shape the ability of agents to function in society. A core set of capabilities promotes success in many aspects of life.
- **The technology of capability formation:** that capabilities beget capabilities. There is a fundamental synergism associated with capability formation. Different capabilities interact dynamically to shape the evolution of future capabilities. There are different periods of effective investment for the development of different capabilities.

Capabilities: The Importance of Cognition, Character, and Health

- Major advances have occurred in understanding which capabilities matter for success in life.
- **Cognitive capabilities** measured by IQ and achievement tests are important predictors of life success.
- So are the **socioemotional capabilities**---sometimes called character skills or personality skills:
  - Motivation
  - Sociability; ability to work with others
  - Attention
  - Self Regulation
  - Self Esteem
  - Ability to defer gratification
  - Health and Mental Health
- **Health and basic biological architecture** play crucial roles not only in promoting adult health but in promoting cognition and character.
- **Synergisms** among capabilities.
- These capabilities can be measured and they are predictive of a variety of outcomes.

Gaps In Capabilities Open Up Early

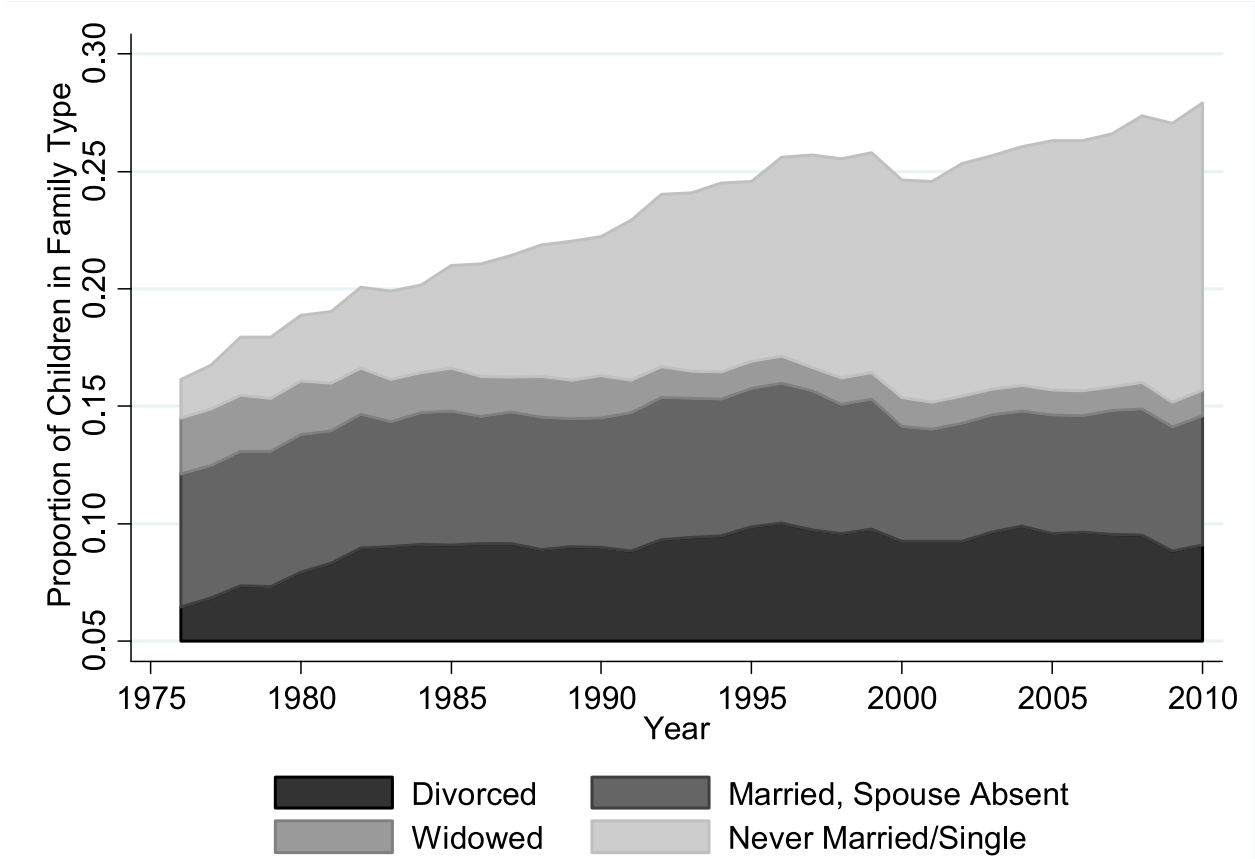
Trend in mean by age for cognitive score by maternal education



