



Advances in the Core Story of Child Development: ECD 2.0 Brings Together Relationships, Health and Community

Presented By:



TTAC

Perinatal and Early Childhood
Mental Health Network
Training and Technical Assistance Center

Who We Are

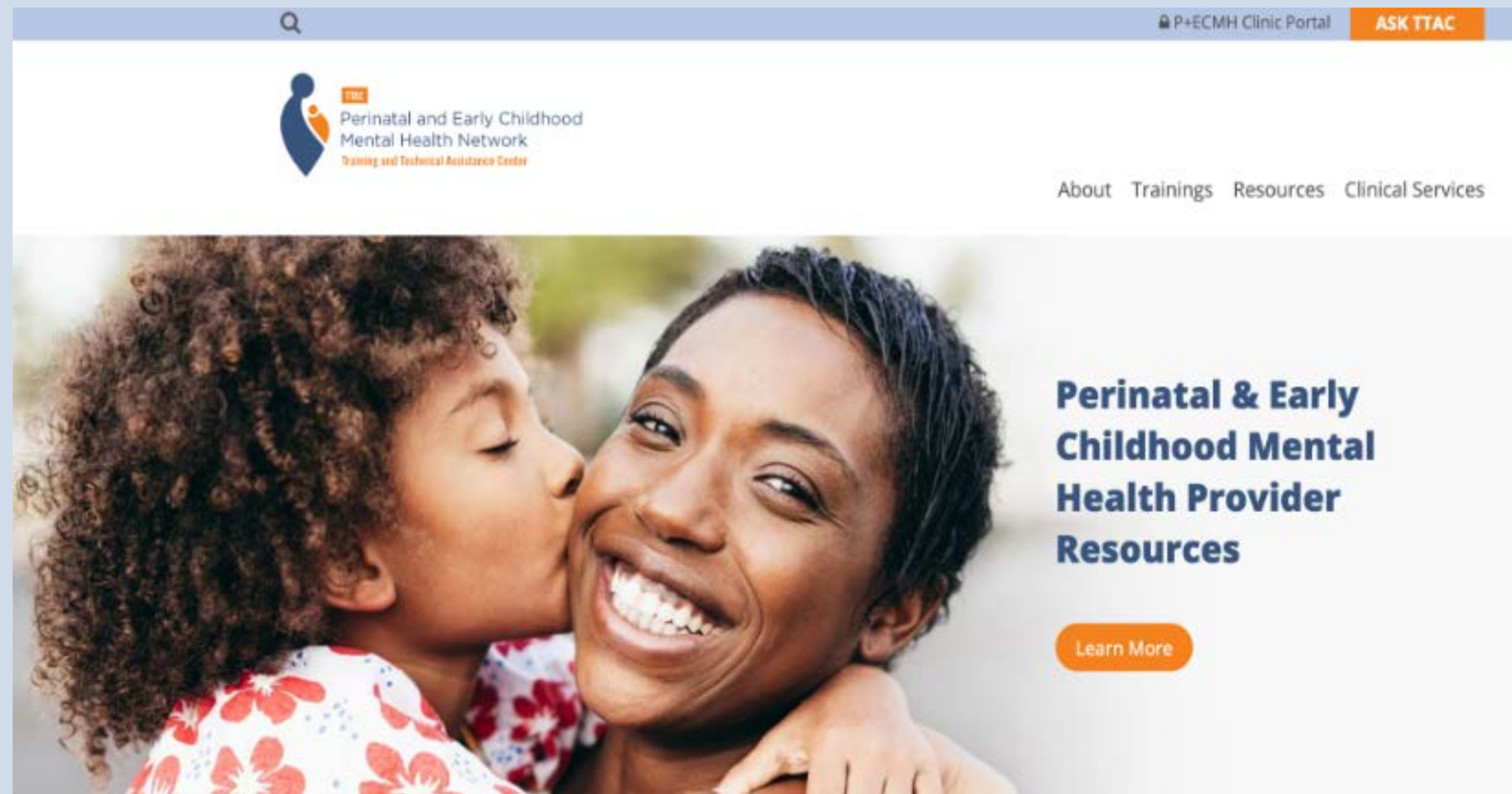
The New York City Perinatal and Early Childhood Mental Health Training and Technical Assistance Center (TTAC), is funded by the NYC Health Department.

TTAC is a partnership between the New York Center for Child Development (NYCCD) and the McSilver Institute for Poverty Policy and Research

- **New York Center for Child Development** has been a major provider of early childhood mental health services in New York with expertise in informing policy and supporting the field of Early Childhood Mental Health through training and direct practice
- **NYU McSilver Institute for Poverty Policy and Research** houses the Community and Managed Care Technical Assistance Centers (CTAC & MCTAC) and the Center for Workforce Excellence (CWE). These TA centers offer clinic, business, and system transformation supports statewide to all behavioral healthcare providers across NYS.

TTAC is tasked with building capacity and competencies of mental health professionals and early childhood professionals in family serving systems to identify and address the social-emotional needs of young children and their families.

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Advances in the Core Story of Child Development: ECD 2.0 Brings Together Relationships, Health and Community

PAT LEVITT, PH.D.

CHIEF SCIENTIFIC OFFICER, SENIOR VICE PRESIDENT AND DIRECTOR, THE SABAN
RESEARCH INSTITUTE

CHILDREN'S HOSPITAL LOS ANGELES

SIMMS/MANN CHAIR IN DEVELOPMENTAL NEUROGENETICS

WM KECK PROVOST PROFESSOR OF NEUROGENETICS

UNIVERSITY OF SOUTHERN CALIFORNIA

CO-SCIENTIFIC DIRECTOR, NATIONAL SCIENTIFIC COUNCIL FOR THE DEVELOPING CHILD

SENIOR FELLOW, CENTER ON THE DEVELOPING CHILD, HARVARD UNIVERSITY

plevitt@chla.usc.edu

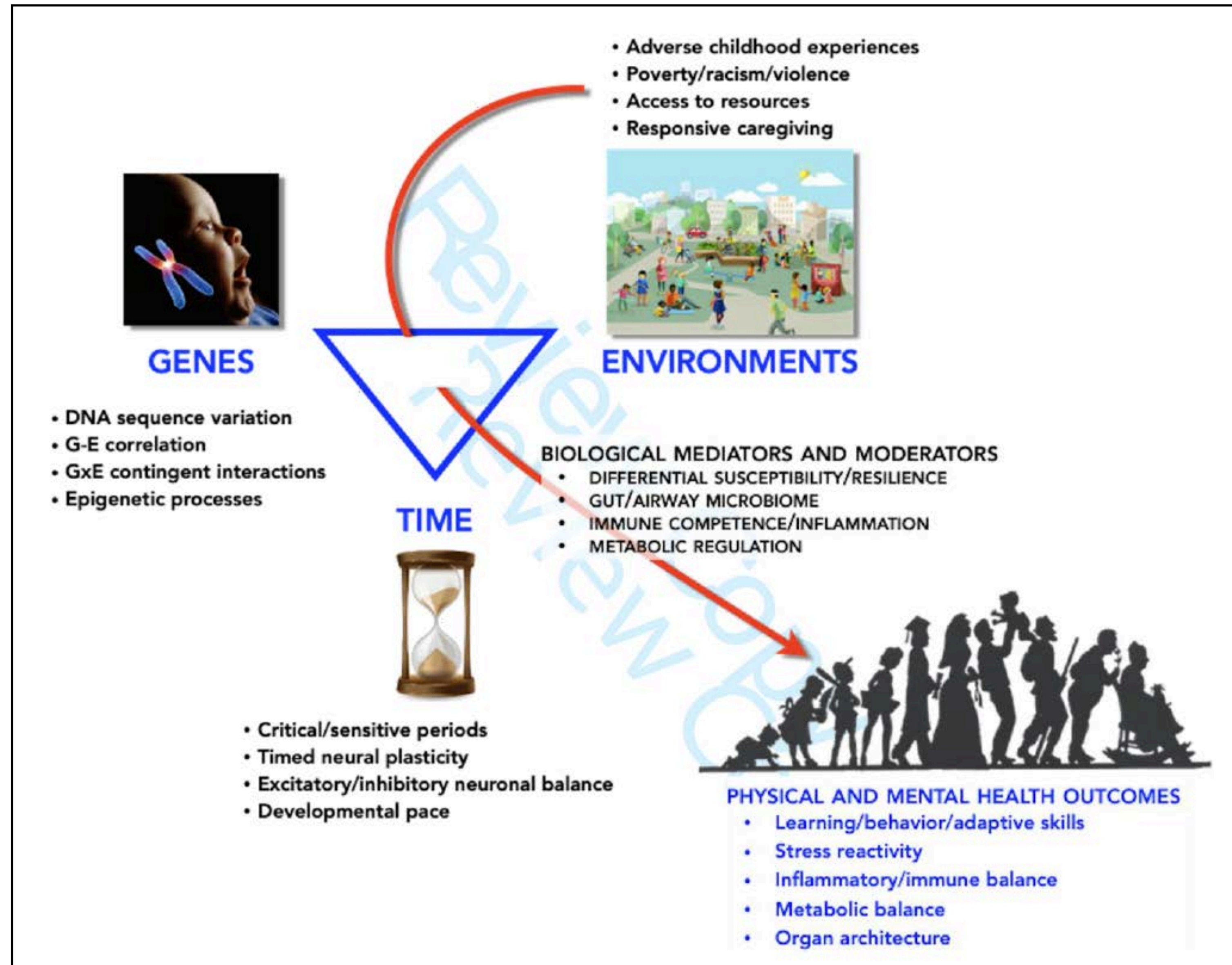
<https://www.chla.org/profile/pat-levitt-phd>

<https://firstplace.gse.harvard.edu/national-scientific-council/>

Today's Lecture

- Genes, environment and time as the key ingredients for healthy child development
- How does early experience impact health across the lifespan?
- The brain is attached to the rest of the body
- Targets for adaptation success
- Biological heterogeneity is good - but it makes things complicated

Genes X Environment X Time



“Tipping the Balance”

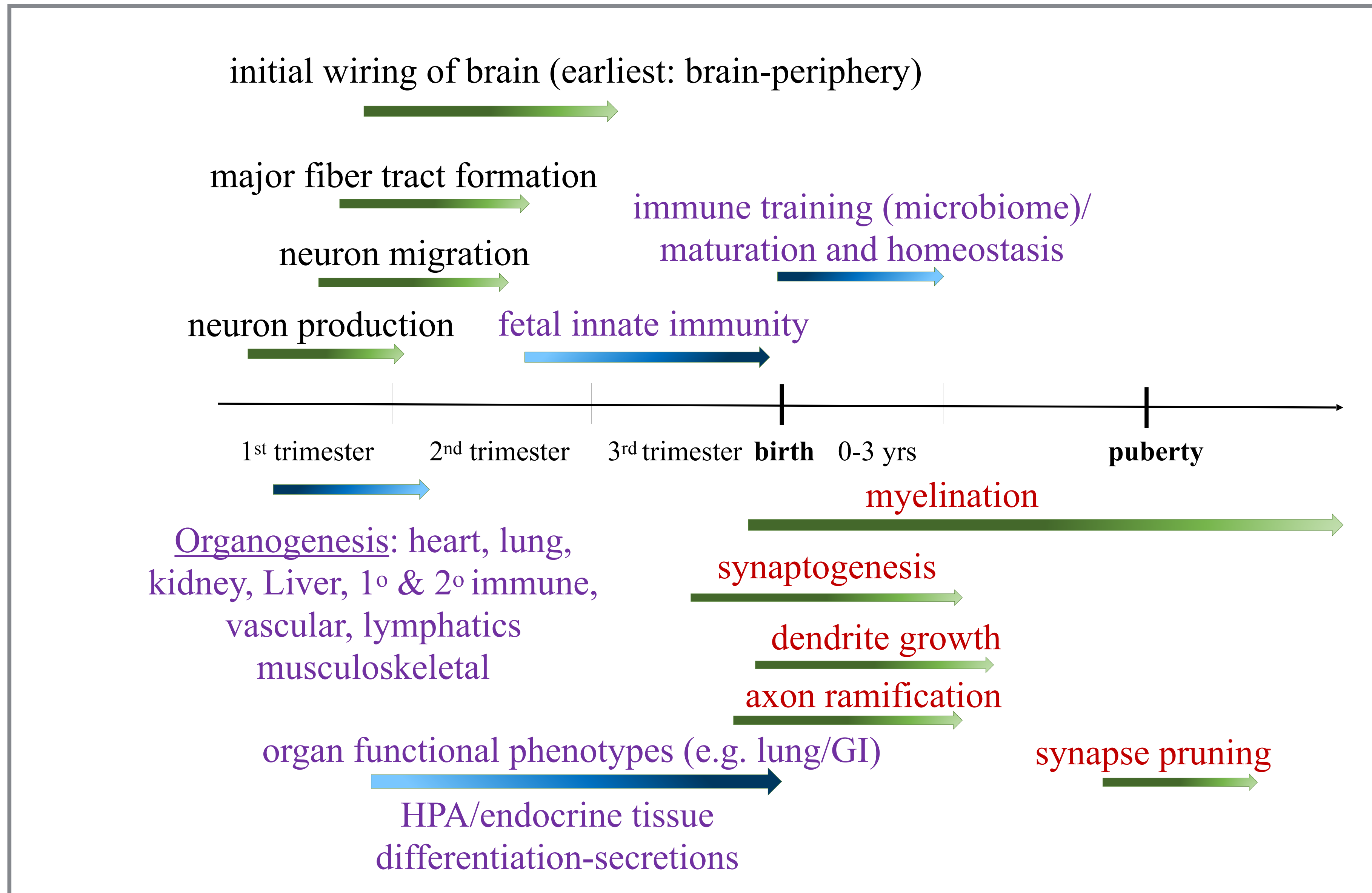
Frameworks:

