



Hillfield Strathallan College

Hamilton, Ont.

Human Development in the 21st Century

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The Founders' Network

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Early human development
(neurobiological pathways)
affects the later stages:

Health (physical and mental)

Behaviour

Literacy and cognition

The quality of populations and societies will influence how well we will cope with the major changes of this century and build pluralistic prosperous democratic societies.

Basic Changes – 21st Century:

1. Population growth and pluralistic societies
2. Aging and developed countries
3. Population migration & social and economic conflicts
4. Environment changes –
 - Climate
 - Water
 - Food

All forms of life are
affected by these
changes.

Schools like Hillfield
Strathallan have a key
role with families and
their children preparing
adults for the 21st
century.

Your Brain Learning and Applications Institute is a very important objective in preparing students for the 21st century.



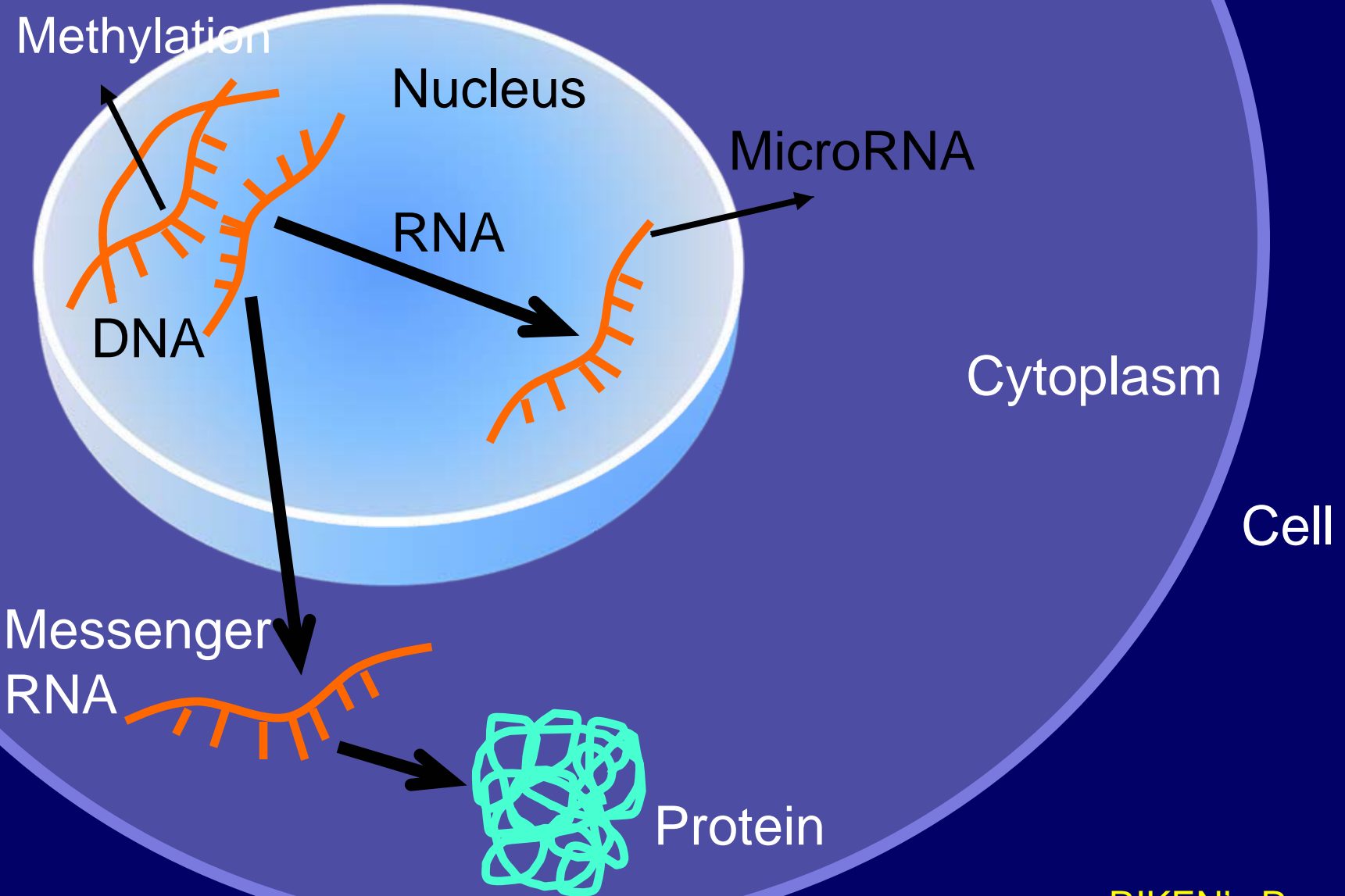
Experience-Based Brain and biological pathway development in the early years of life sets neurological and biological pathways that affect throughout life:

- Health (physical & mental)
- Learning (literacy)
- Behaviour

Brain Development

1. 100 billion neurons (conception to 6 months after birth).
2. How do neurons (with the same genes) differentiate?
3. Now do neurons form synapses (trillions)?

Genetics and Epigenetics



Epigenetics

Epigenetics is the molecular and cellular mechanisms activated by stimulation governing the function of genes.

- DNA methylation
- Chromatin structure
- Non coding RNA (microRNA)

Brain and Human Development

Nature

Nurture

Genes → Epigenetics ← Stimulation and Nutrition

Gene Function

Neurobiological

Pathways

Physical
Health

Mental
Health

Behaviour

Learning



What is stimulation?

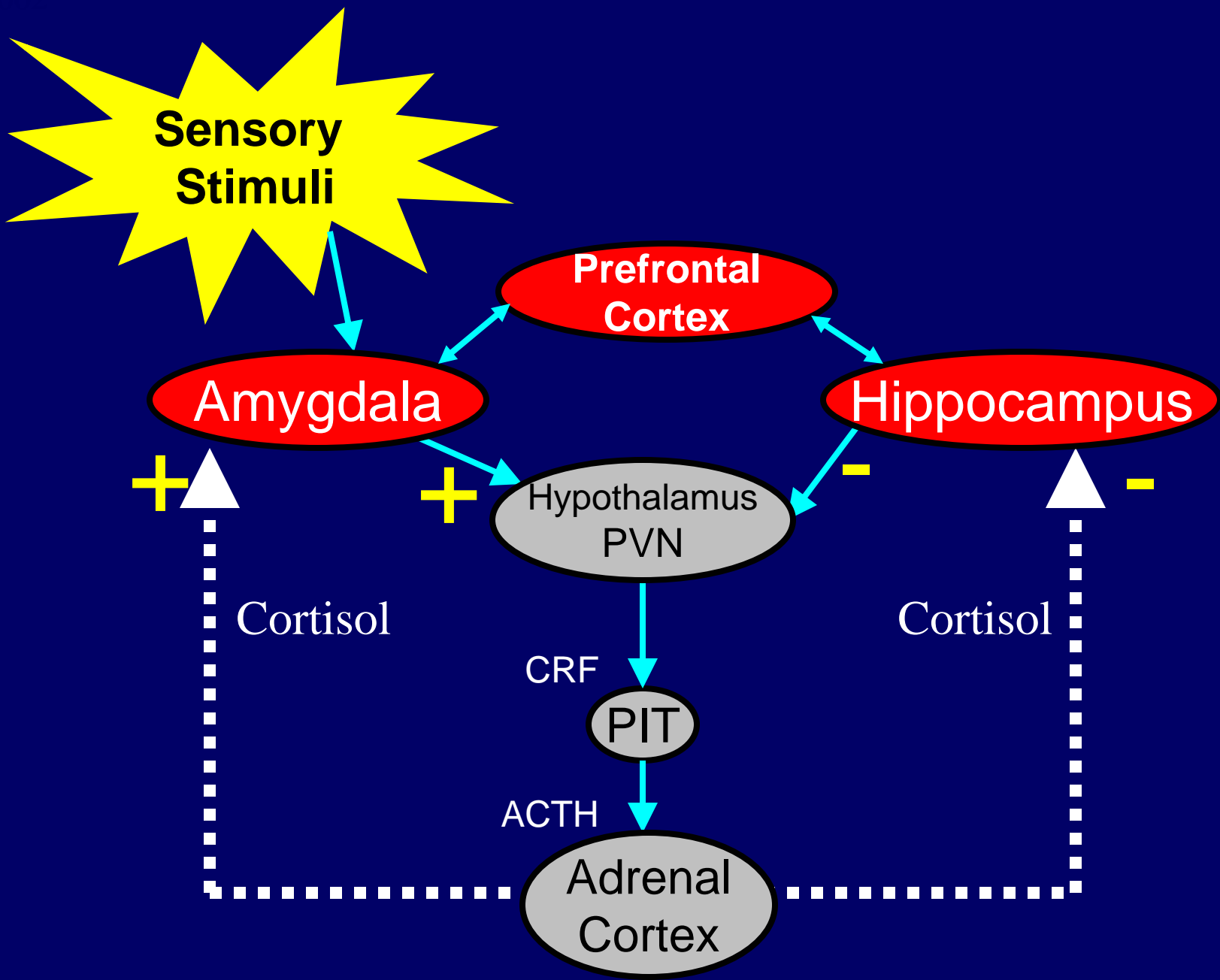
The stimuli that you encounter both pre- and post-natally as well as in later stages...