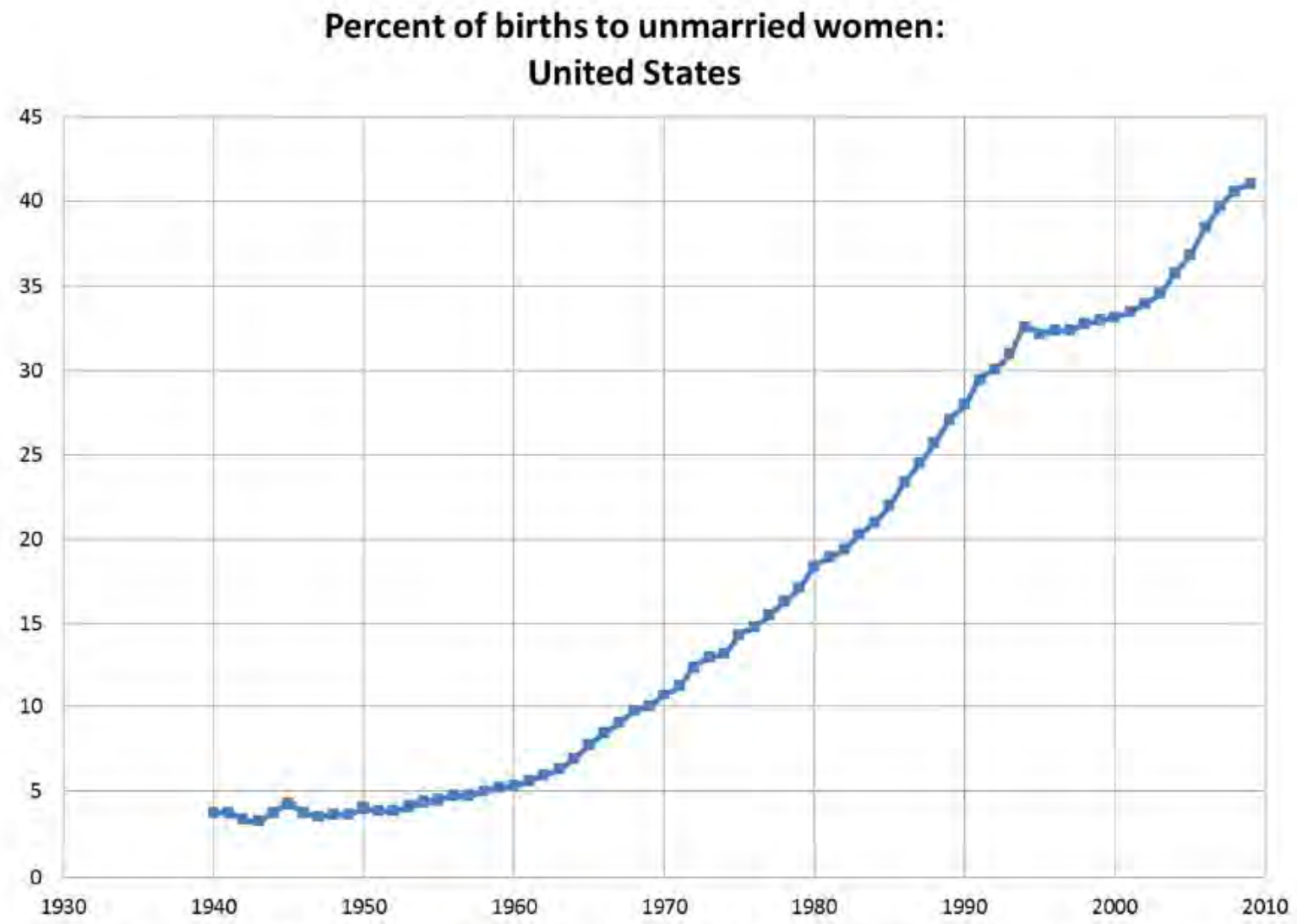
Each score standardized within observed sample. Using all observations and assuming data missing at random. Source: Brooks-Gunn et al. (2006).

How to Interpret This Evidence?

Children Under 18 Living in Single Parent Households by Marital Status of Parent



Source: March CPS 1976-2010 ; Note: Source: March CPS 1976-2010. Note: Parents are defined as the head of the household. Children are defined as individuals under 18, living in the household, and the child of the head of household. Children who have been married or are not living with their parents are excluded from the calculation. Separated parents are included in "Married, Spouse Absent" Category



Source: Center for Disease Control and Prevention; Note: For the period 1940-1950 on 1940 and 1950 birth rates are presented; Age of mother 15-44

Mothers' Speech and Child Vocabulary: Hart & Risley, 1995

Children enter school with "meaningful differences" in vocabulary knowledge.

1. In a typical hour, the average child hears:

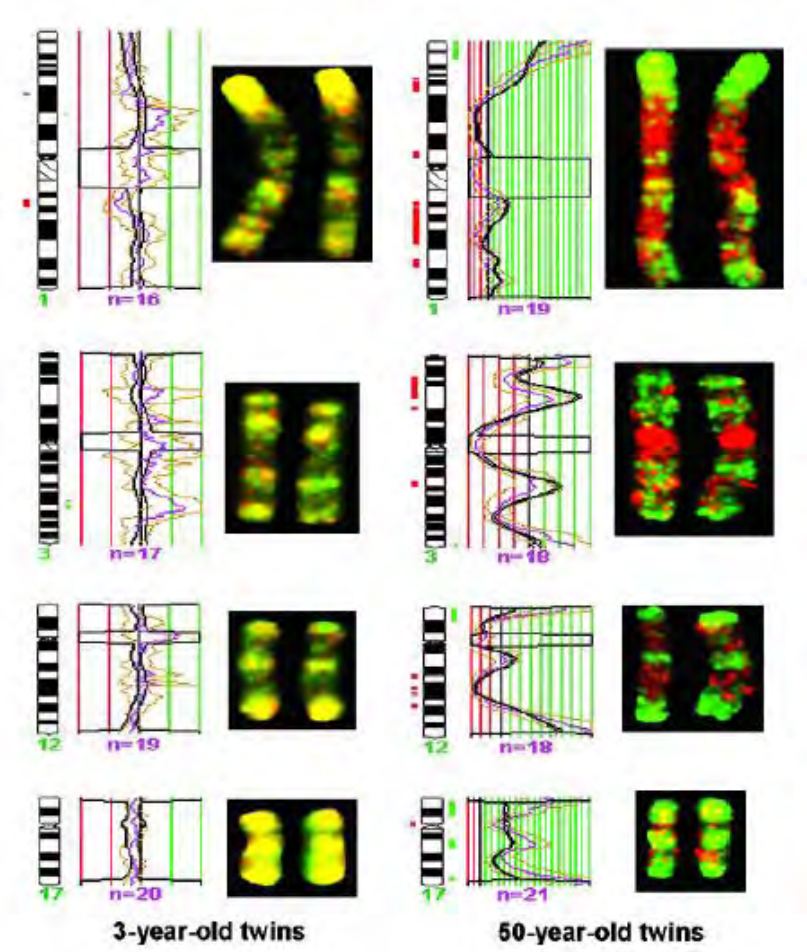
Family Status	Actual Differences in Quantity of Words Heard	Actual Differences in Quality of Words Heard
Welfare	616 words	5 affirmatives, 11 prohibitions
Working Class	1,251 words	12 affirmatives, 7 prohibitions
Professional	2,153 words	32 affirmatives, 5 prohibitions