<http://www.frameworksinstitute.org/>

In Development, Time Matters

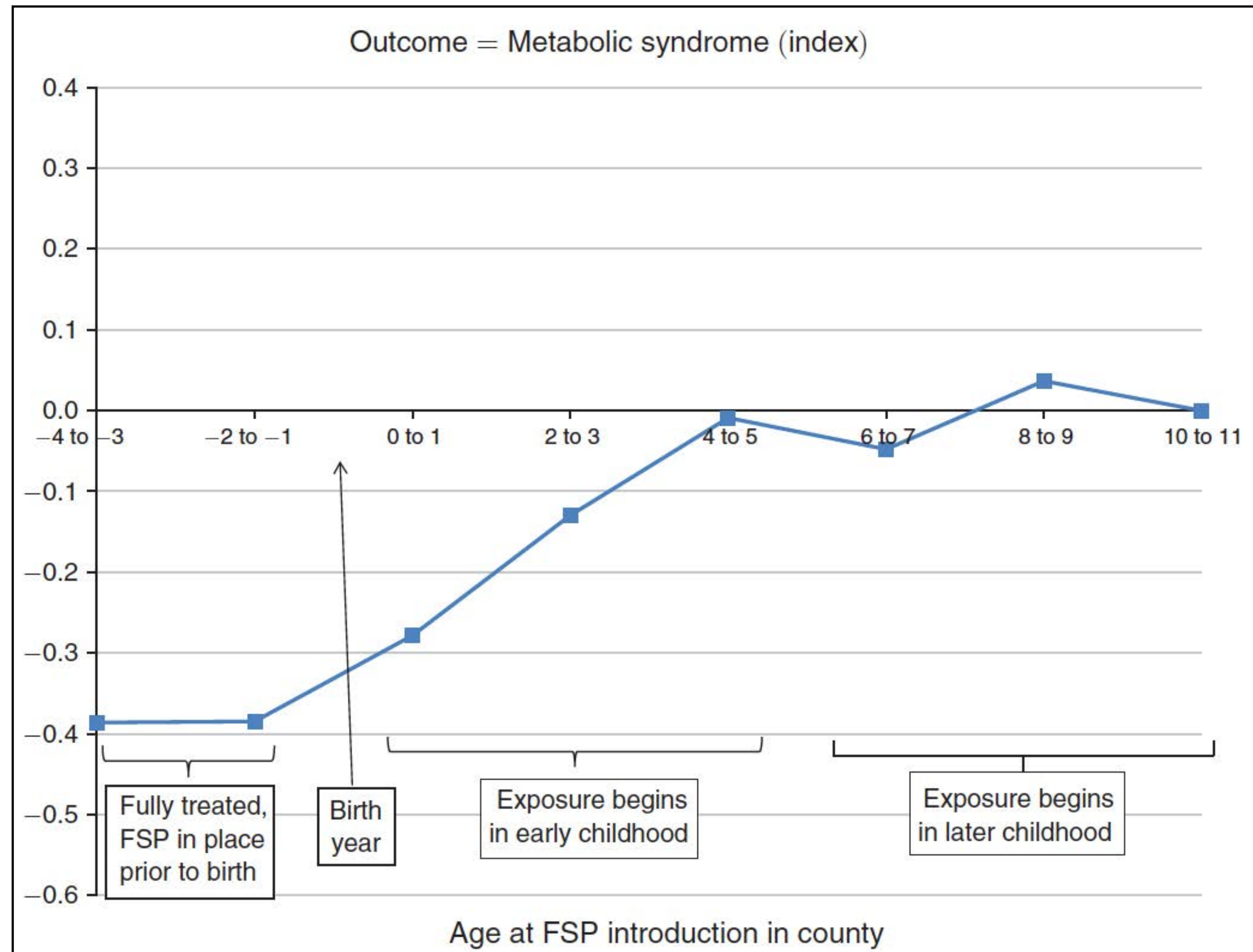
$$d = \frac{\triangle}{t}$$

HUMAN DEVELOPMENT - STARTS EARLY & EXTENDS INTO ADULTS

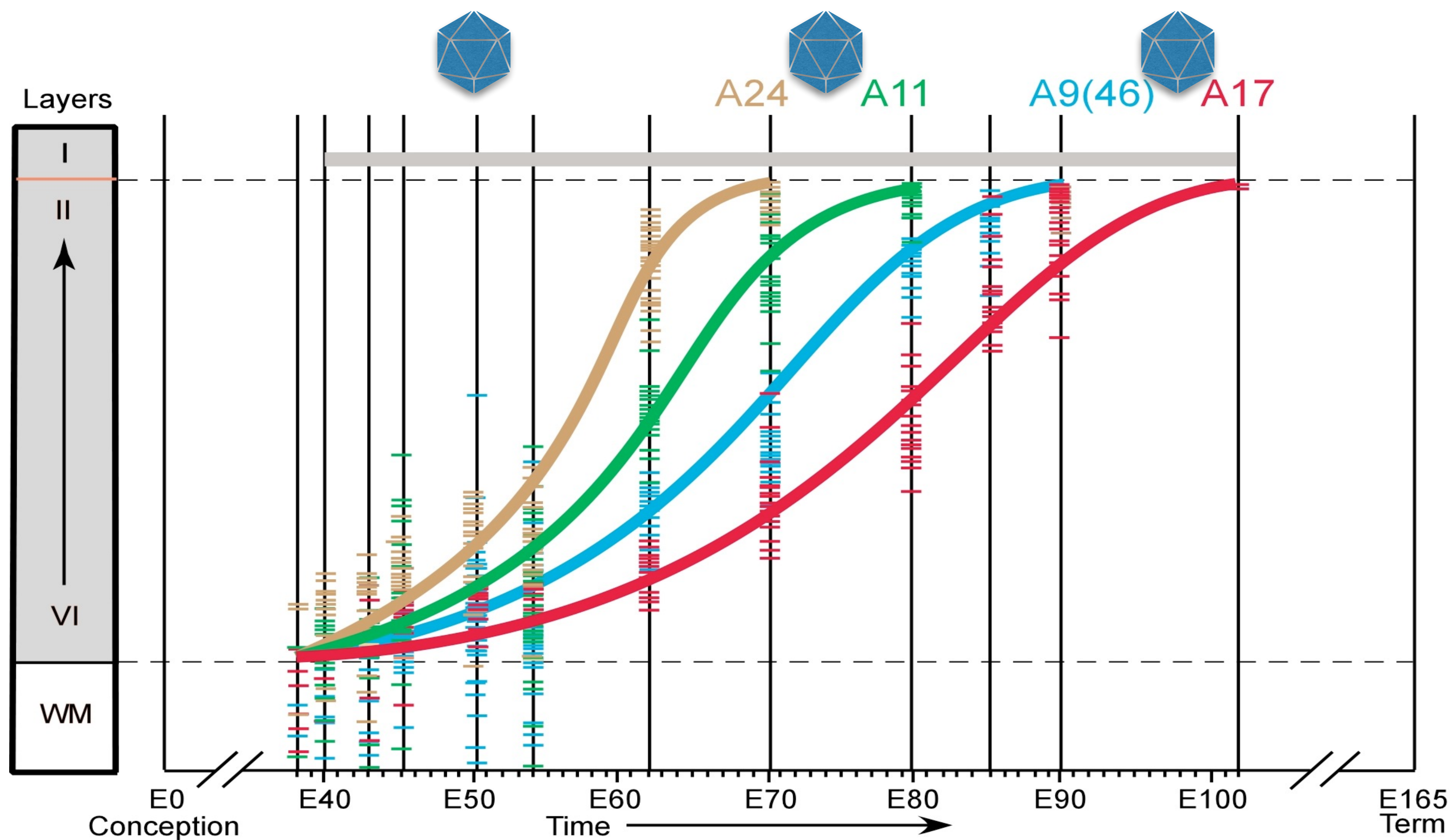


Timing In Development Matters

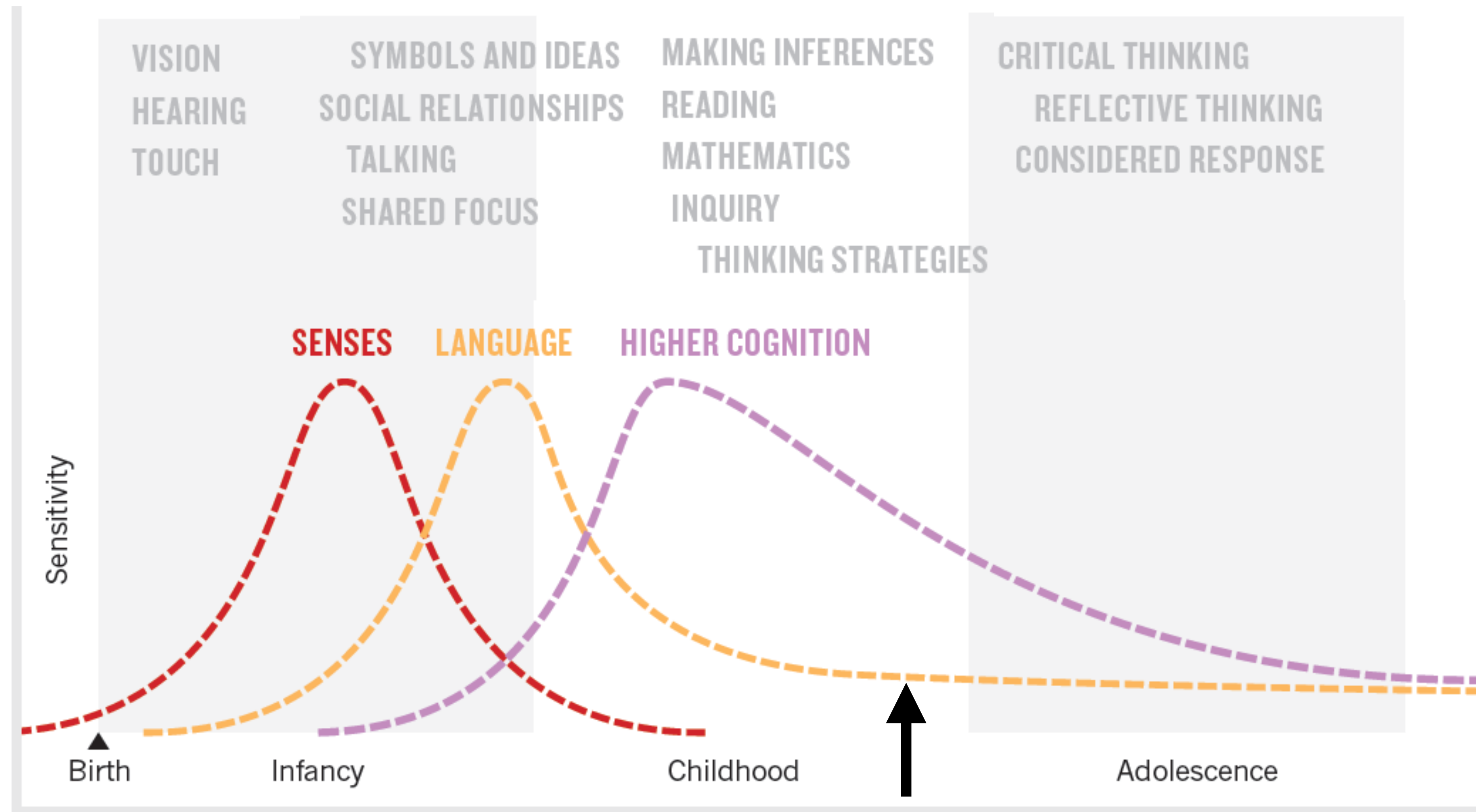
ACCESS TO RESOURCES MATTERS - and so does timing