Examples: sound, touch, vision, smell, food, thoughts, drugs, injury, disease etc.

Stimulation of the neurons in the brain through sensing pathways sets their functions through epigenetics.

The Stress Pathway

- **Health (physical and mental)**
- **Behaviour**
and
- **Epigenetics**



Individual differences in stress reactivity of the adult are determined by maternal behaviour during infancy

HIGH LG

LOW LG

**Development of
Stress Reactivity**

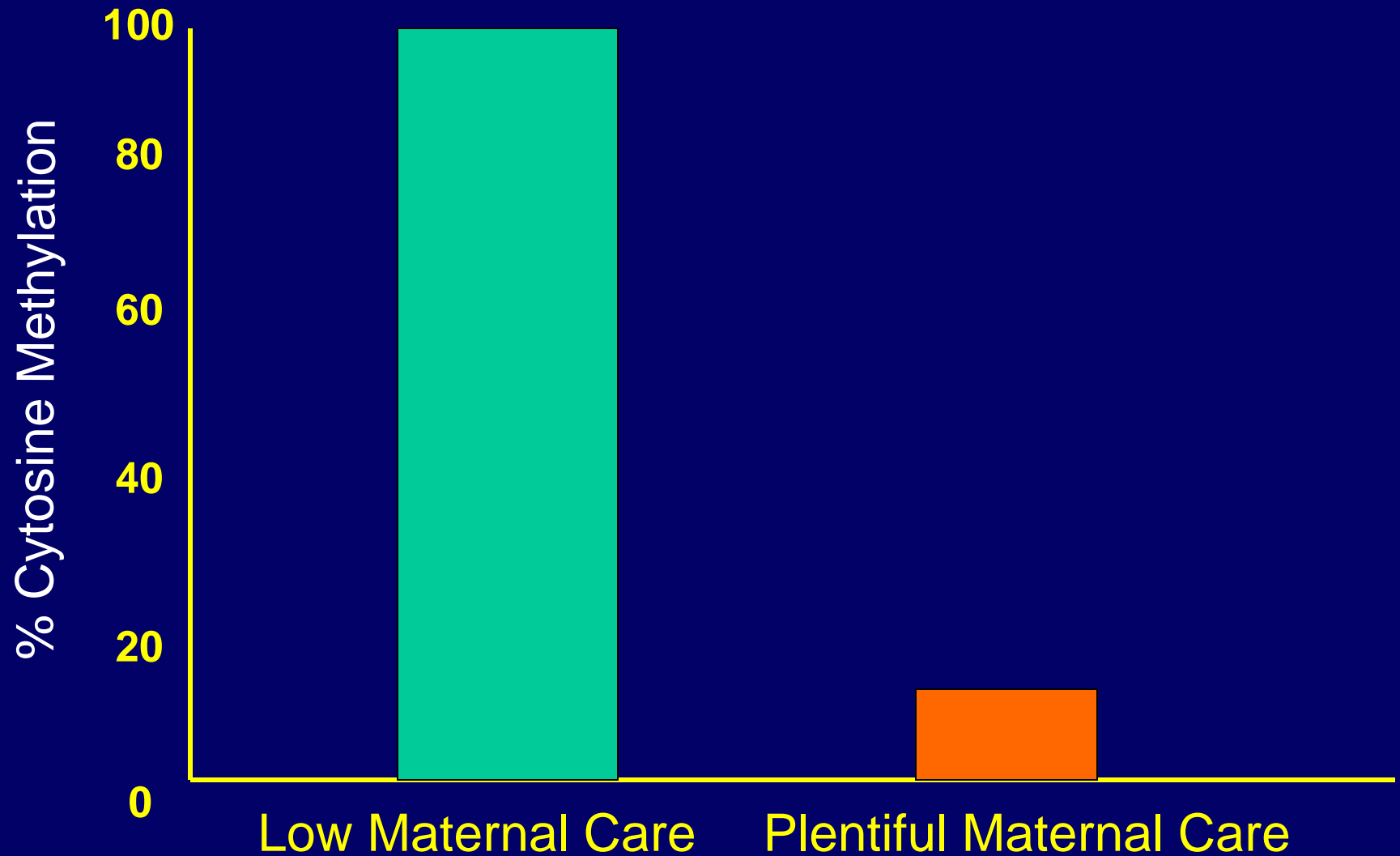
**Modest Stress
Reactivity**

Reduced Risk
for Disease

**Increased Stress
Reactivity**

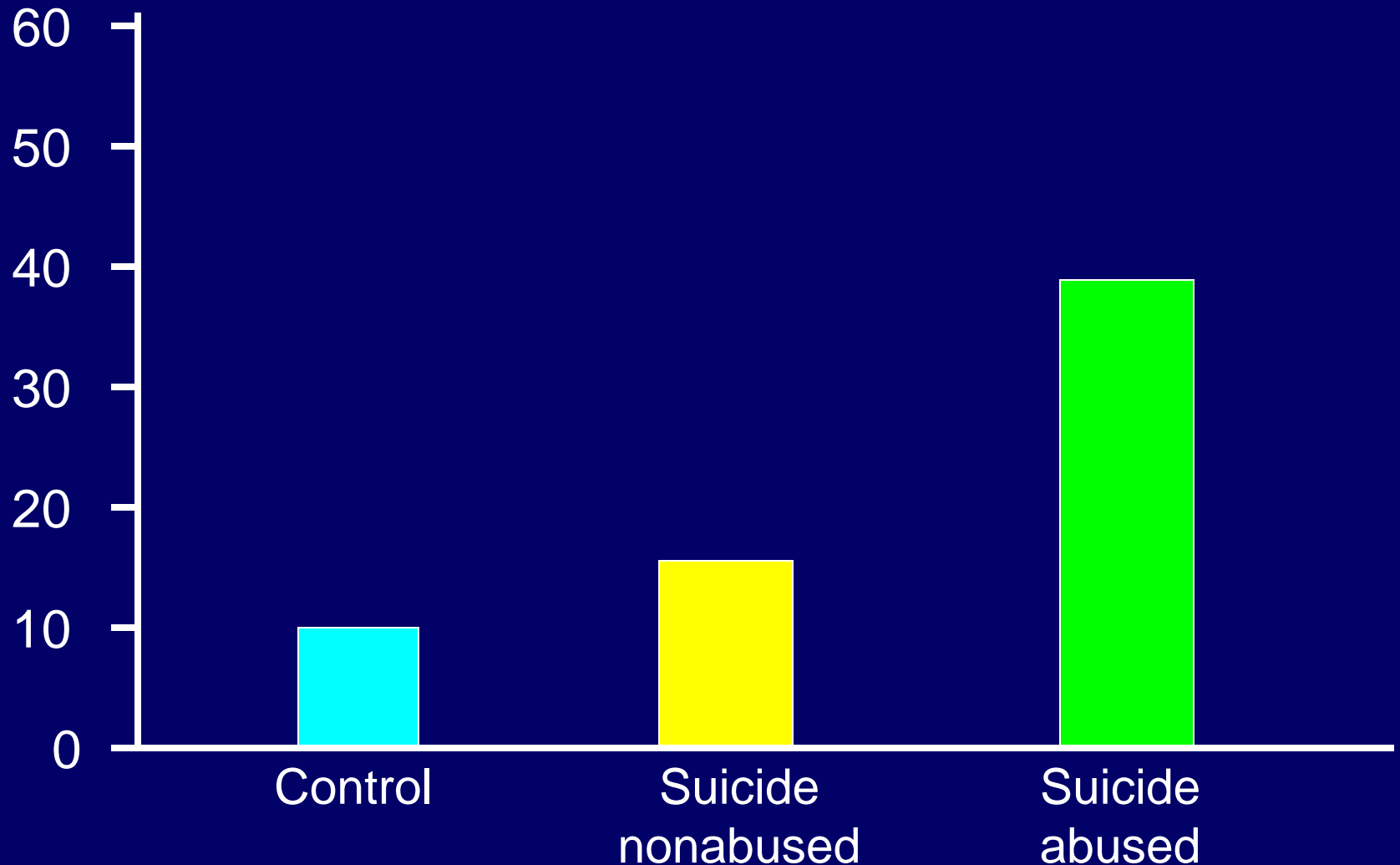
Increased Risk for Heart
Disease, Type II Diabetes,
Alcoholism, Affective
Disorders, Brain Aging, etc.