2. Cumulative Vocabulary at Age 3

Cumulative Vocabulary at Age 3	
Children from welfare families:	500 words
Children from working class families:	700 words
Children from professional families:	1,100 words

Genes, Biological Embedding of Experience and Gene-Environment Interactions

DNA methylation and histone acetylation patterns in young and old twins



Source: Fraga, Ballestar et al. (2005)

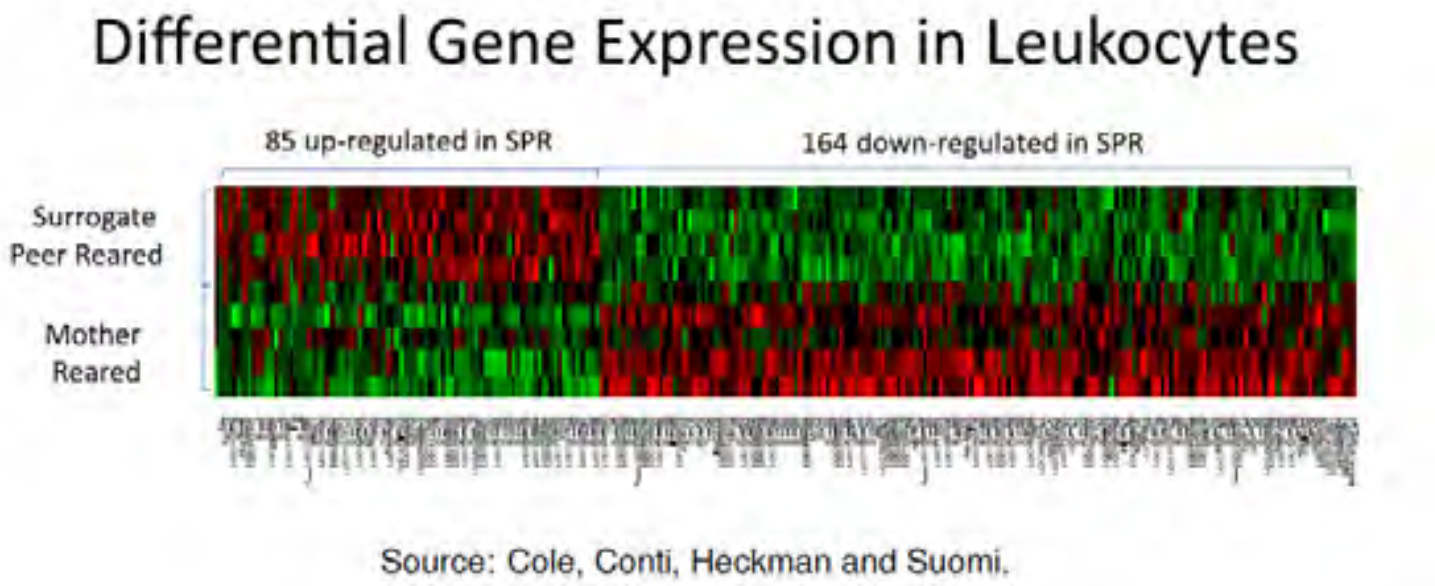
How Do Early Experiences Get Under the Skin?

- Much work on epigenetic mechanisms.
- In joint work Gabriella Conti, Steve Cole, Stephen Suomi and I investigate **epigenetic mechanisms** in Rhesus Monkeys.
- They have roughly 97% of the same genes as we do.
- We show that adversity-related changes in expression of basal leukocyte genes emerge *early* in life (4-month old rhesus monkeys), and independently of cumulative exposures.
- We also show that the adverse effects of early rearing conditions are *not compensated* by a normal social environment later in life.

The Rhesus Monkeys Experiment

Early Life Experiences Change The Way Genes Express Themselves

Up- and Down-Regulated Genes in Rhesus Monkeys



Source: Cole, Conti, Heckman and Suomi.