Timing of Insult Will Have Differential Effects

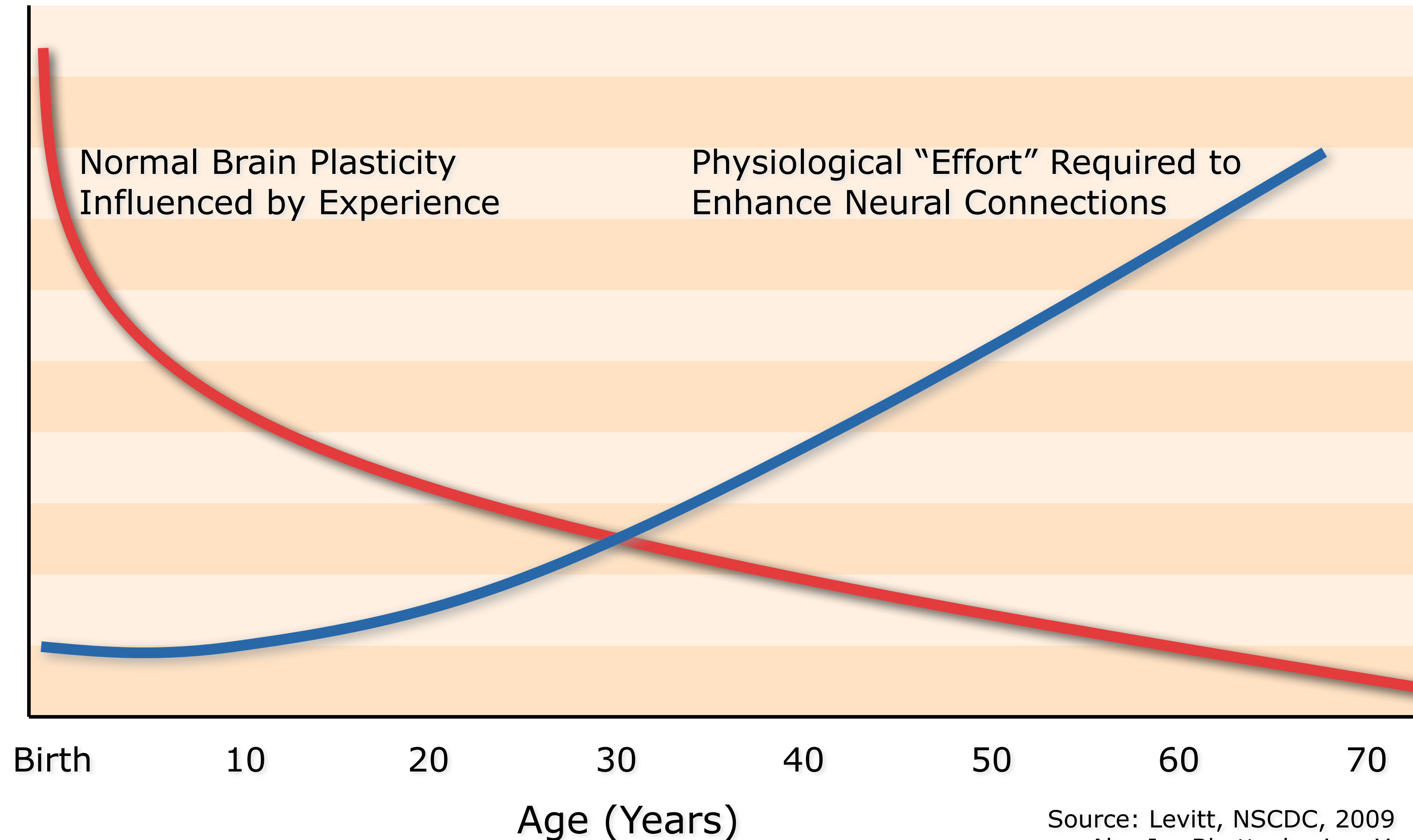


Open and Shut - Critical Periods of Brain and Child Development



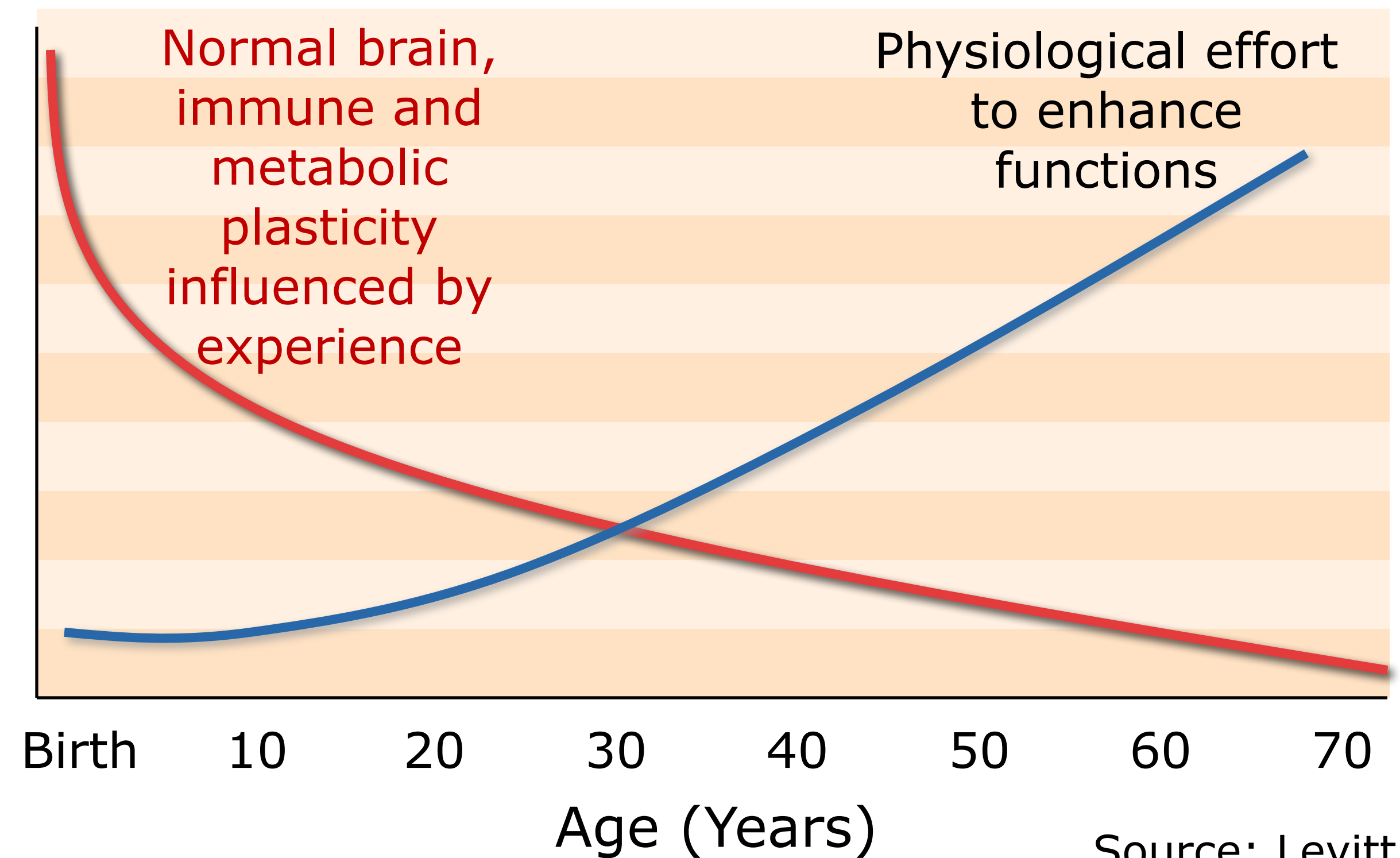
When do most U.S. school systems start to teach foreign language?

For many functions, the brain's capacity for change decreases over time (cost-effective factor) - **but not all functions are impacted equally**



Source: Levitt, NSCDC, 2009
Also In: Bhattacharjee, Y.
National Geographic 227, 2015

Does the impact of early introduction of food stamps remind you of this?

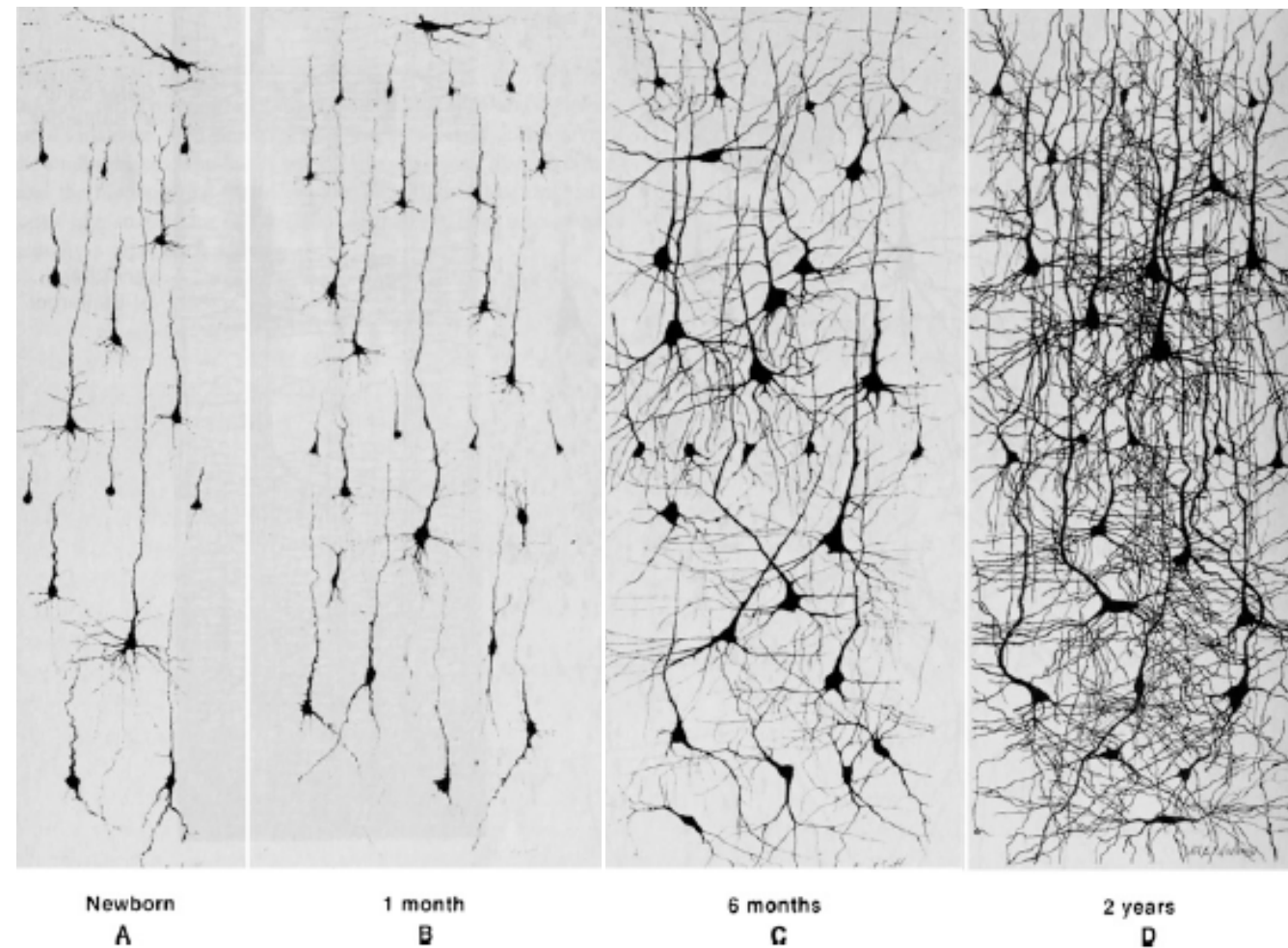


Source: Levitt
(2009)