Methylation of GR Gene and Behaviour - Rats



Suicide and Methylation (Hippocampus)

Methylated clones (%)



5-HTT Gene and Depression

Age 26

Depression

Risk

Length of normal gene

S = Short Allele

L = Long Allele

SS

SL

LL

.70

.50

.30

No Abuse

Moderate Abuse

Severe Abuse

Early Childhood

A. Caspi, Science, 18 July 2003, Vol 301.



Kaiser Permanente – ACE Study

(Adverse Early Childhood Experience)

- Ischemic heart disease
- Blood pressure
- Obesity
- Drug and alcohol addiction
- Depression
- Suicide

Mental Disorders

- Monozygotic Twins

For many mental disorders, monozygotic twins (same genotype) who are reared in the same family are discordant (different phenotype) as adults in 20% to 30% of the cases – epigenetic effect.

Stress Pathway and Health

Cortisol – Over Production

Behaviour, depression, type II diabetes, cardiovascular disease, memory, immune system function, drug and alcohol addiction

Cortisol – Under Production

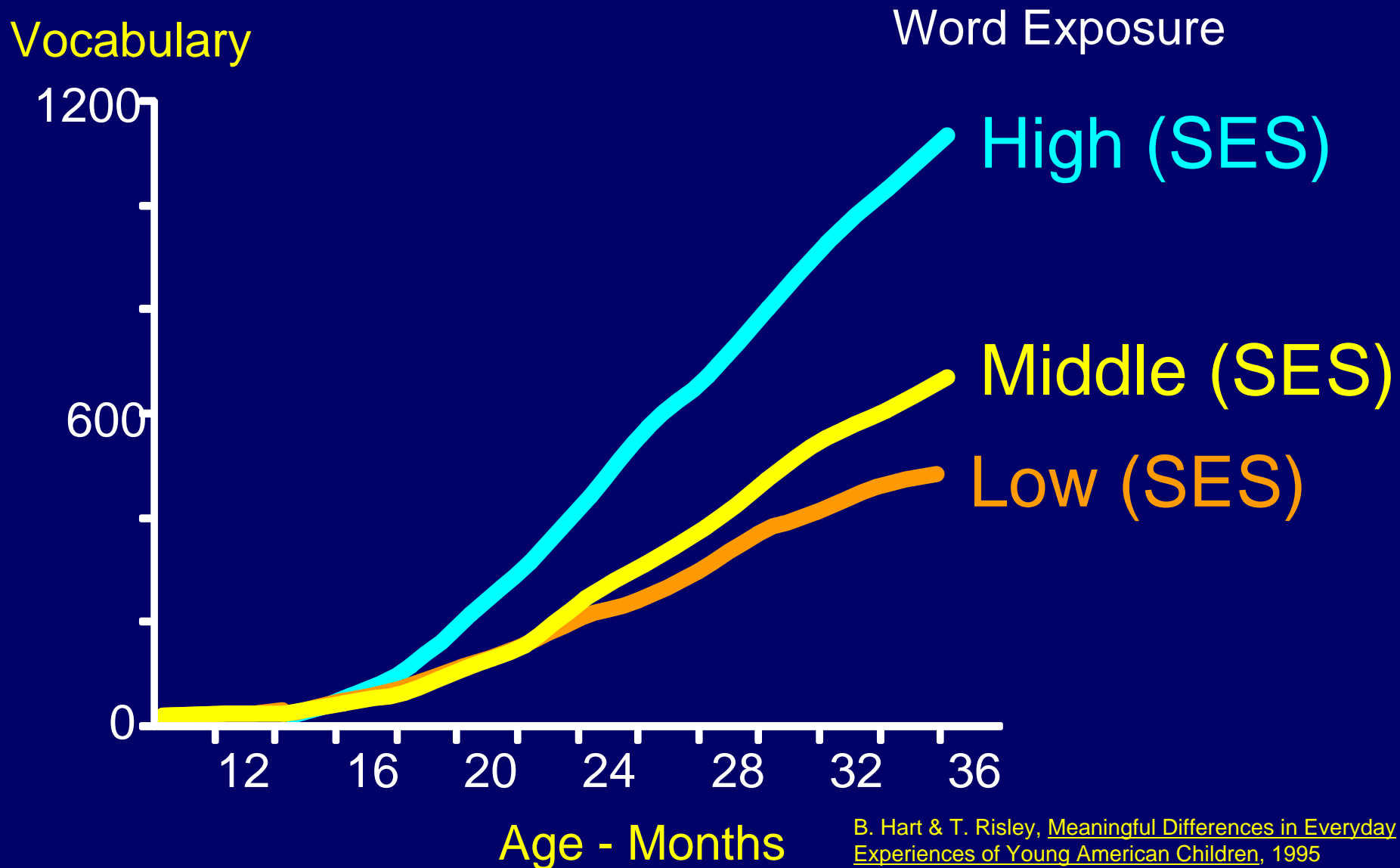
Chronic fatigue syndrome, fibromyalgia, immune system (autoimmune disorders) rheumatoid arthritis, allergies, asthma

Early Human Development
and
Literacy

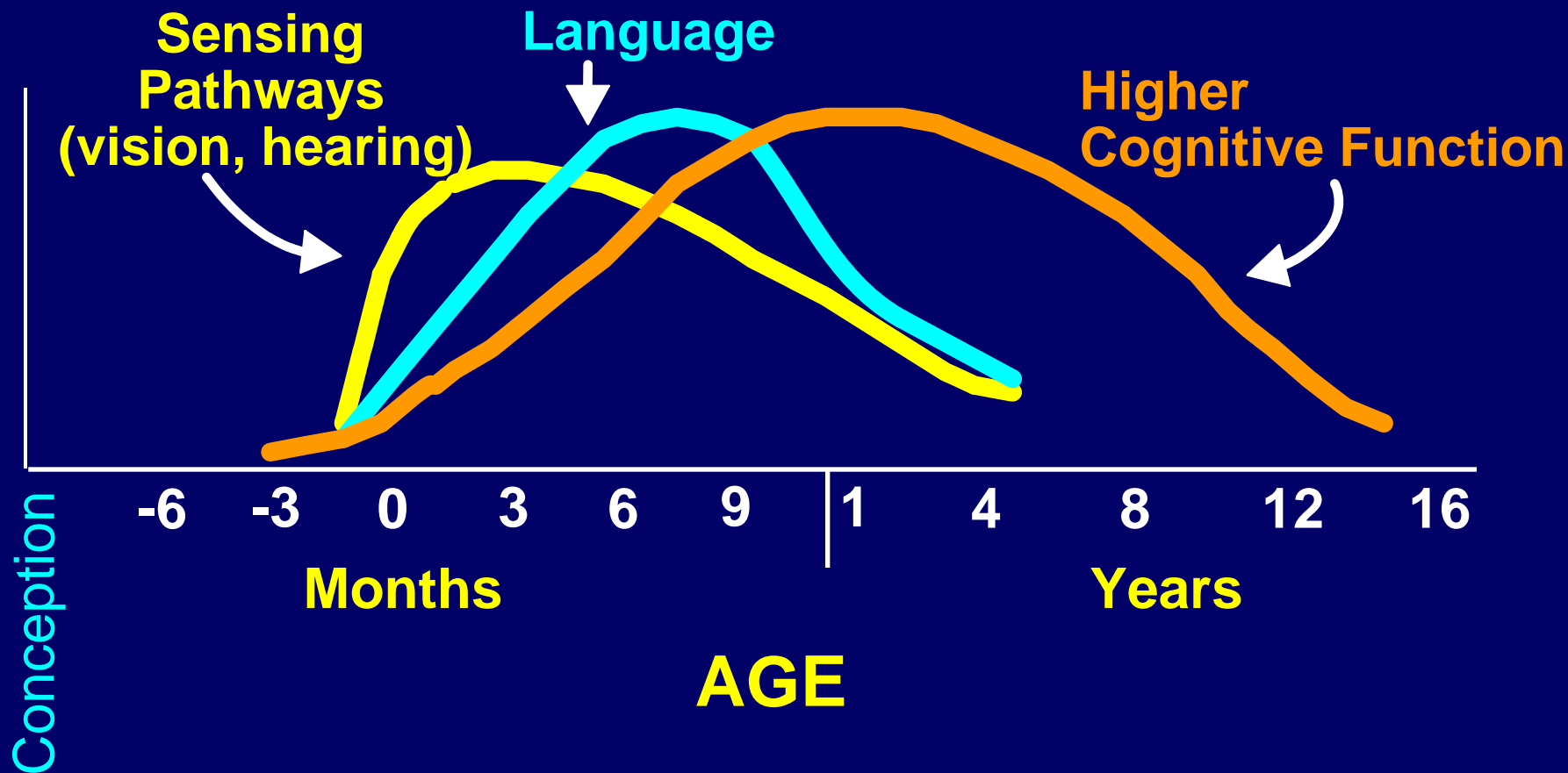
Early Child Development and Language

- Starts early – first 7 months – neurons differentiate language sounds (e.g. English, Japanese)
- Sets capability for mastering multiple languages
- Sets literacy and language learning trajectory for the second and third stages of development