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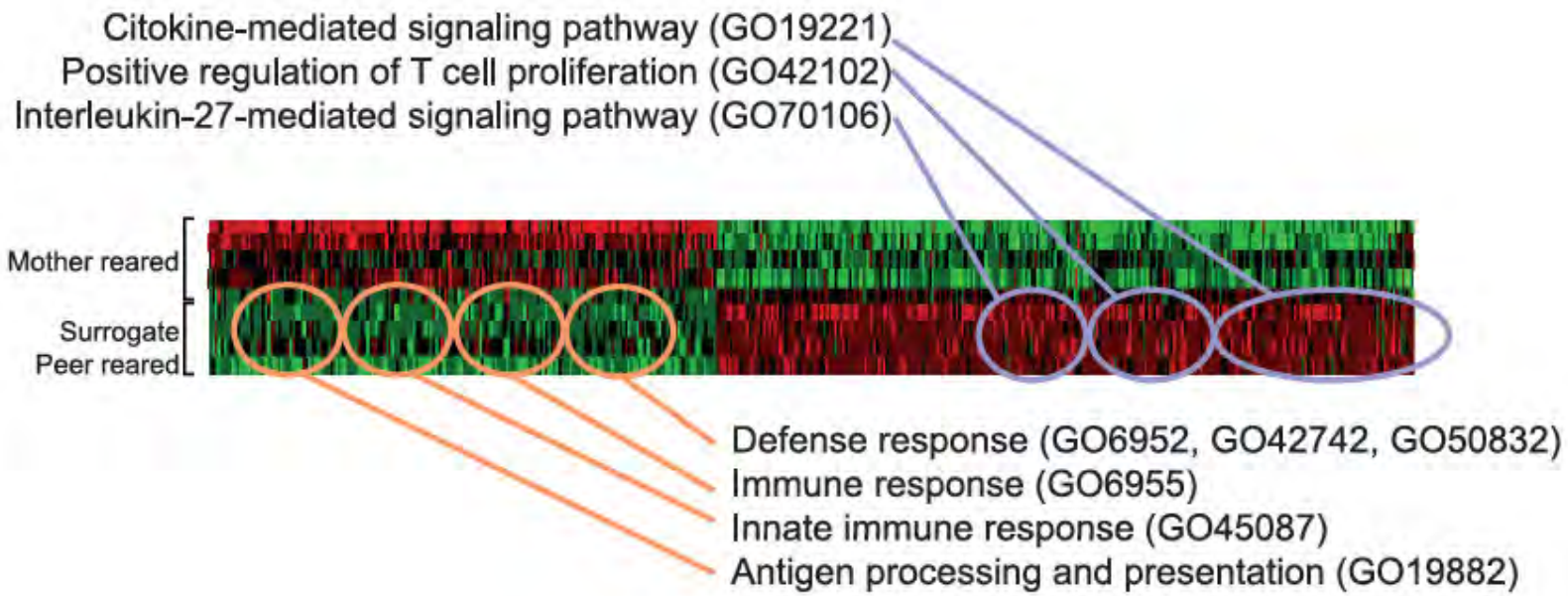
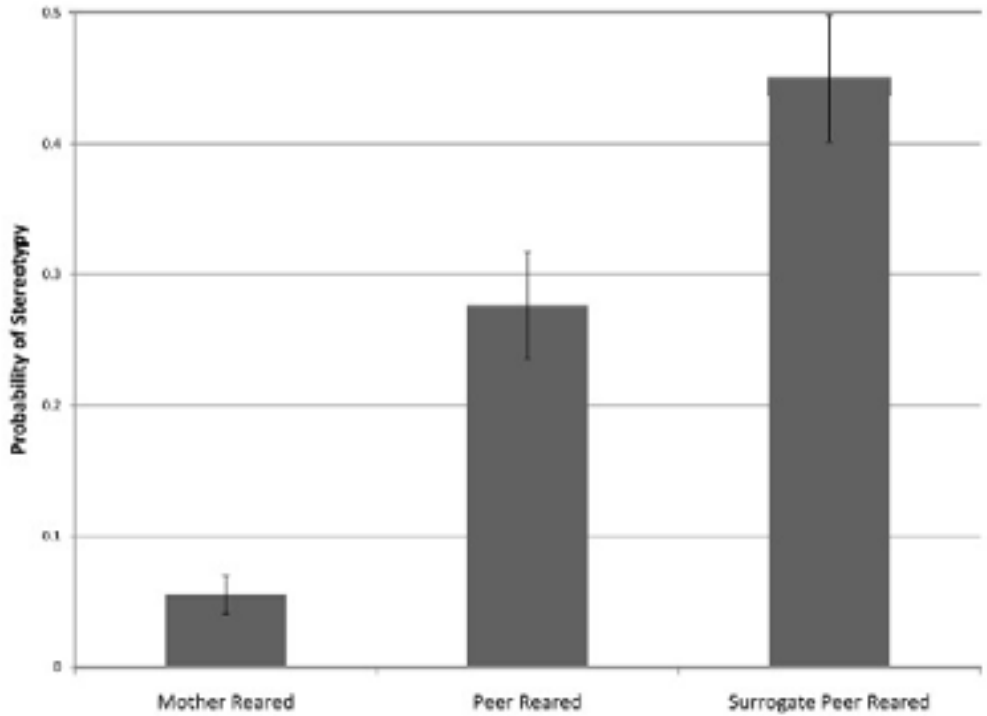


Source: Cole, Conti, Heckman and Suomi.

Later Life Effects of Early Adverse Rearing Conditions

Early Life And Later Mental Health

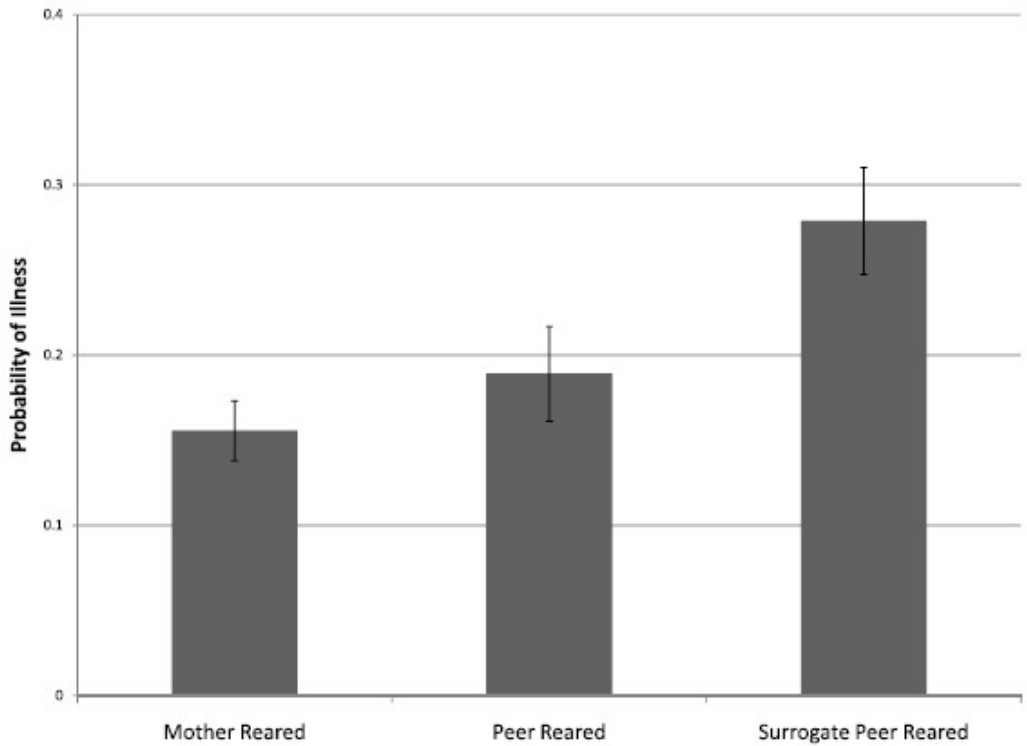
Probability of Developing a Stereotypy



Source: Conti, Hansman, Heckman and Suomi.