Infant - Zero to Two: 2 Million Synapses/Second Microbiome Established: Training the Immune System

Dramatic Growth of Neuronal Architecture - Birth - 2 yrs

(1-2 million synapses formed per second in the early years)



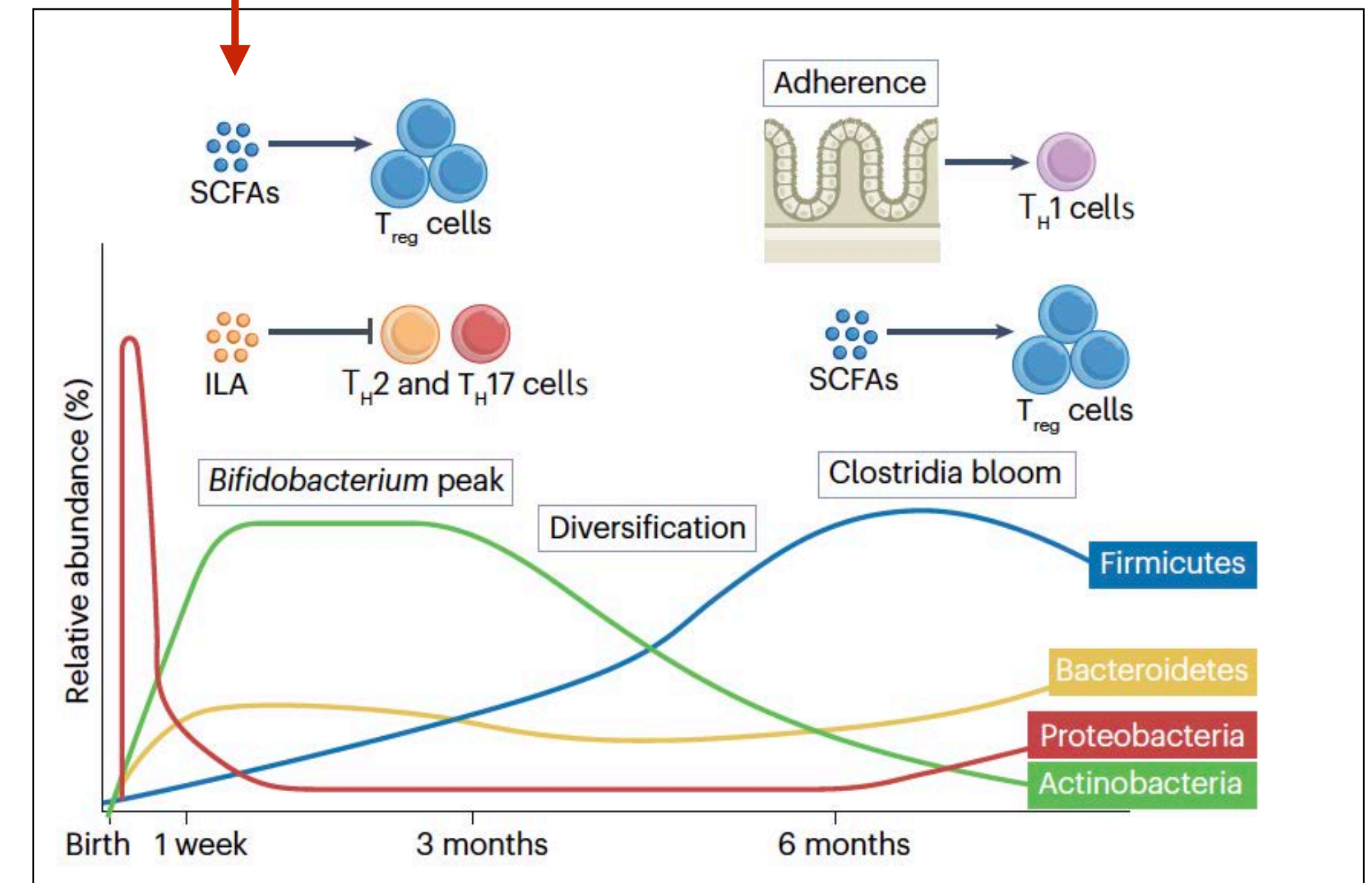
Courchesne et al, Neuron 56, 2007



birth

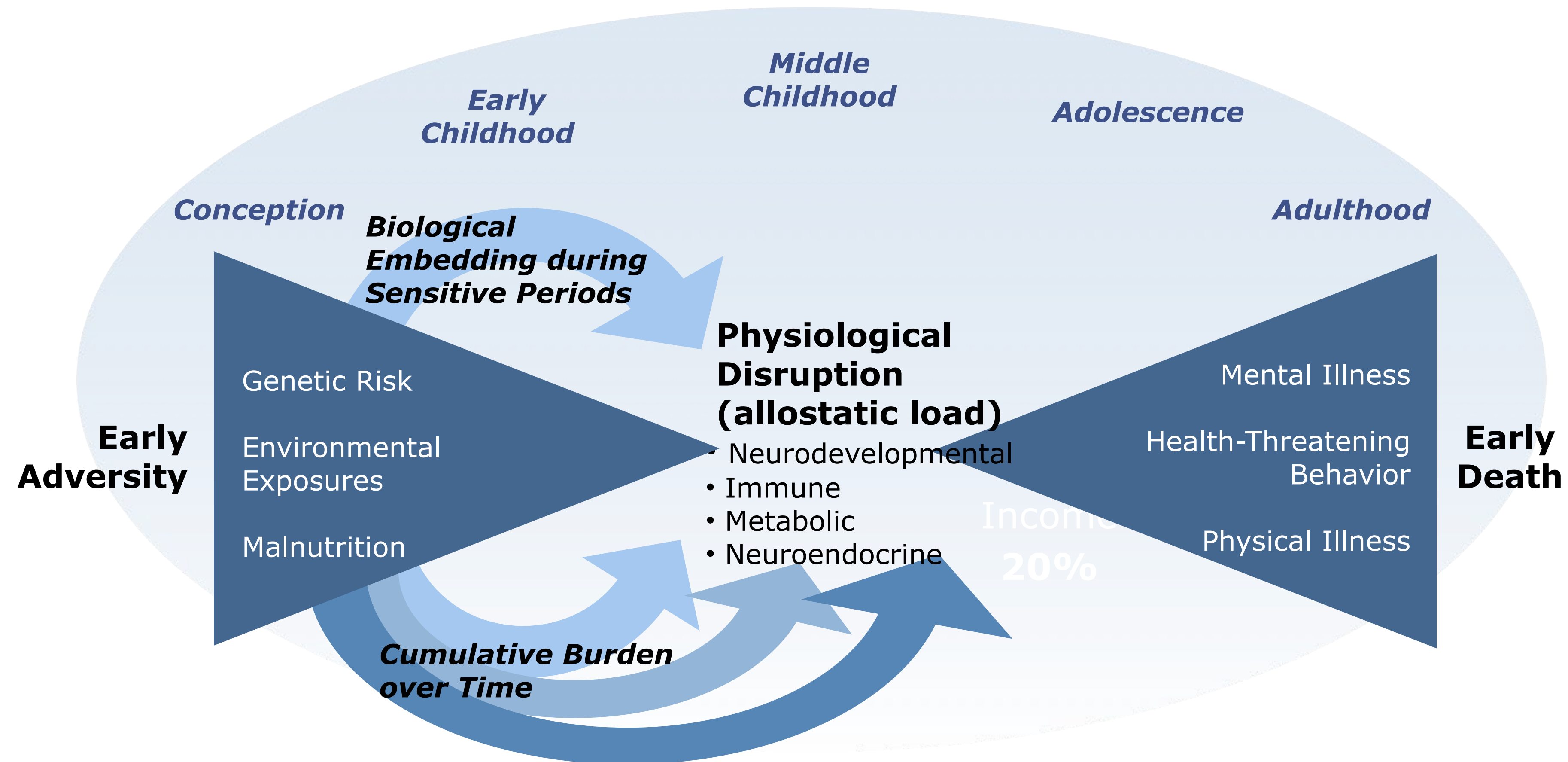
Early Education of Immune System Cells

microbiome products



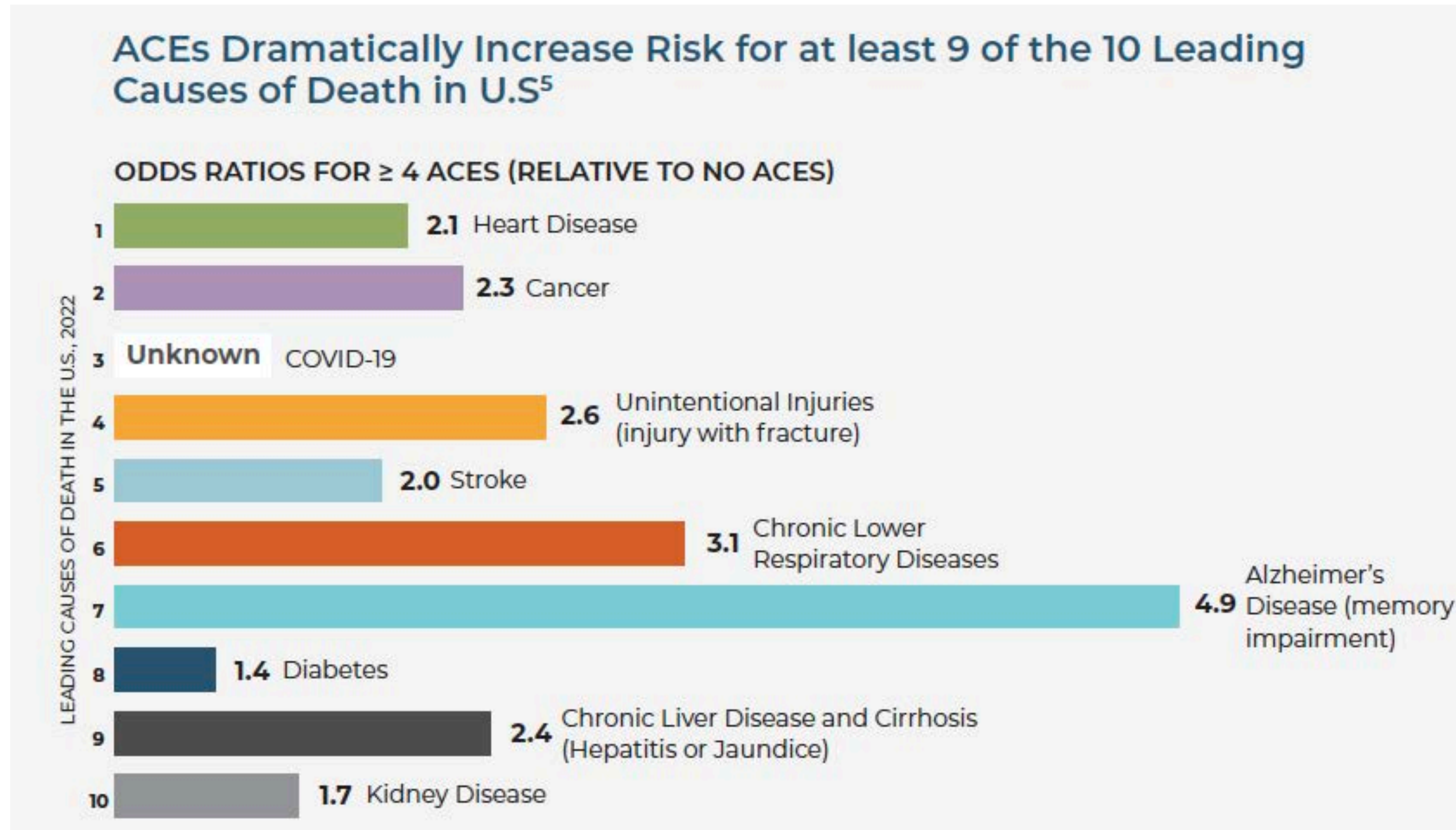
Donald and Finlay 2023 Nature Reviews Immunology