Vocabulary Growth – First 3 Years



Human Brain Development – Language and Cognition



Early Development Instrument (EDI)

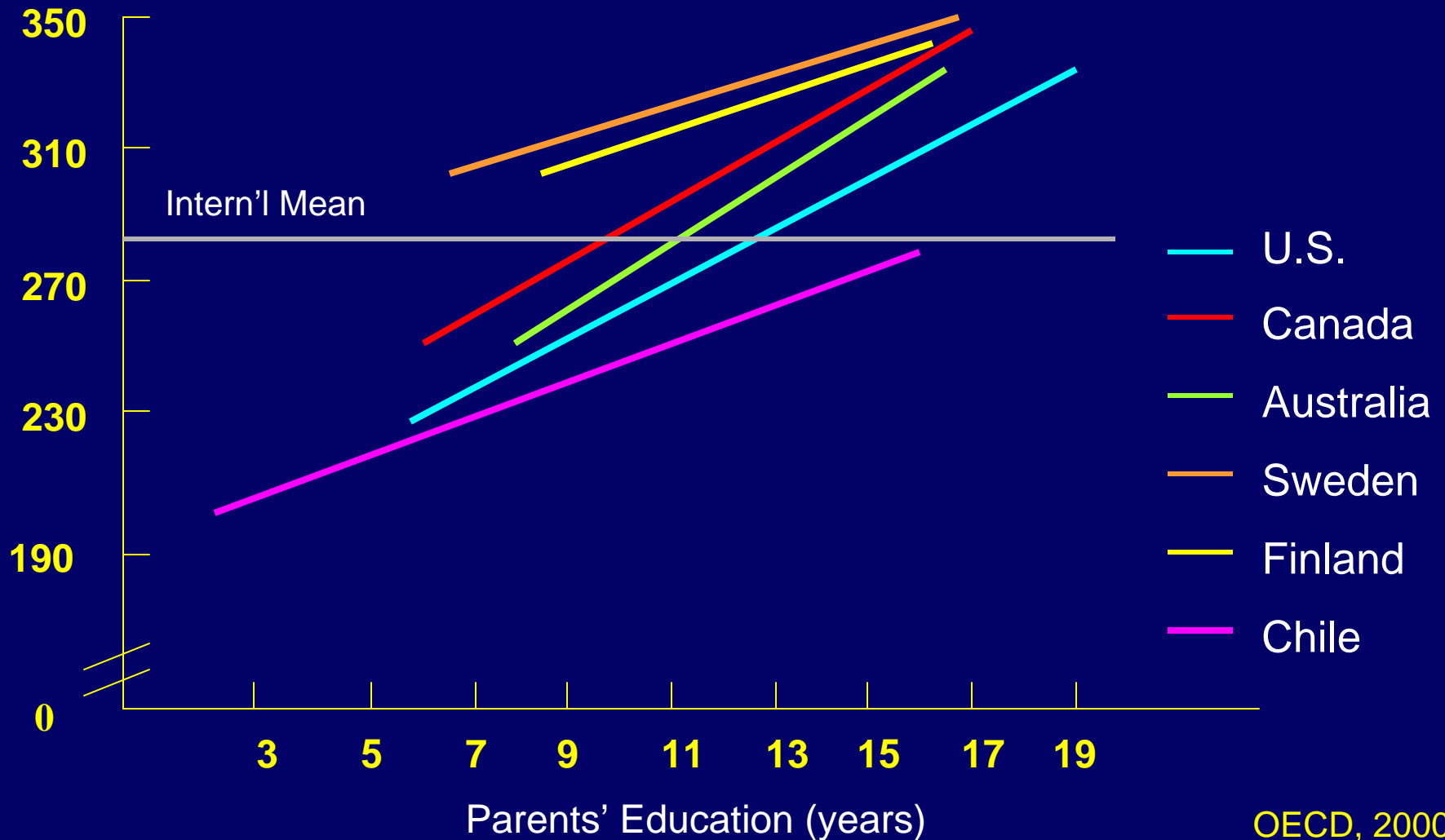
- Physical health and well-being
- Social knowledge and competence
- Emotional health/maturity
- Language and cognitive development
- Communication skills and general knowledge

Vancouver EDI (kindergarten) and Reading – Grade 4

# of Vulnerabilities	% Failing Grade 4 Test	% Not Passing Grade 4
0	13.6	17.8
1	26.7	33.9
2-3	29.5	43.1
4-5	48.4	68.3

Socioeconomic Gradients for Adult Document Literacy Scores (16 to 65)