Early Life And Later Physical Health

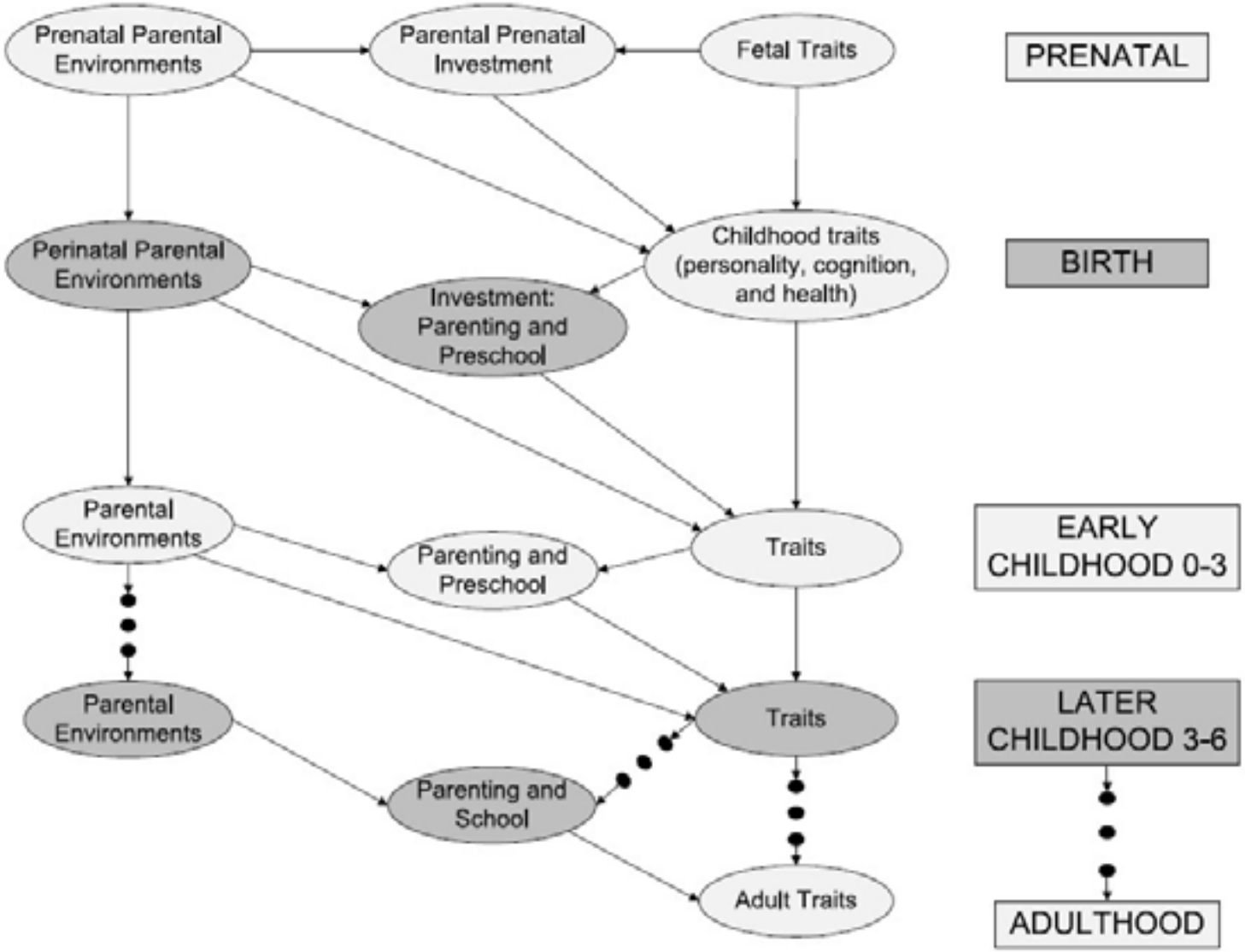
Probability of Developing an Illness, Male



Source: Conti, Hansman, Heckman and Suomi.

Critical and Sensitive Periods

A Life Cycle Framework for Organizing Studies and Integrating Evidence: The Technology of Life Cycle Capability Formation