The Developmental Roots of Health Disparities: How Adversity is Built Into the Body



ACES Aware Report 2019-2023

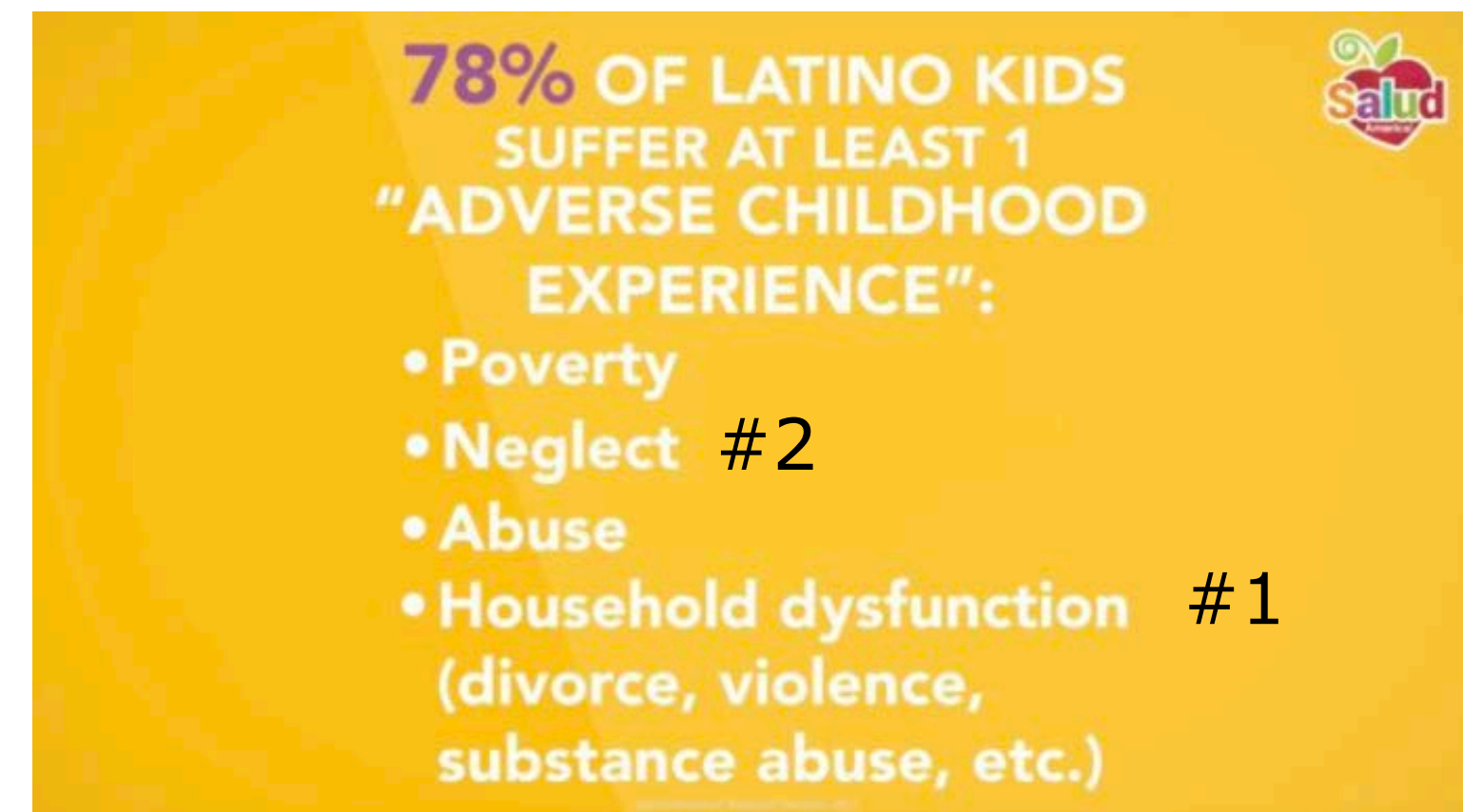
(ACEs Cost 14.1 Trillion Annually in Healthcare Costs)



At The Population Level

Salud America!

<https://salud-america.org/latino-childhood-development-research-childhood-trauma/>



Unpredictability is a **HIGH** stress generator

ECD 2.0: Connecting the Brain to the Rest of the Body in a Broader Ecological Context

- Impacts of conditions and experiences beyond caregiving that are built into many biological systems, as well as the brain
- Effects of a range of disruptions (e.g. toxic stress, chemical exposures, air pollution) on multiple developing systems, with negative implications for lifelong physical and mental health
- Importance of preventing or reducing effects of early adversities to promote physical and mental health across the lifespan
- Expand focus on structural inequities to include the cumulative threats and burdens of systemic racism
- Focus on individual variation in sensitivity to the environment and on which interventions work for whom, why, and in what contexts
- Research on developing immune and metabolic systems calls for more attention to prenatal period and early infancy

Addressing Toxic Stress/Early Adversity - The Importance of Connecting the Brain and Body

[http://developingchild.harvard.edu/
resourcecategory/multimedia/](http://developingchild.harvard.edu/resourcecategory/multimedia/)

Experience as an Important Driver of Development

Why does early have long-lasting effects?