Mean Scores

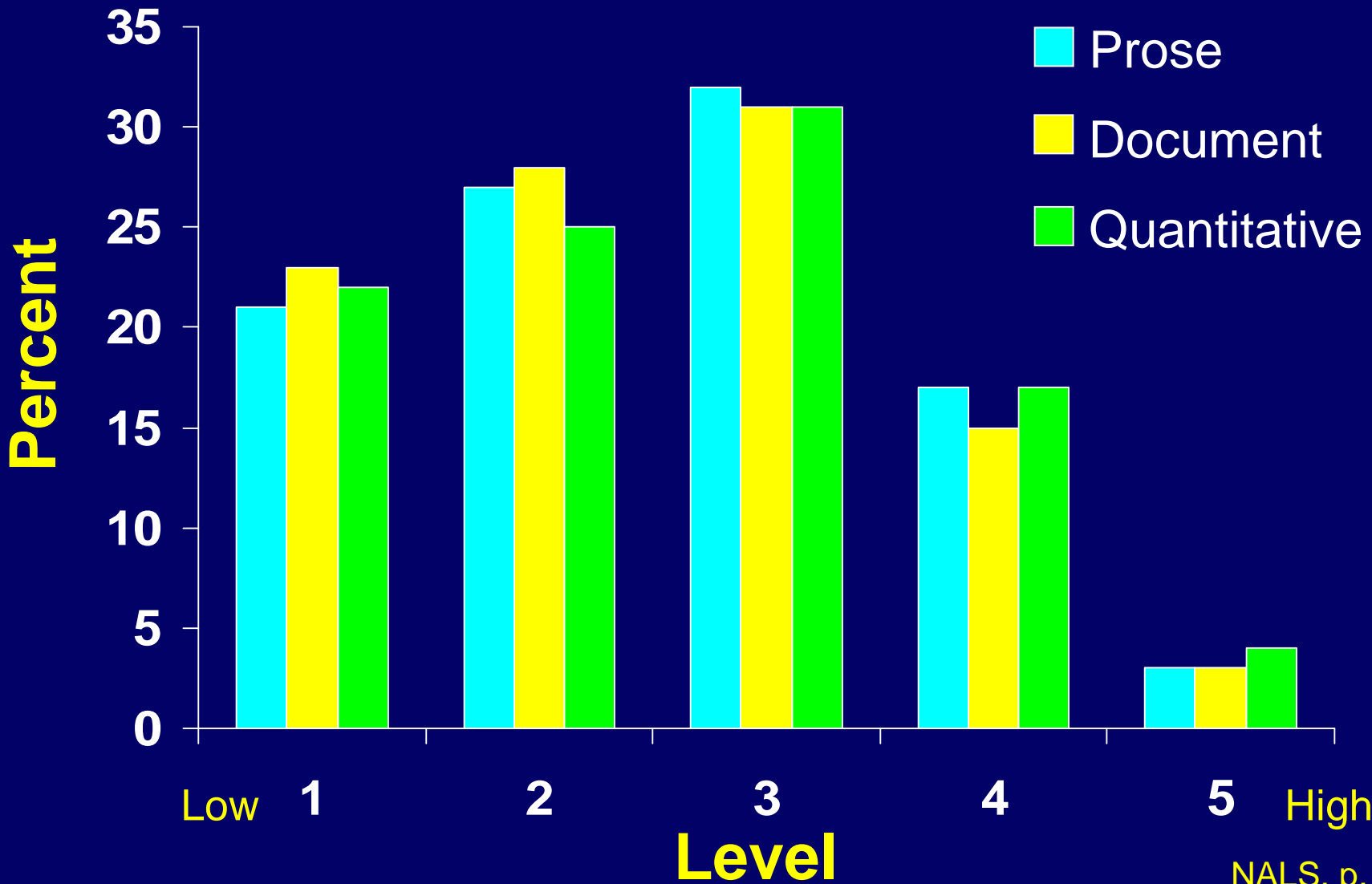


Document Literacy

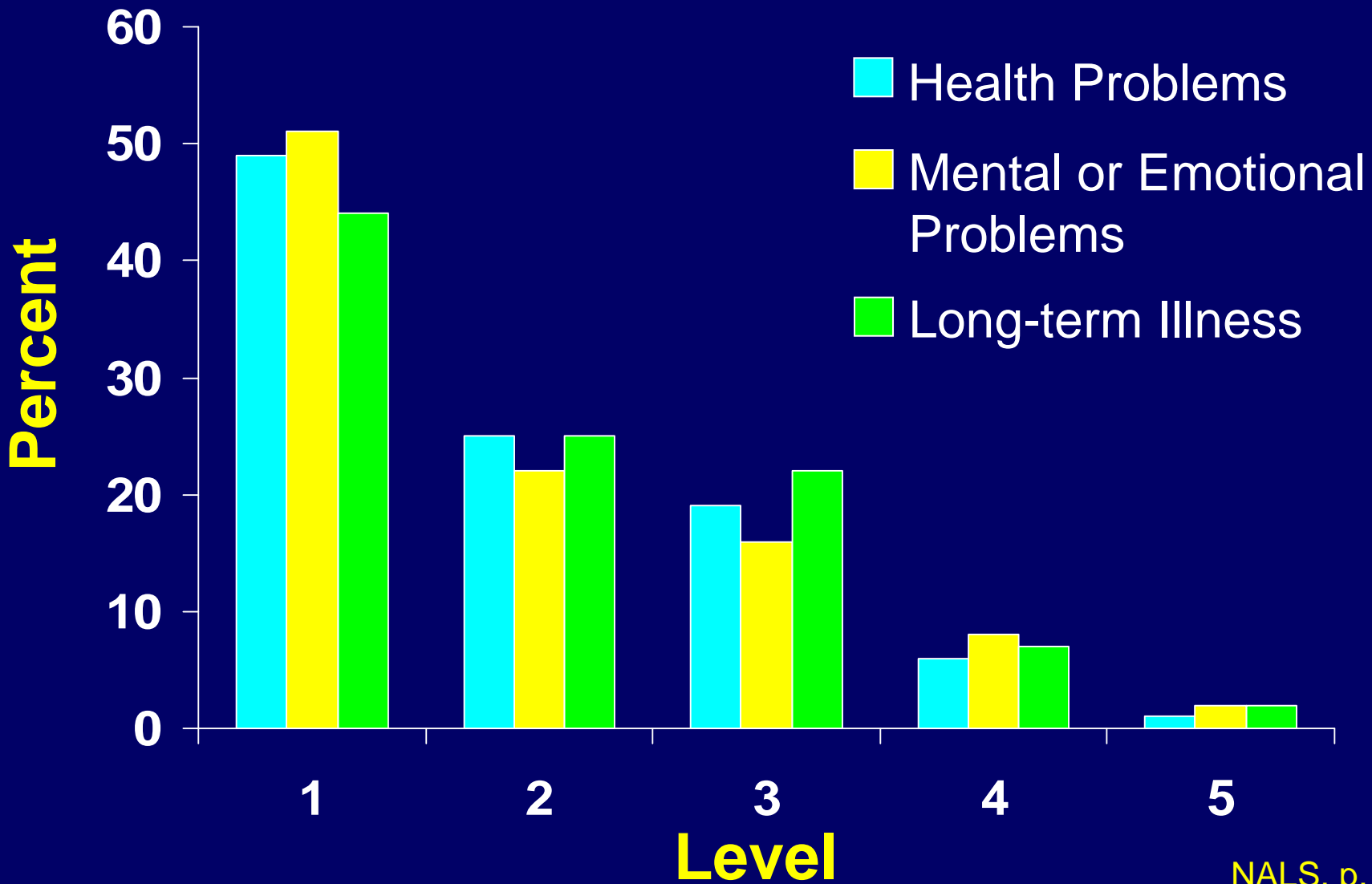
1994 – 1998, Ages 16 to 65

	Level 1 and 2 (low)	Level 4 and 5 (high)
Sweden	23%	34.0%
Canada	42%	23.0%
Australia	43%	17.0%
United States	48%	18.0%
Chile	85%	3.0%
Mexico	84%	1.7%

Literacy Levels for the Population Ages 16 to 65 – USA

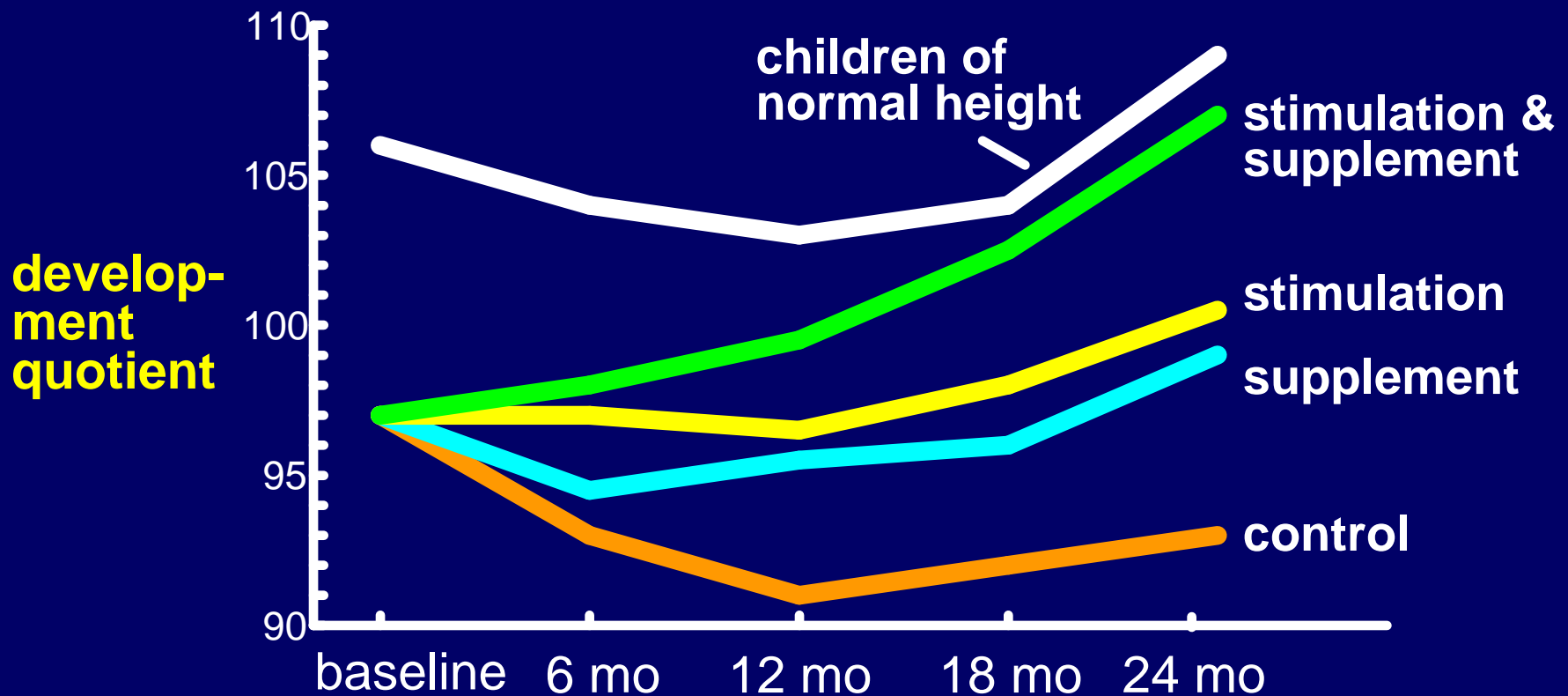


Literacy Levels (Quantitative) and Physical, Mental or Other Health Conditions – USA



Human Experiments

Mental Development of Undersized Children (Low Height for Age) : The Jamaican Study





A “Natural” Experiment: Romanian Orphan Adoption

Children adopted into middle class homes after 8 months in the orphanages show at 11 years in contrast to children adopted early:

1. Abnormal brain development (small brain, low metabolic activity, abnormal EEG)
2. Social and cognitive problems (IQ loss)
3. High vulnerability to behavioural problems (ADHD, aggression, quasi-autism)

Bucharest Early Intervention Project

Foster parent care vs orphanage care

The children who were youngest when placed in foster parent care are approaching normal development, a recovery that sadly does not seem to be occurring in children first placed in foster care after the age of 2.