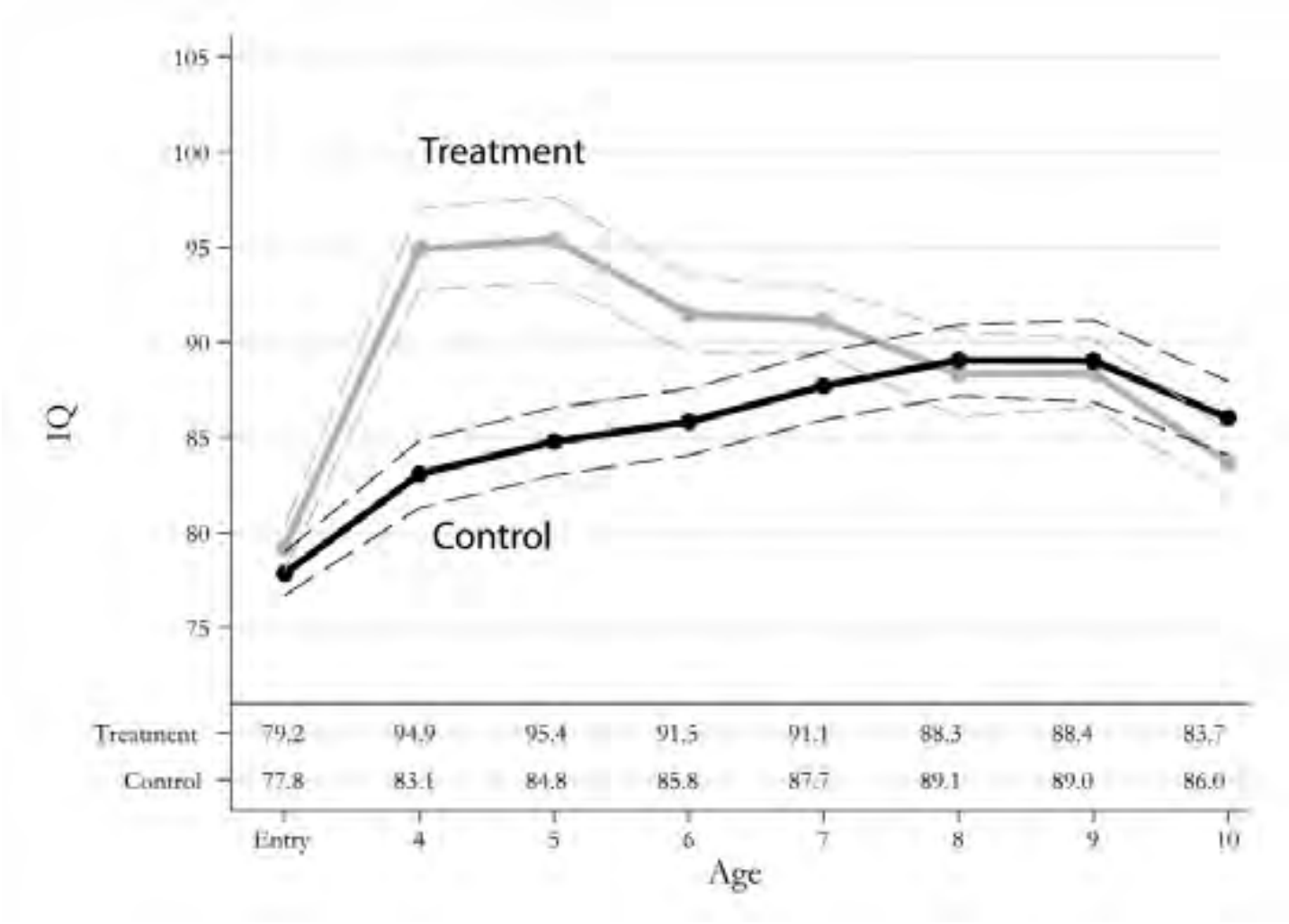


Enriched Early Environments Compensate In Part For the Risks Arising from Disadvantaged Environments

HighScope Perry Preschool Program

- The Perry preschool program enriched the lives of low income black children with initial IQs below 85 at age 3.
  - $2\frac{1}{2}$ hours per day
  - 5 days per week
  - 2 years during each school year (mid-October to May).
  - home visits
  - program stops after two years
- Focused on "Plan---Do---Review."
  (Teach children to plan a task, to stay on the task, and to review it --- a strong and personal social skills component.)
- Visits with parents one day every two weeks.

Cognitive Dynamics



- Yet has a statistically significant rate of return of around 6.2-9% per annum---for both boys and girls---above the post World War II stock market returns to equity in U.S. labor market estimated to be 5.8%.
- The Perry Preschool Program worked primarily through **noncognitive** channels. (Less aggression; more self-control.)
- It also worked through promoting adult health.
- The development of effective tools of causal analysis of small sample social experiments with multiple outcomes and possible threats to validity:
  1. Ex post reassignment of treatment.
  2. Contamination of controls (substitutes for the treatment found in the controls).

Perry Preschool Project			
Variable Description	**Control Mean**	**Diff. Means**	***p*-value**
Behavioral Risk Factors			
Never drunk without permission by age 15 (F)	0.682	0.152	**0.040**
Never smoked marijuana by age 27 (F)	0.364	0.156	**0.089**
Drinks alcohol never or once in a while at age 27 (F)	0.773	0.107	**0.013**
Always wears a seat belt at age 27 (M)	0.359	0.227	**0.045**
Non-smoker at age 27 (M)	0.462	0.119	**0.080**
Non- or light drinker ($<$3 glasses/time) at age 27 (M)	0.778	0.156	**0.070**
Always wears a seat belt at age 40 (M)	0.618	0.182	**0.080**
Non-smoker at age 40 (M)	0.472	0.161	**0.020**
Any change in diet in past 15y at age 40 (M)	0.229	0.151	**0.018**
Regular physical activity in past month at age 40 (F)	0.091	0.284	**0.002**
Never got a traffic ticket in past 15y at age 40 (M)	0.265	0.269	**0.086**
Health Care Coverage			
Never w/o health insurance in past 15y at age 40 (F)	0.682	0.068	**0.044**
Yrs w/o health insurance in past 15y at age 40 (F)	1.045	-0.587	**0.056**
Health			
Never classified as mentally impaired by age 19 (F)	0.636	0.280	**0.036**
No. of sick days in bed in past 12m at age 27 (F)	8.455	-5.175	**0.035**

- Carolina Abecedarian Program is also effective and worked through similar channels.