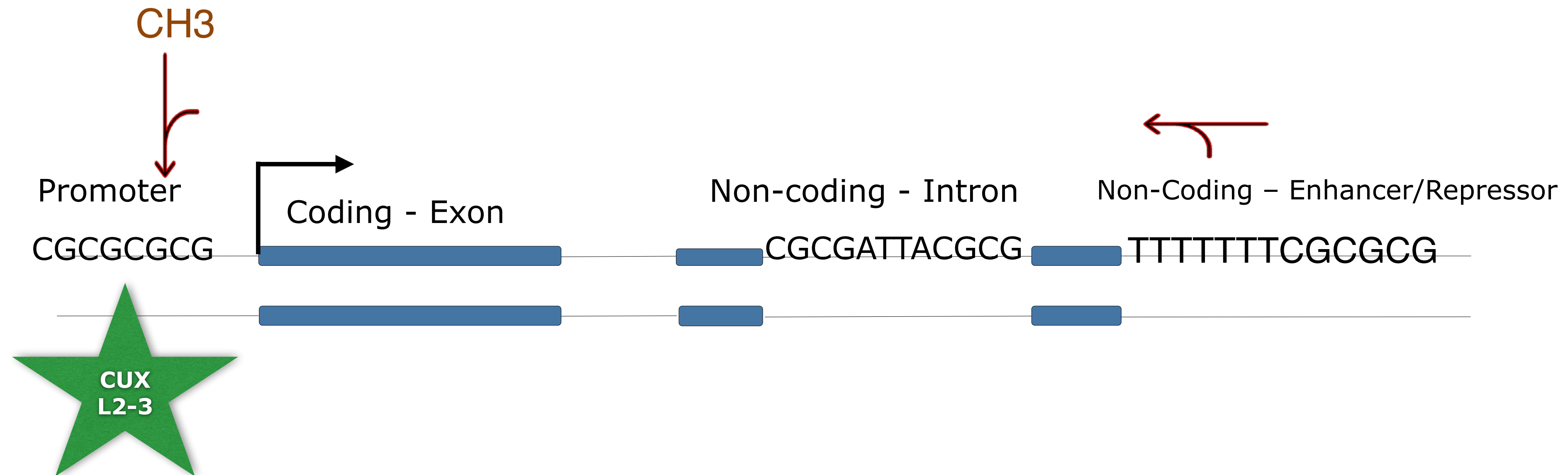
2010

Early Experiences Can Alter Gene
Expression and Affect Long-Term
Development

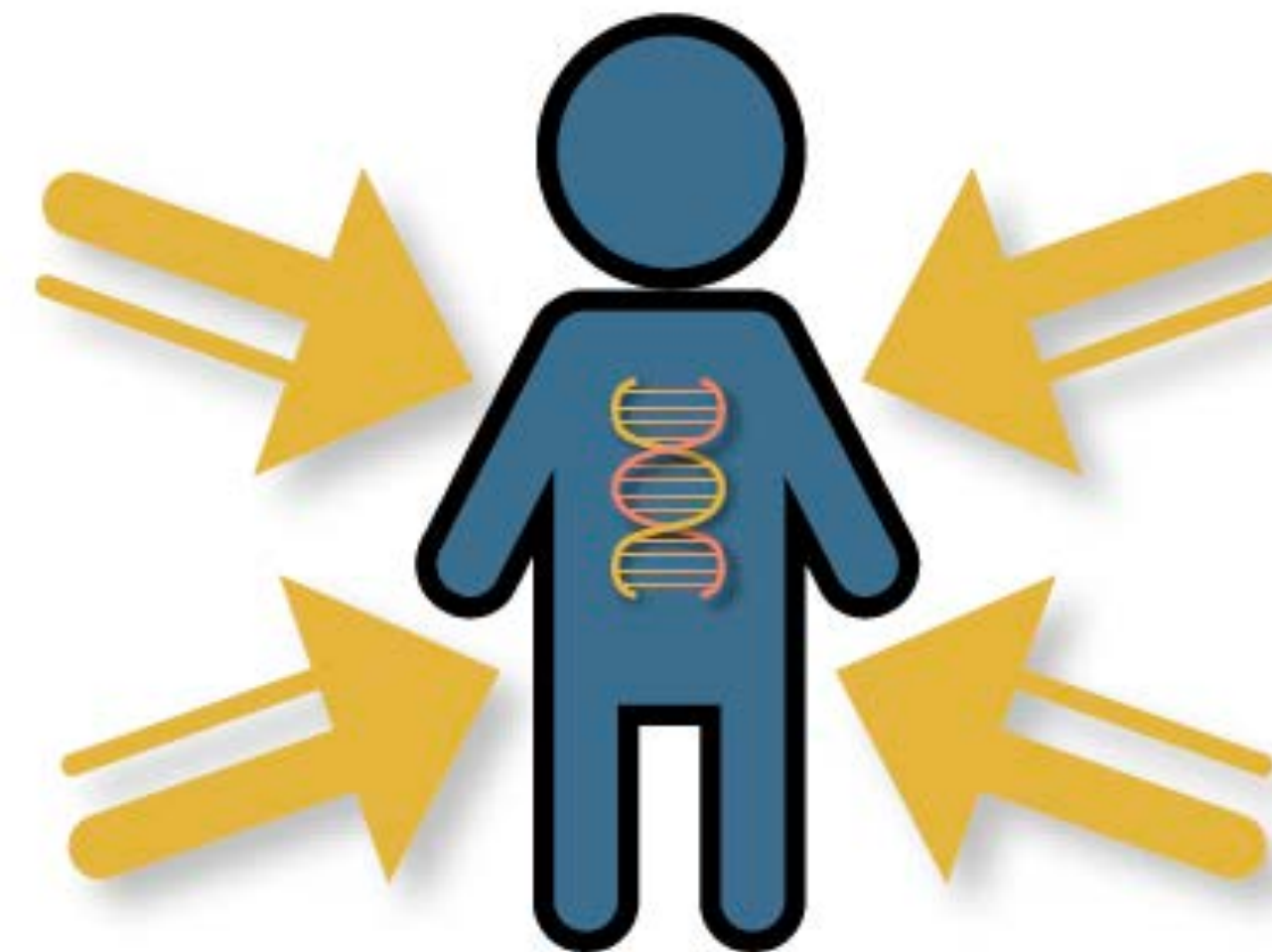
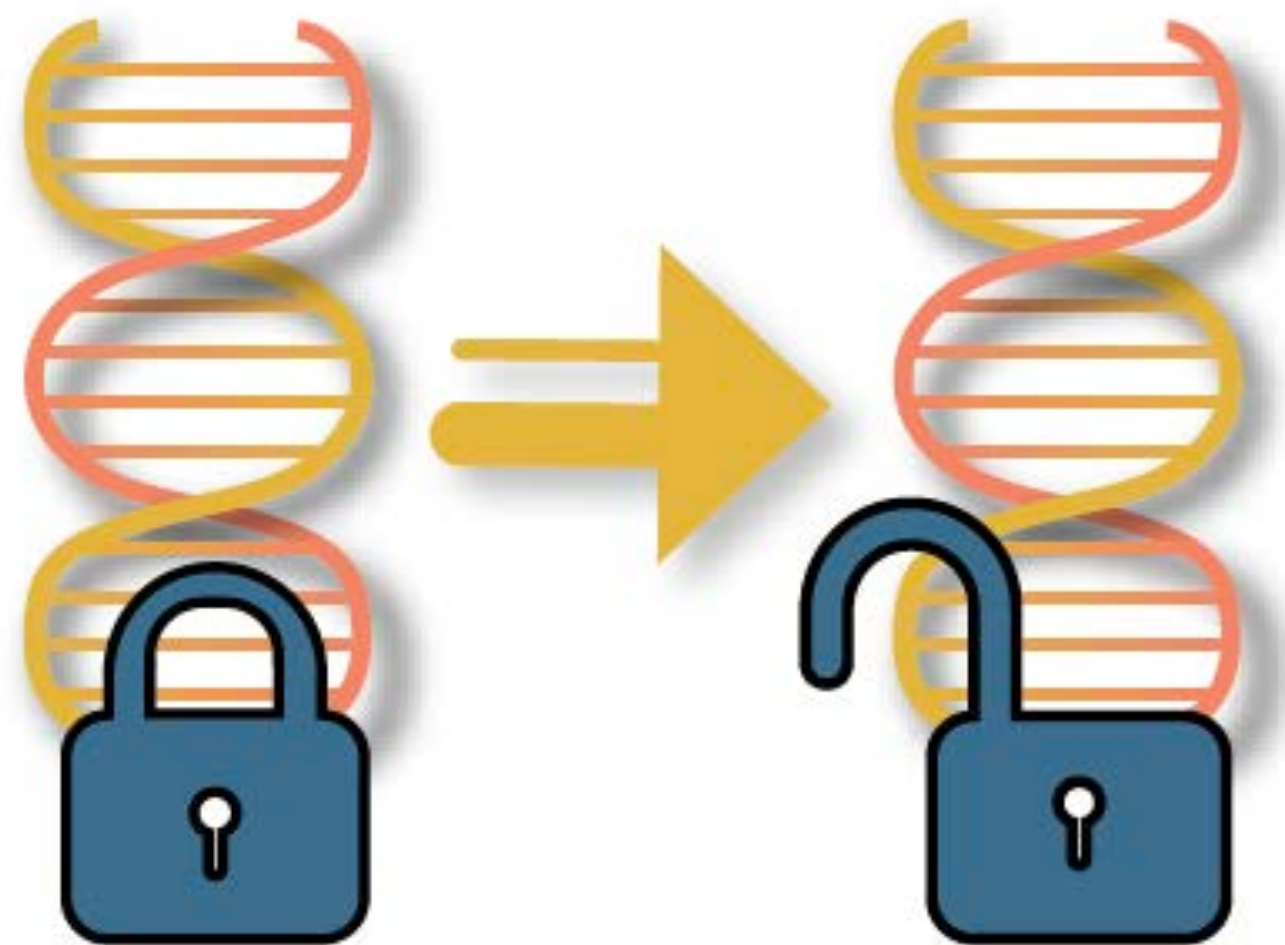
WORKING PAPER 10

10

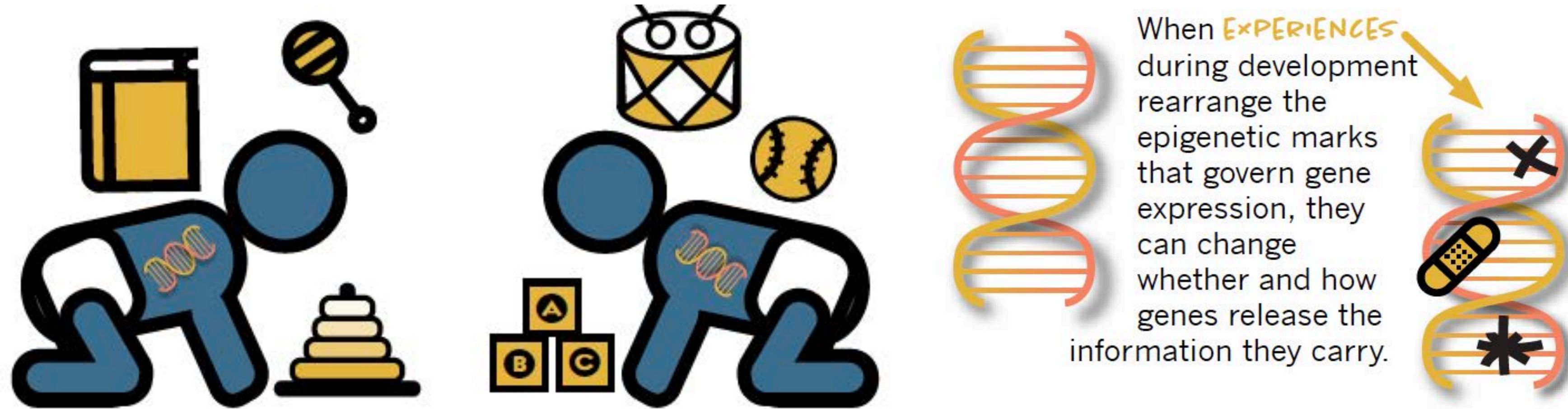
Genetic Architecture

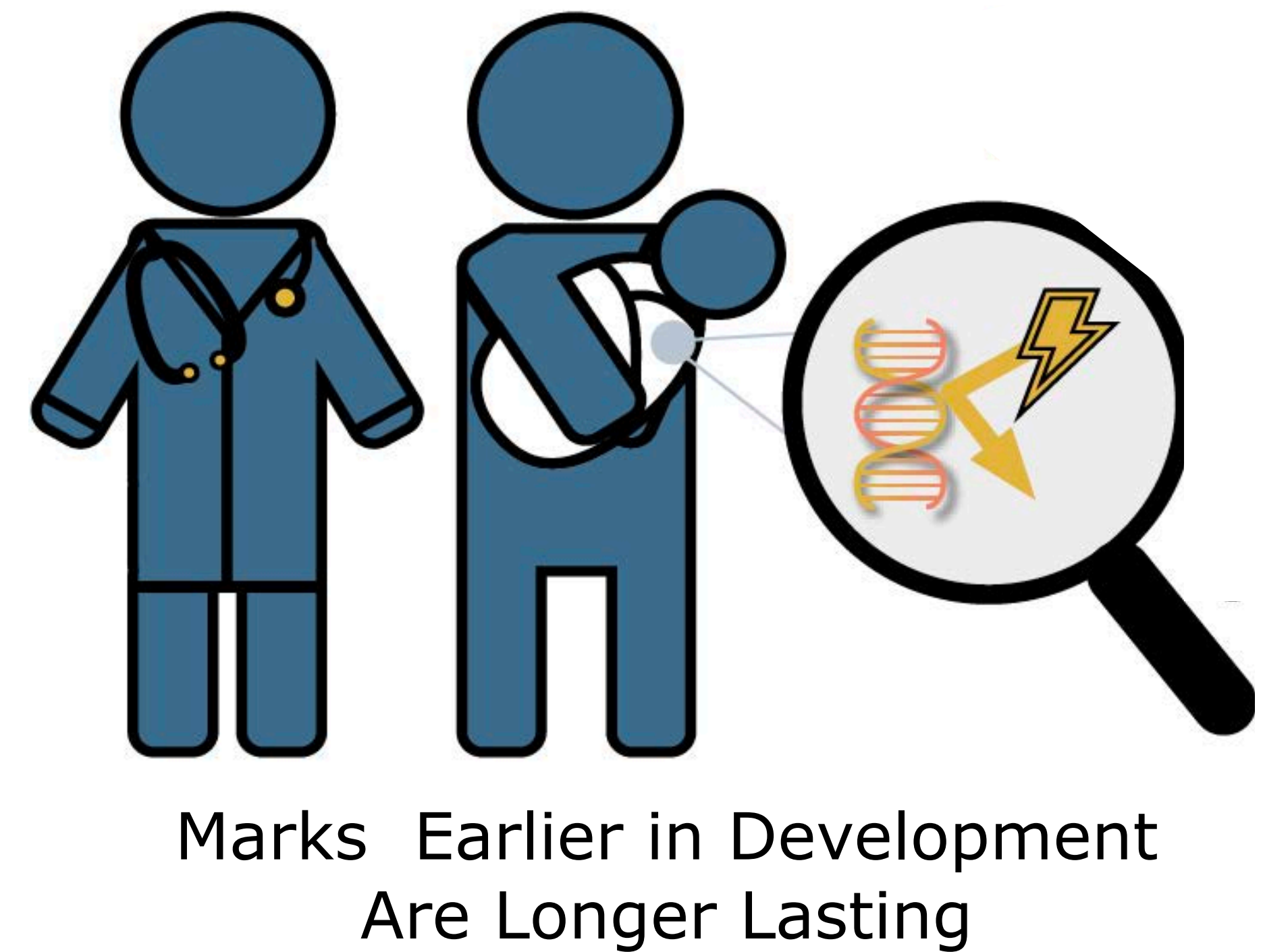
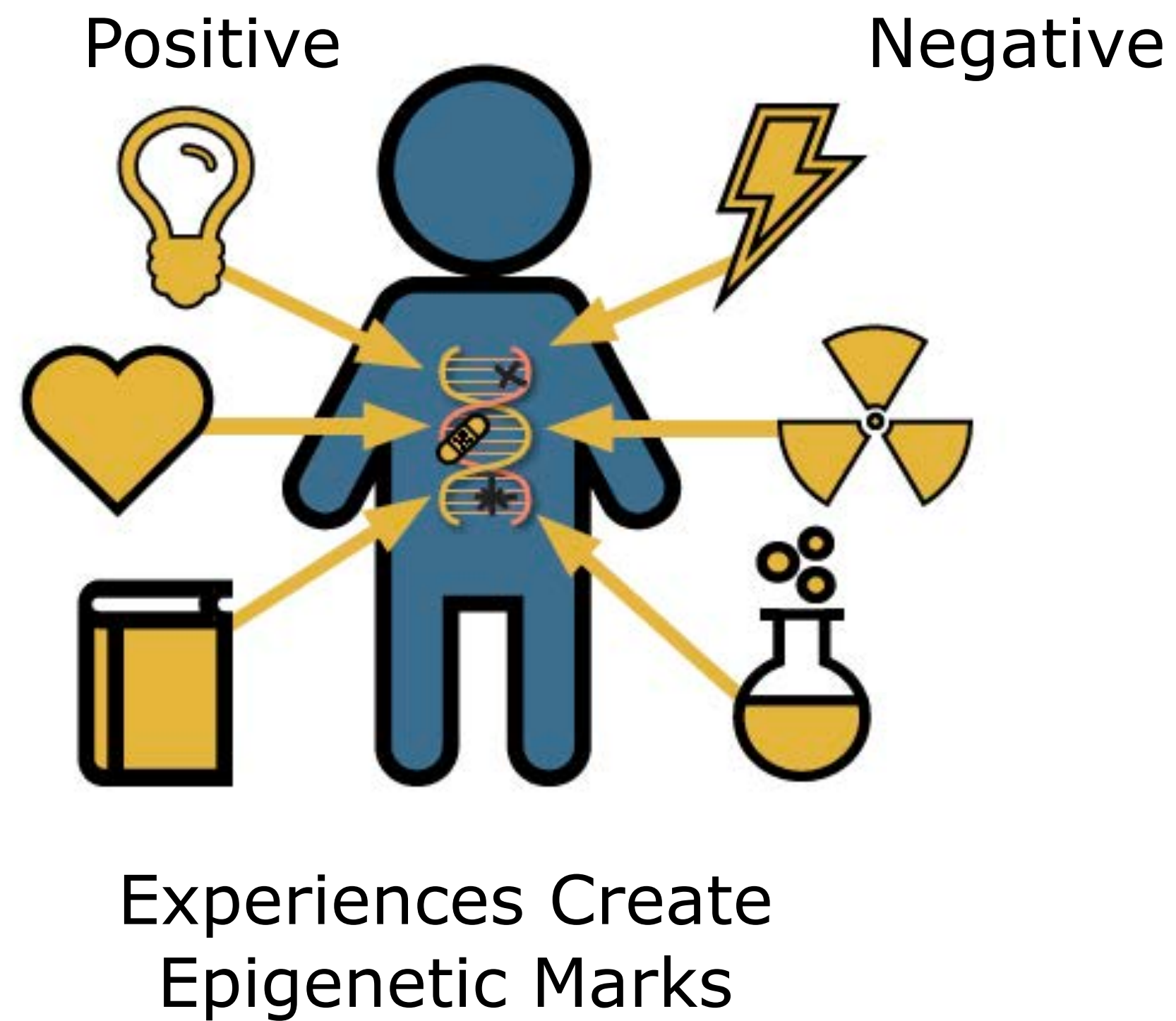