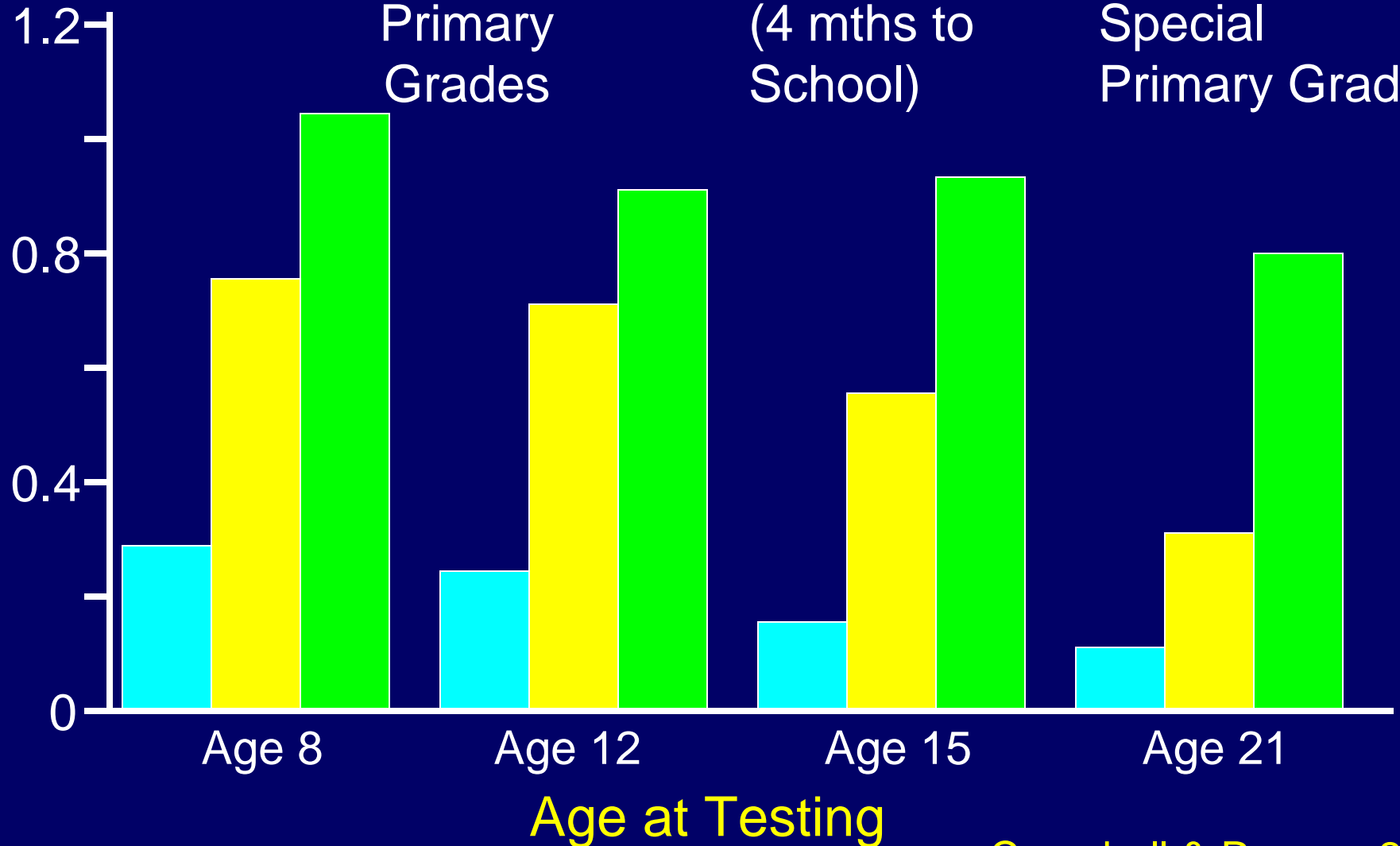
Abecedarian Study – Reading

Effect Size

Special
Primary
Grades

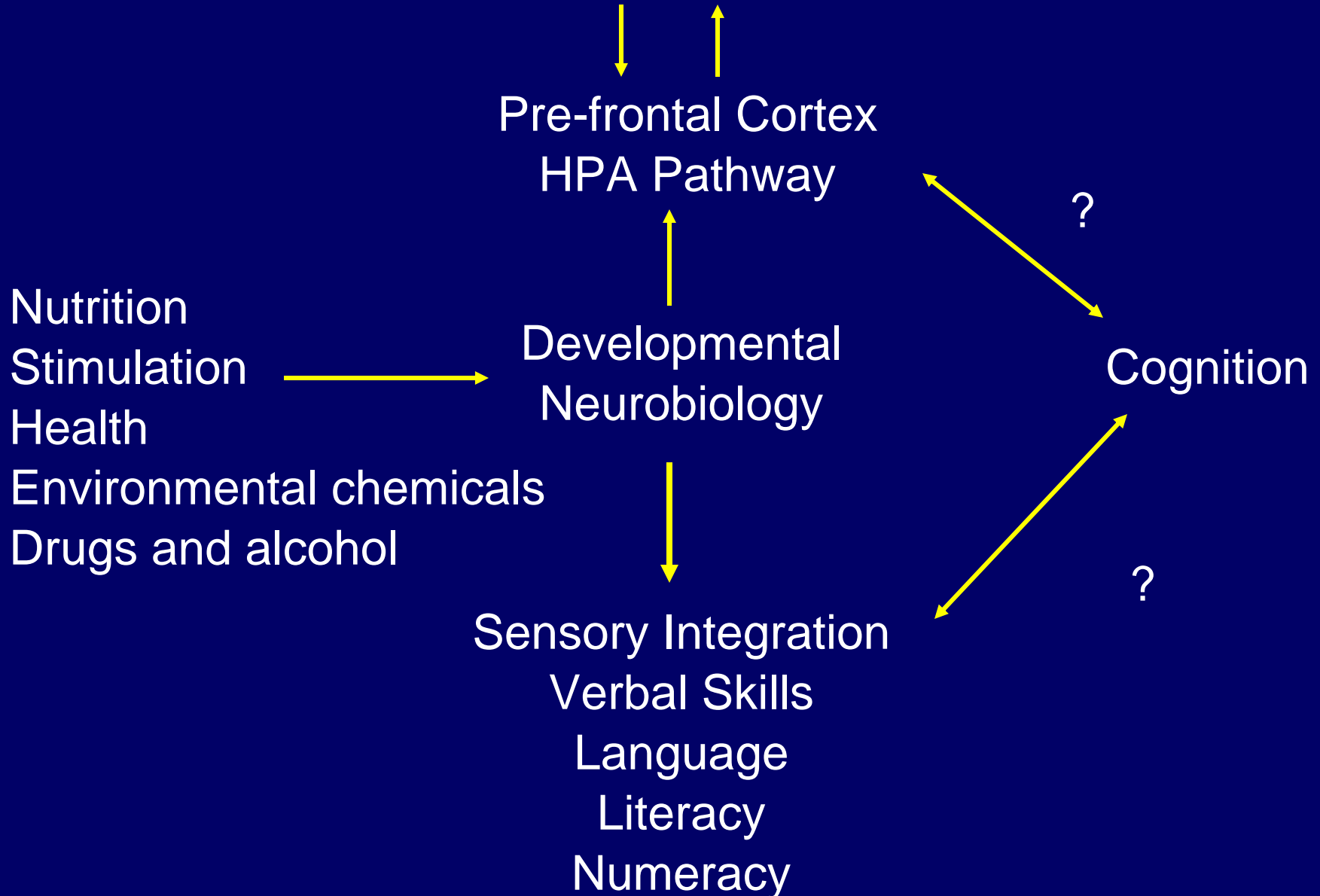
Preschool
(4 mths to
School)

Preschool &
Special
Primary Grades



Literacy and Behaviour

Behaviour – Physical & Mental Health



Population Studies

Scandinavia and Canada

Child Poverty Adult Literacy (16-25)

%

Level 4&5

Finland

2.8

Norway

3.4

36%

Sweden

4.2

34%

Canada

15.0

23%

Sweden Education Expenditure

	Cost/Student	Enrollment
Preschool* (1-6)	\$16,500	80 – 95%
Compulsory School (7-16)	\$10,500	Compulsory

* Maternal and parental paid leave 480 days

Scandinavia

	0-6 %GDP	Parental Leave (months)	Govt. Ministry
Finland	1.7	12	Social Affairs and Health
Norway	1.7	12	Education
Sweden	1.9	16	Education
Canada	0.4	12	Fragmented



Cost to Individuals and Canadian Society of Poor Early Child Development (estimates)

Crime and Violence \$120 Billion/year

Mental Health \$100 Billion/year
Behaviour and
Alcohol and Drug Addiction

Cost of universal high quality ECD program – about \$22 billion per year (1.5% of GDP)

Political Problems

- 20 – 30 years before change in adult population
- However, changes in behaviour and school performance ages 4 and on.