Abecedarian Project Project			
Variable Description	**Control Mean**	**Diff. Means**	***p*-value**
Behavioral Risk Factors			
Started smoking by age 15 (parent report) (M)	0.190	-0.114	**0.064**
First tried marijuana before age 17 (F)	0.393	-0.233	**0.053**
First drink before age 17 (F)	0.571	-0.291	**0.047**
Always wears a seat belt at age 21 (F)	0.500	0.220	**0.028**
Started smoking regularly before age 17 (M) (M)	0.304	-0.189	**0.030**
Carried a gun last 30 days at age 21 (M)	0.304	-0.304	**0.006**
Has drank and driven in past month at age 21 (F)	0.222	-0.102	**0.042**
n a physical fight last 12m at age 21 (F)	0.741	-0.261	**0.018**
No. snacks/hamburgers yesterday at age 21 (F)	2.286	-0.846	**0.020**
Physical activity in past week at age 21 (F)	0.071	0.249	**0.012**
Attempted suicide in past 12m at age 21 (F)	0.179	-0.179	**0.011**
Health Care Coverage			
Covered by health insurance at age 21 (F)	0.429	0.411	**0.004**
Covered by health insurance at age 30 (M)	0.476	0.228	**0.088**
Health			
BMI at age 1 (M)	18.107	-1.539	**0.007**
Sick a lot in last 3y at age 15 (M)	0.429	-0.317	**0.031**
BSI Depression score at age 21 (F)	59.643	-5.601	**0.002**
Diastolic BP in mid-30s (M)	92.000	-13.474	**0.025**
Diastolic BP in mid-30s (F)	89.227	-3.894	**0.031**
Systolic BP in mid-30s (M)	143.333	-17.544	**0.038**
Systolic BP in mid-30s (F)	135.636	-5.970	**0.010**
HDL Cholesterol in mid-30s (M)	42.000	11.211	**0.009**
Triglycerides in mid-30s (M)	170.167	-61.956	**0.037**

Understanding the Dynamics of Capability Formation: Capabilities Beget Capabilities

i. Based on a modern understanding of the life cycle of capability formation.
ii. Capability formation is dynamic in nature--capabilities beget capabilities. Stocks of capabilities cross fertilize other capabilities.
iii. **Dynamic and Static Complementarities**.

Capabilities Enhance Each Other: Technology of Capability Formation

Capabilities at later ages = ϕ(Capabilities today, investments, environments)

Personality and Social Capabilities	→	Cognitive Capabilities
(sit still; pay attention and stay focused; engage in learning; open to experience)		
Health	→	Cognitive Capabilities
(fewer lost school days; ability to concentrate, basic IQ, motor and perceptual competence)		
Cognitive Capabilities	→	Produce better health practices; produce more motivation and openness to experience; greater perception of rewards
(child better understand and controls its environment)		
Outcomes		Increase productivity in a variety of aspects of life, higher income, better health, more family investment, upward mobility, reduced social costs

Static Complementarity

The productivity of investment greater for the more capable.

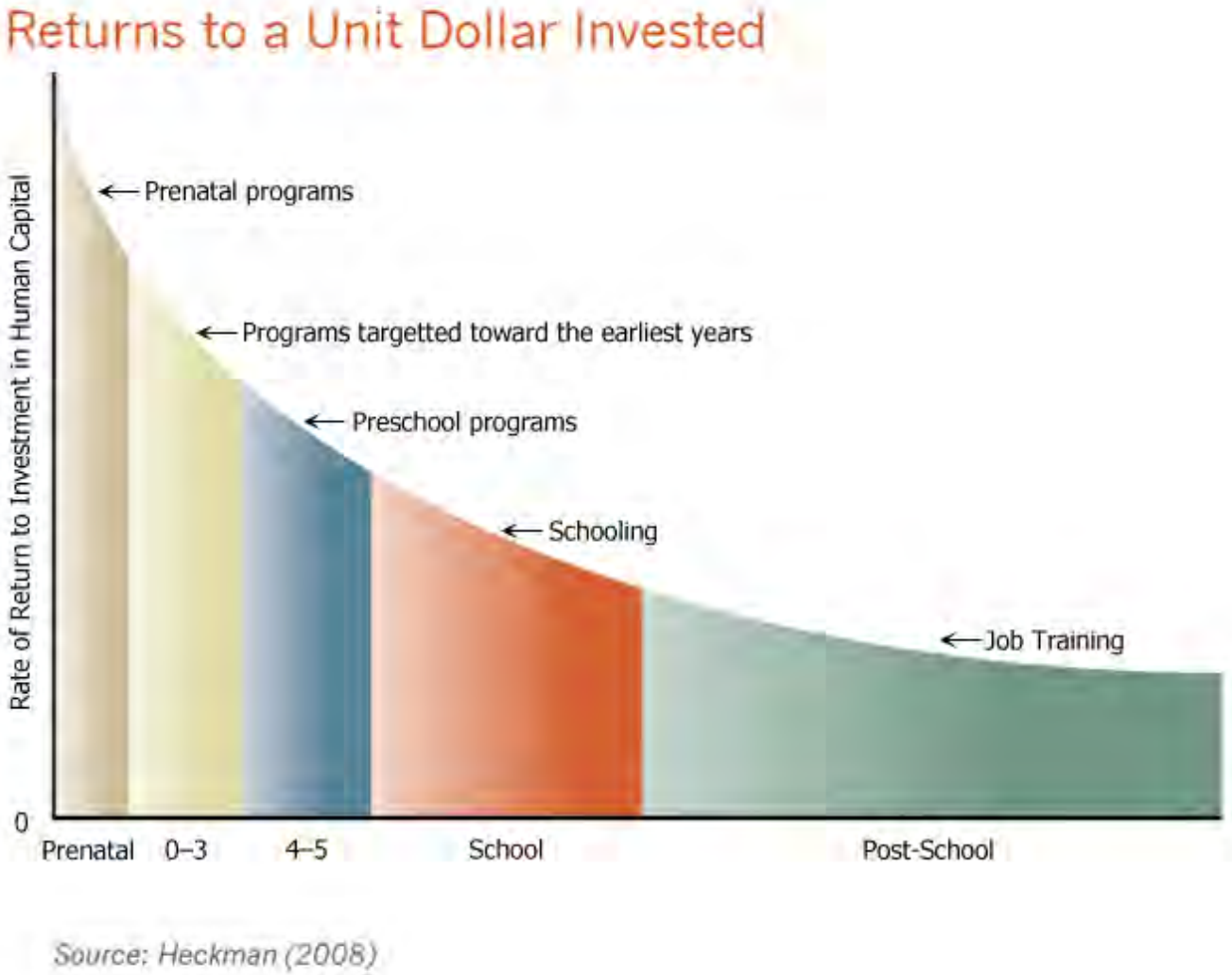
- High returns to more capable people.
- Does this justify social Darwinism?
- On grounds of economic efficiency, should we invest primarily in the most capable?
- Not necessarily.