Epigenetics (*"above the genome"*) Unlocks The Genes We Inherit



The Unlocking Occurs Via Experiences





'Memories' pass between generations

🕒 1 December 2013



James Gallagher

Health and science reporter, BBC News

Behaviour can be affected by events in previous generations which have been passed on through a form of genetic memory, animal studies suggest.

Preconception and Prenatal Origins of Health Disturbances – Generational Implications Due to Impact on Germ Cells

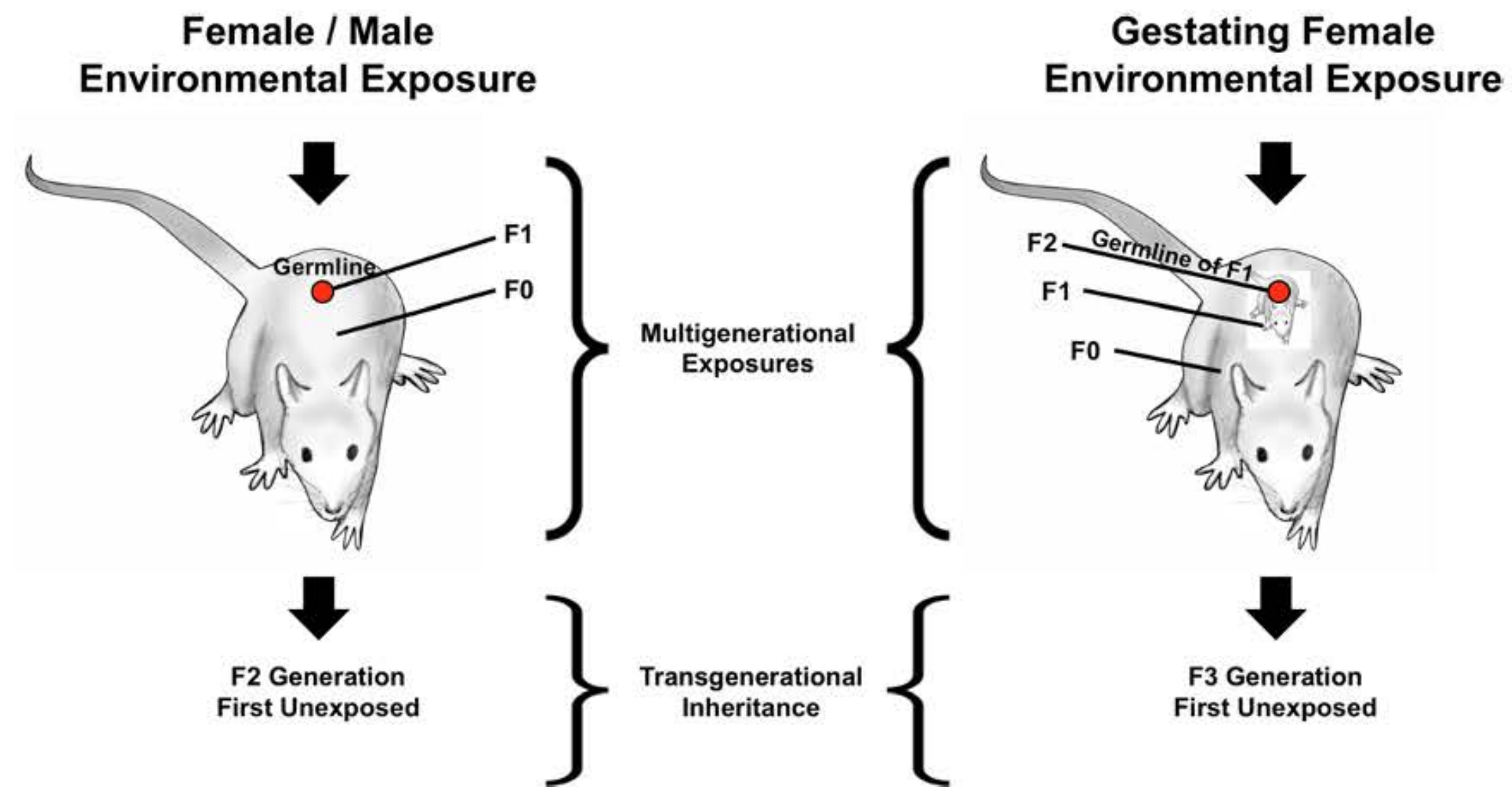
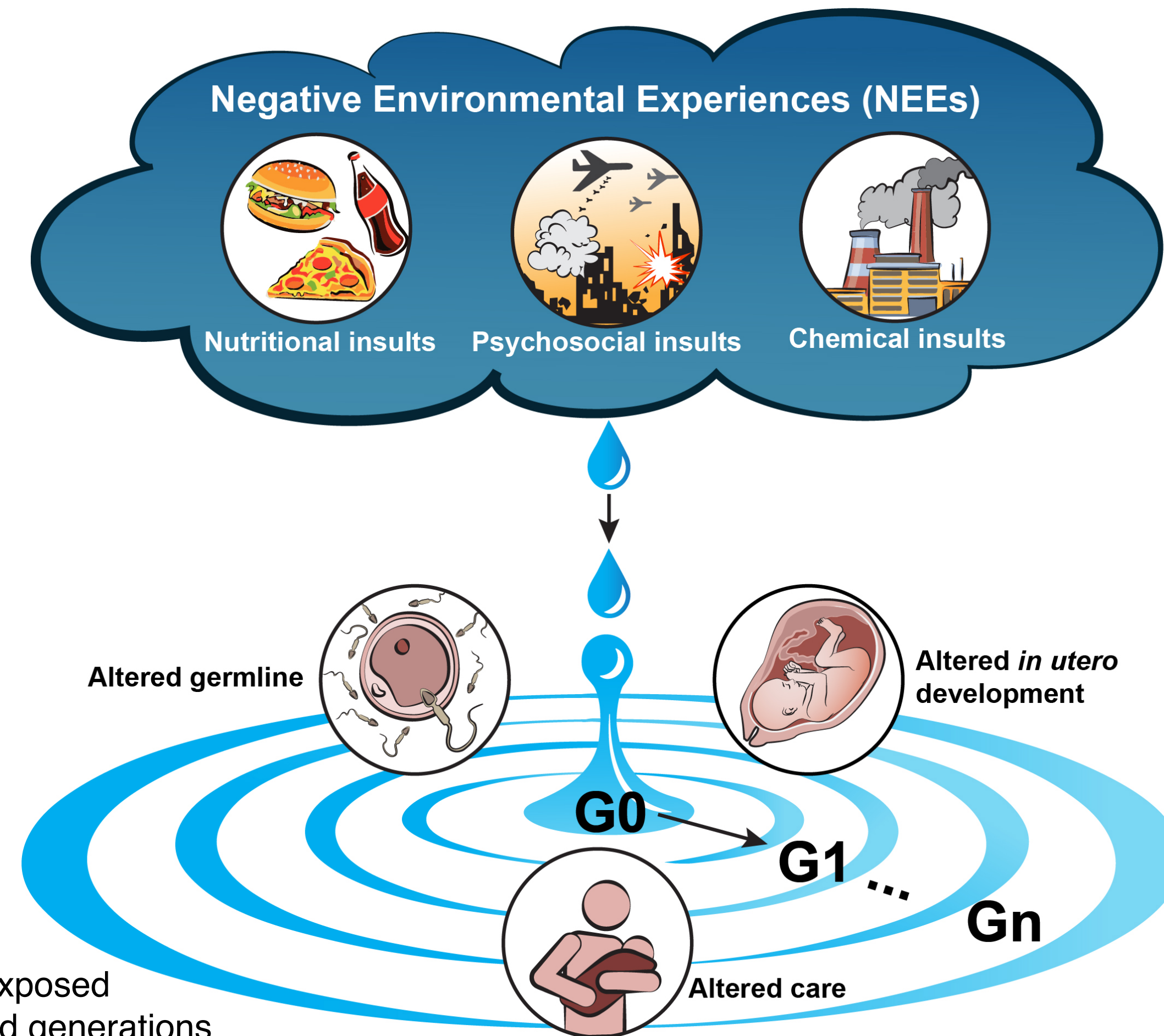


Figure 1 Schematic of multigenerational exposure and transgenerational inheritance.

Legacies of stress ripple within and across generations



G0 = generation directly exposed
G1..Gn = future unexposed generations

Taylor...Dias,
Biological Psychiatry 2025

Creation of Chemical Signatures – Our Epigenome



Frameworks Institute

***The Signature Can Control When and Where Genes
are Expressed***





Readers

DNA to RNA
(transcribe)