Cuba

- Developed in the 1970s an integrated structure for healthy early human development – the polyclinics and family medicine
- 1994 – started Educate Your Child
- In terms of health and learning, Cuba is outstanding

Community Polyclinics

Pregnancy to Age 6

**Services provided by
Community Polyclinics**



Developmental Health
(pre and post natal)

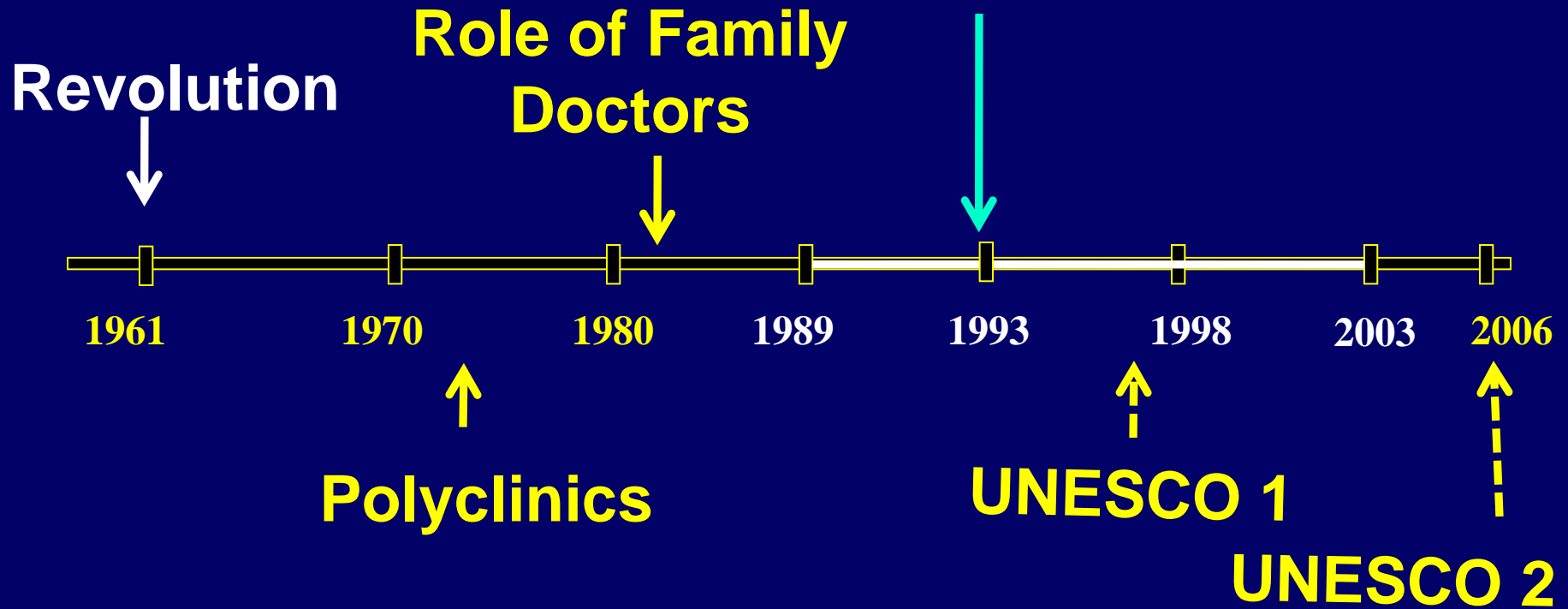
Nutritional support

Child (Care) Stimulation
(Puericultura)

Weekly Home Visits

Early Human Development in Cuba

Educate Your Child



Health Data

Cuba

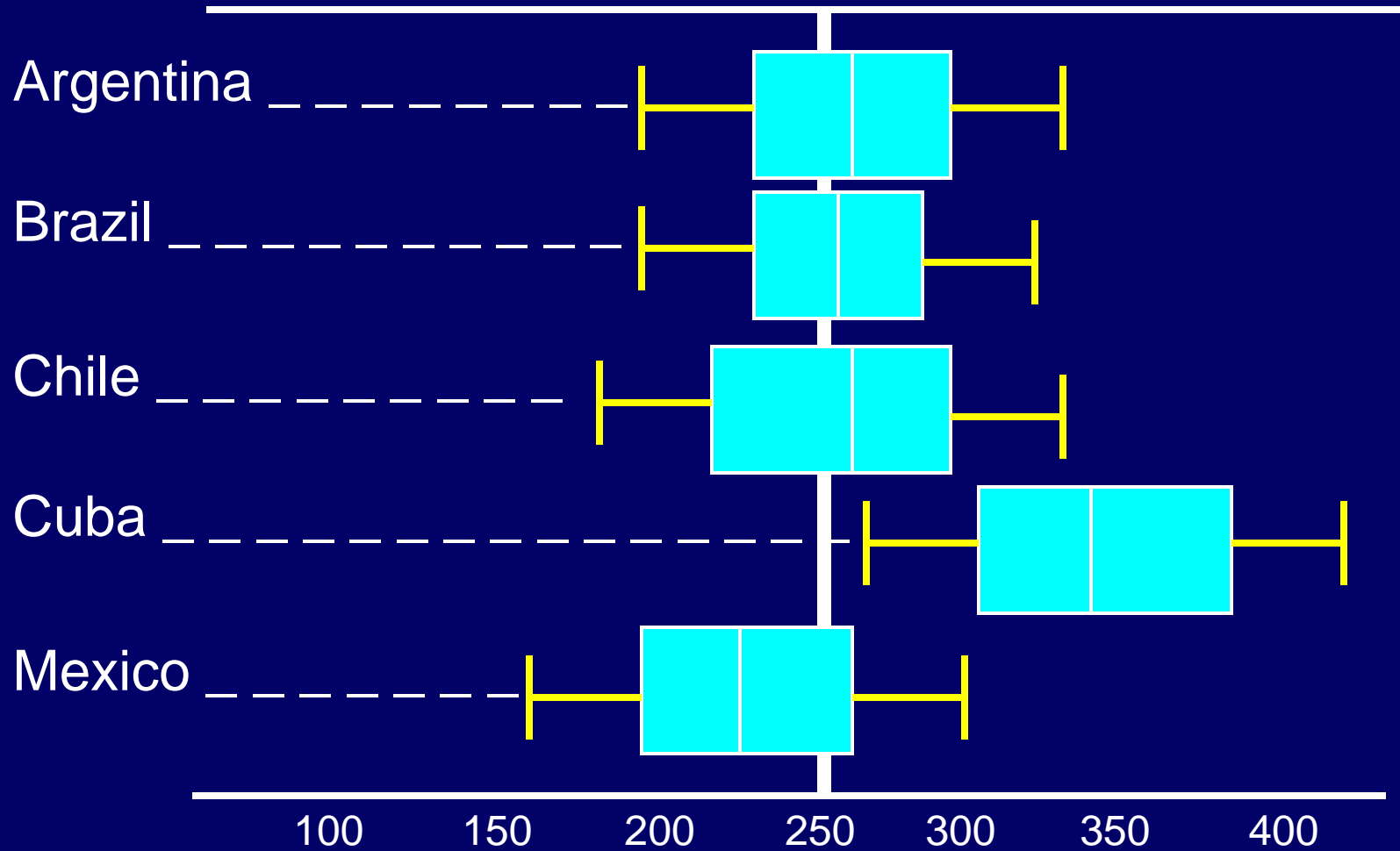
UNESCO Under 5 Mortality Rate per 1000, by decade

	1970	1990	2010
Argentina	72.6	28.0	12.9
Brazil	120.8	52.0	19.9
Chile	92.1	18.2	6.5
Cuba	38.9	13.9	5.2
Mexico	107.5	41.9	16.6