Dynamic Complementarity

- If we invest today in the base capabilities of disadvantaged young children, there is a huge economic and social return.
- Makes downstream investment more productive.
- **No tradeoff between equality and efficiency goals**.
- Augmenting this investment by public infrastructure and schools gives agency to people and enhances economic and social functioning.

Later Remediation Targeted to the Less Able is Costly and Often Ineffective

What Should We Do for The Disadvantaged Adolescents Who Do Not Receive Skill-Enhancing Enriched Early Environments And Have Cognitive Deficits?

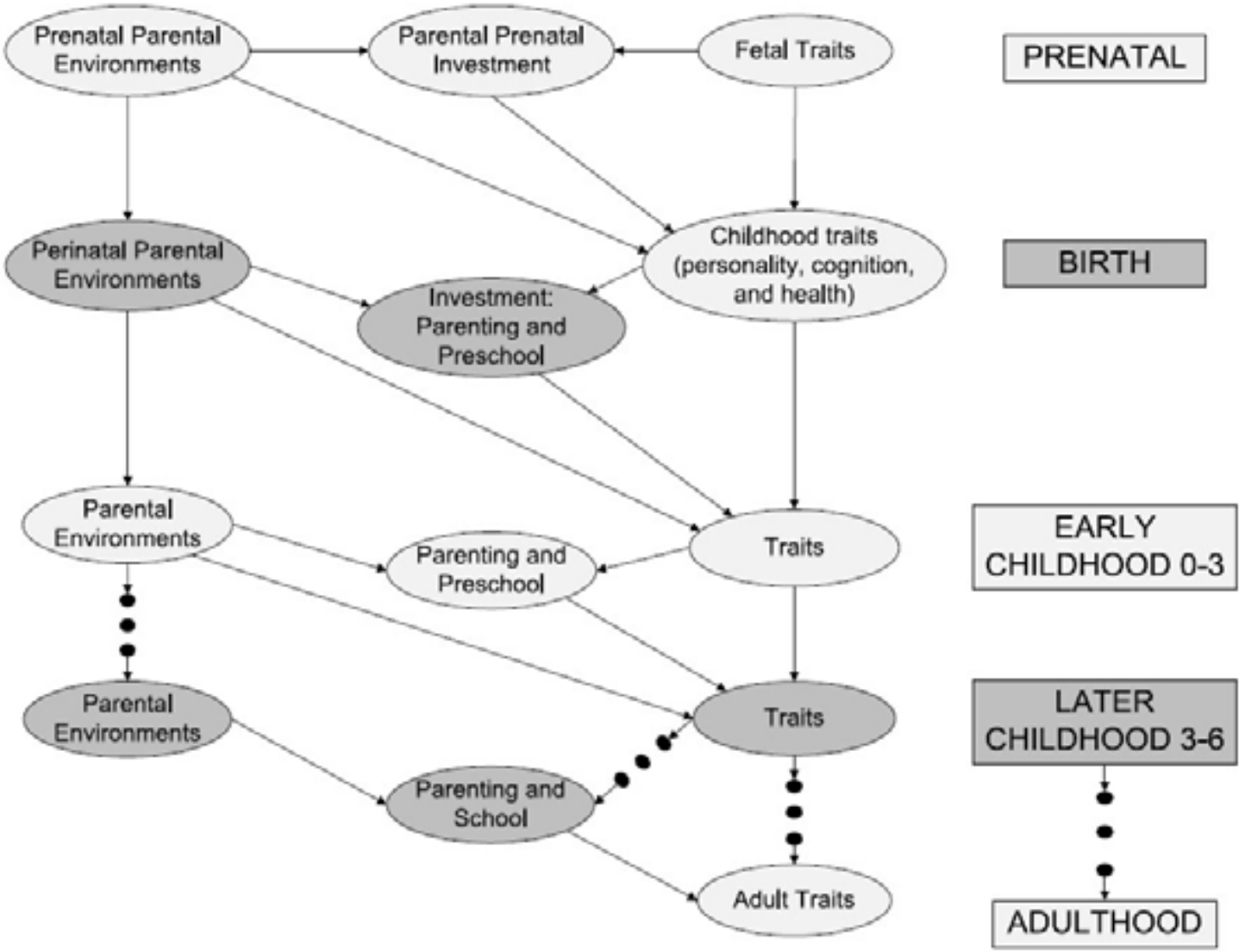


Source: Heckman (2008).

Prevention, not Remediation

3. What are the new research opportunities for the future of your field?

A Life Cycle Framework for Organizing Studies and Integrating Evidence: The Technology of Life Cycle Capability Formation



- Creating deeper causal understandings of the linkages of the human development process.
- Go beyond lists of treatment effects to understand causal mechanisms.
- Understanding development, resilience, and the effectiveness of remediation.
- Understanding the linkages between external interventions and family life.

- Create an economics rooted in biology and psychology that draws from and contributes to biology and psychology.
- Synthesizing experimental and observational data through a biologically and psychologically based framework of human development.
- Prioritize spending on social policy guided by hard empirical analyses of effective interventions.