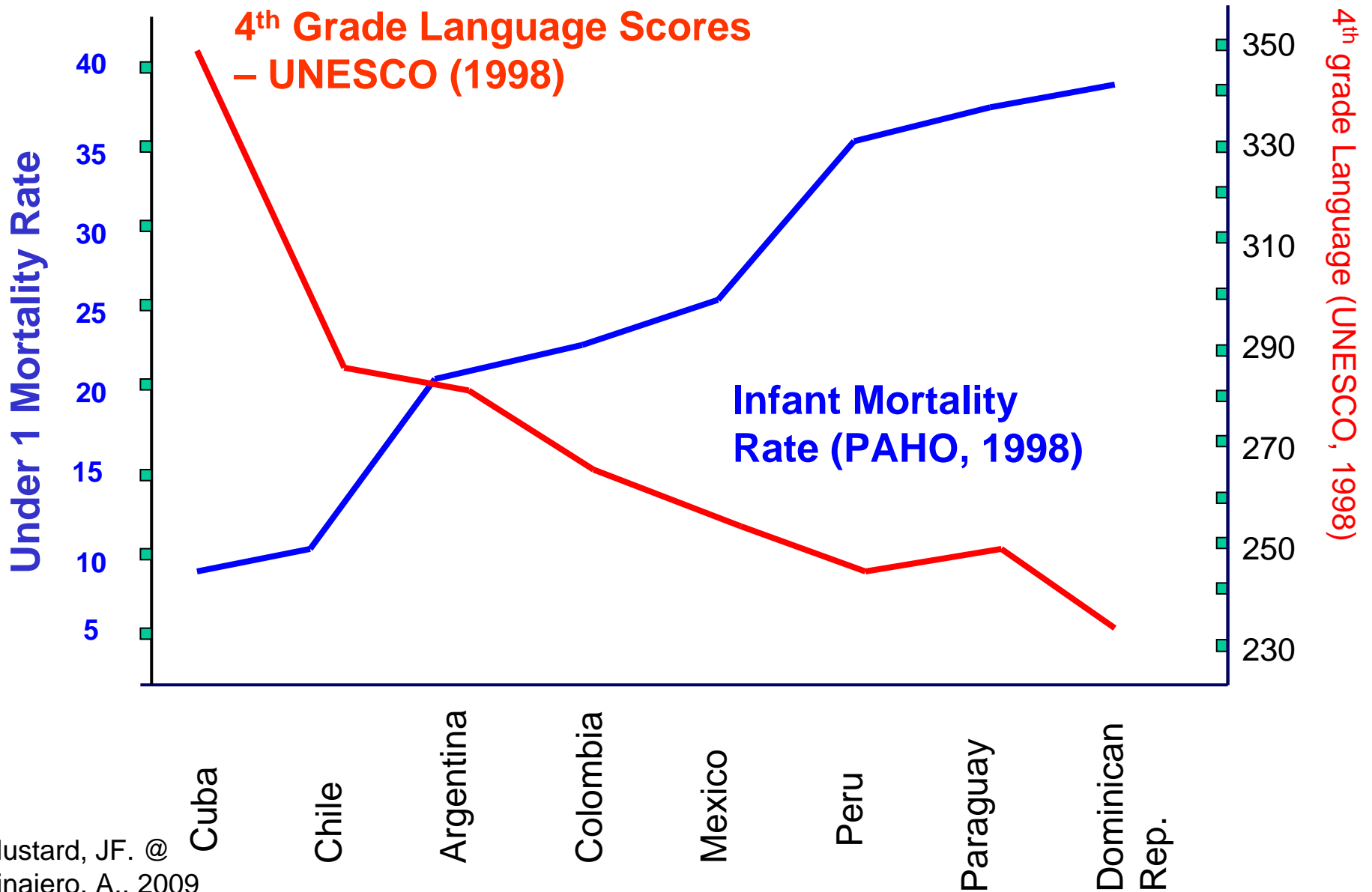
UNESCO Postneonatal Mortality Rate per 1000, comparison of 1990 and 2010

	1990	2010
Argentina	10.5	3.8
Brazil	23.8	8.2
Chile	7.6	2.1
Cuba	4.6	1.7
Mexico	21.2	8.2

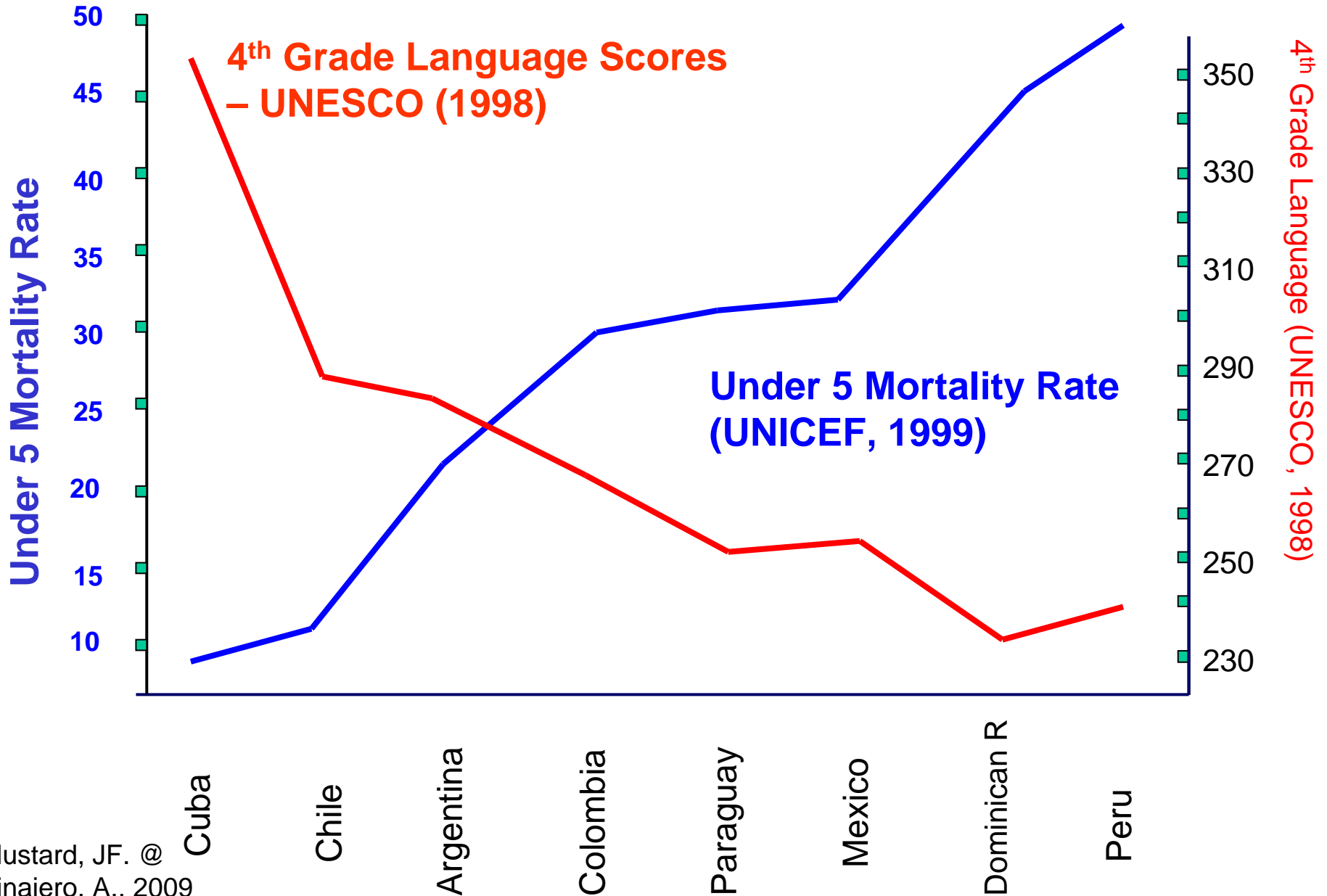
Grade 3 Language Scores



Health and Language Scores



Health and Language Scores



Success by Ten

Early Child Development

- Intervene early
- Intervene often
- Intervene effectively

Policies to Foster Human Capital

"We cannot afford to postpone investing in children until they become adults nor can we wait until they reach school - a time when it may be too late to intervene."

Heckman, J., 2001
(Nobel Prize Economics, 2000)

Early Child Development and Parenting Centres

- Available from pregnancy to school entry
- Provide support for parents (centres and home visits)
- Learning parenting by doing
- Provide non-parental care
- Nutrition and stimulation
- Stage 1 of human development (conception to age 6)

Creating ECD Infrastructure

- Centres as part of primary schools.
- Training staff in developmental neurobiology and developmental health and learning.
- Establish leaders (principals for integrated ECD programs and primary schools).
- Pay equity.
- Paternal paid leave.
- Publicly financed.



Chapter 5 – WHO Marmot Commission

Equity From the Start

Science of Early Child Development

“The science of ECD shows that brain development is highly sensitive to external influences in early childhood starting in utero with life long effects.”

WHO, 2008

WHO – Marmot Commission on Social Determinants of Health

Chapter 5 – Equity from the Start

Recommendation 5.1:

WHO and UN Children's Fund (UNICEF) set up an interagency mechanism to ensure policy coherence for early child development such that, across agencies, a comprehensive approach to early child development is acted on.

WHO, 2008

Recommendation 5.2

The Commission recommends that:

Governments build universal coverage of a comprehensive package of quality early child development programmes and services for children, mothers, and other caregivers, regardless of ability to pay.

With Our Best Future in Mind – Pascal report (Ontario)

Recommendation 1:

The province should create a continuum of early learning, child care, and family supports for children from the prenatal period through to adolescence, under the leadership of the Minister of Education.

With Our Best Future in Mind – Pascal report (Ontario)

Recommendation 2:

The Ministry of Education should establish an Early Years Division to develop and implement an Early Years Policy Framework that will create a continuity of early learning experiences for children from 0 to 8 years of age.

Hillfield Strathallan as a private school has the opportunity to be a private initiative to establish and integrate human development programs to improve the quality of the next generation of Canadians.

This investment in early human development is critical for Canada to have a pluralistic stable prosperous non-violent society in the 21st century and demonstrate to other societies what can be done.



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