Writers

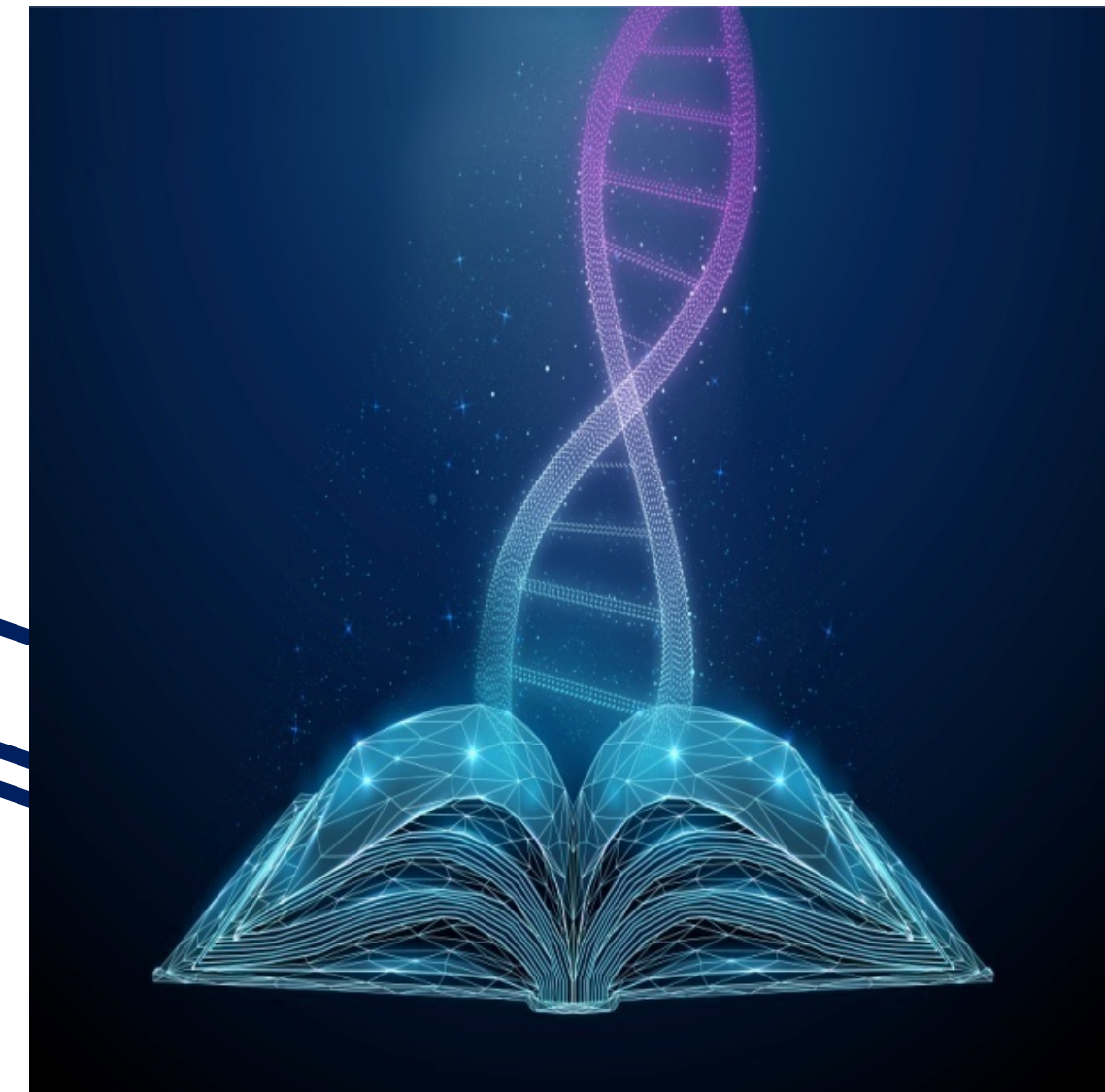
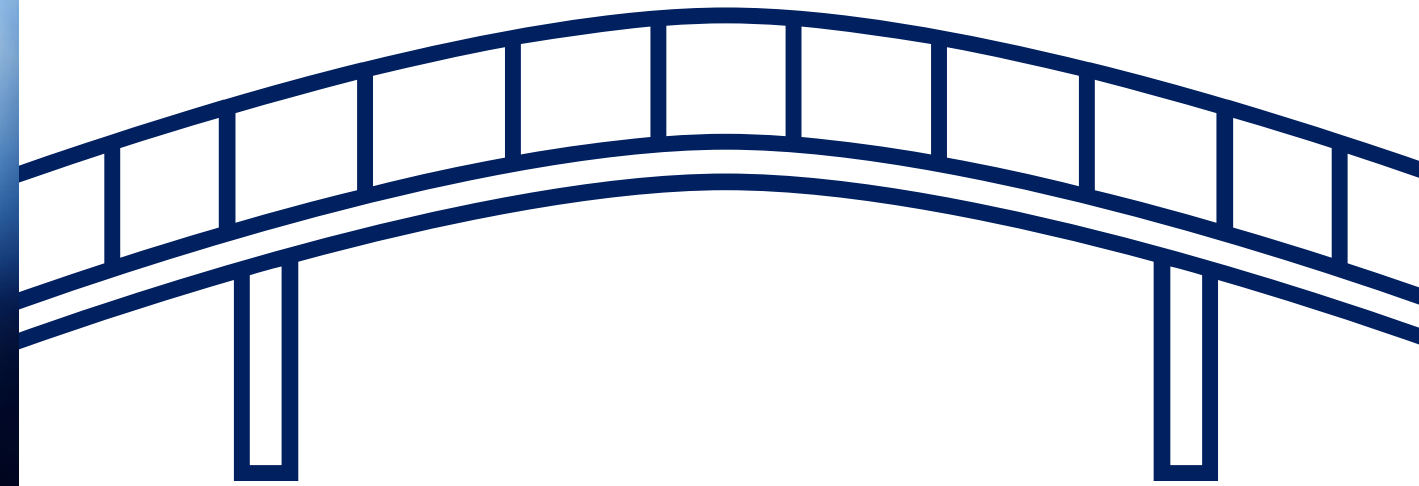


Erasers

Demethylation



EPIGENETICS

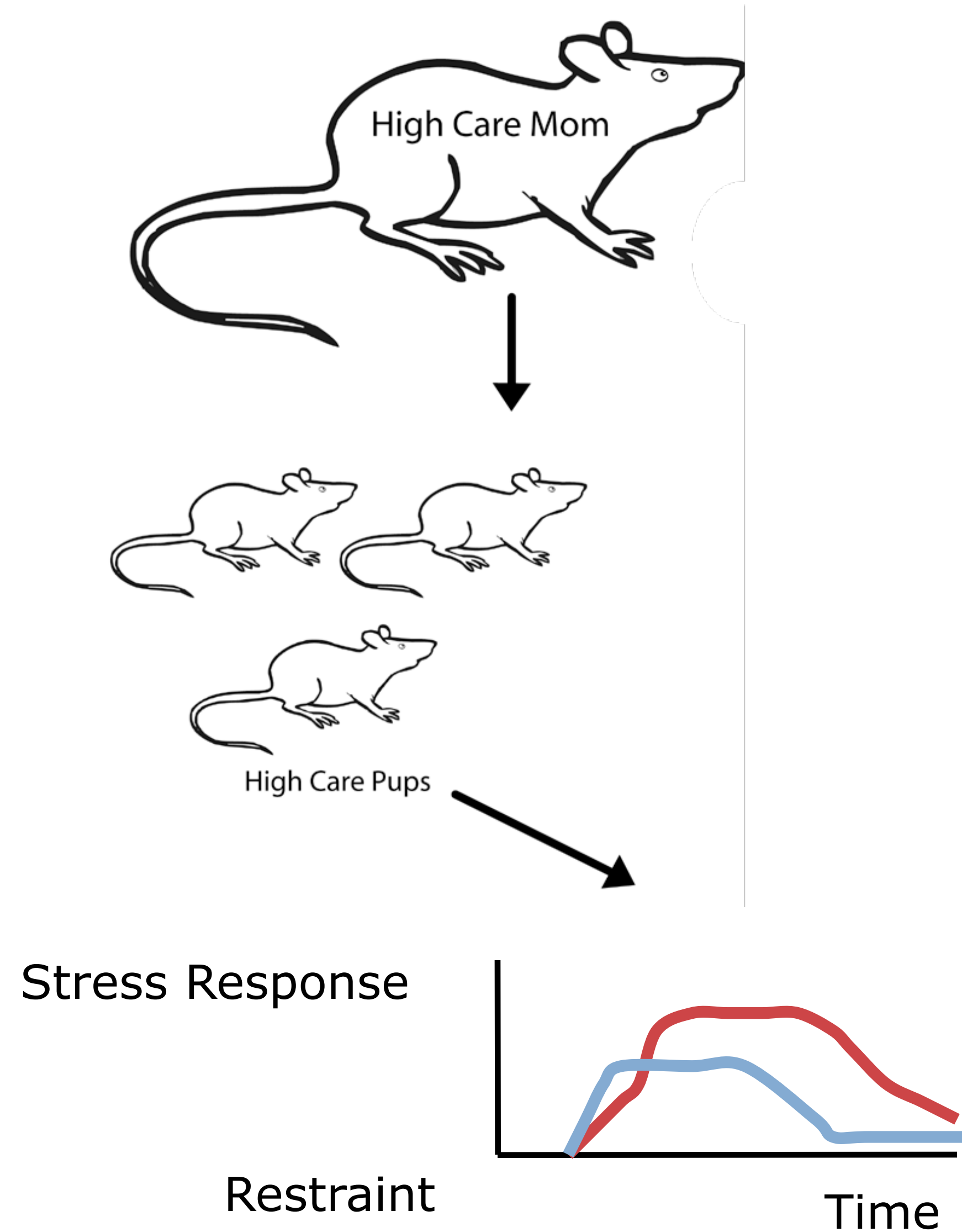


Experiences/Exposures Are Drivers of **Editing** of the Genome



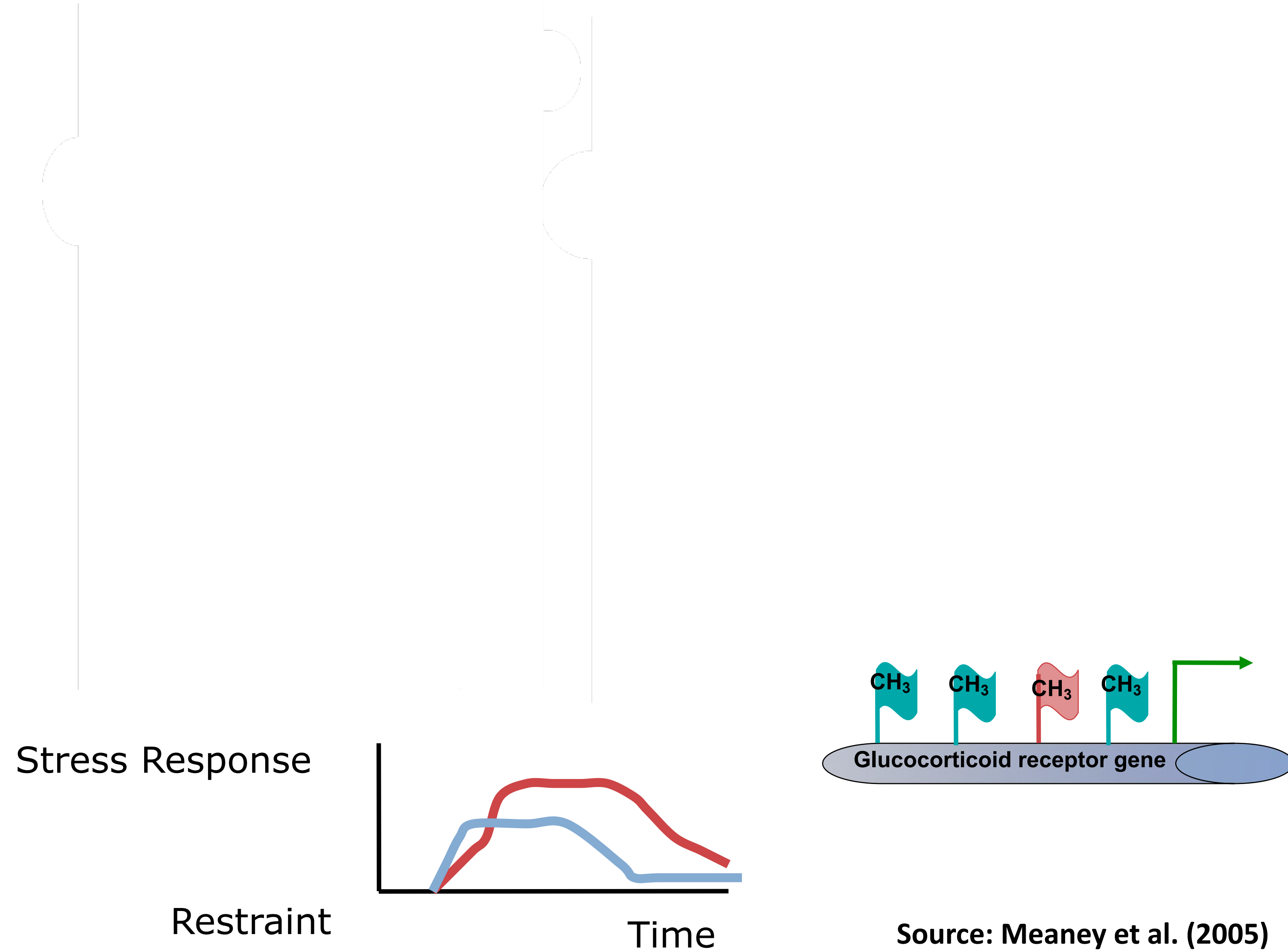
How Do We Know Epigenetics Occurs Via Experiences?

Early Allostatic Load – Generation of Epigenetic Changes



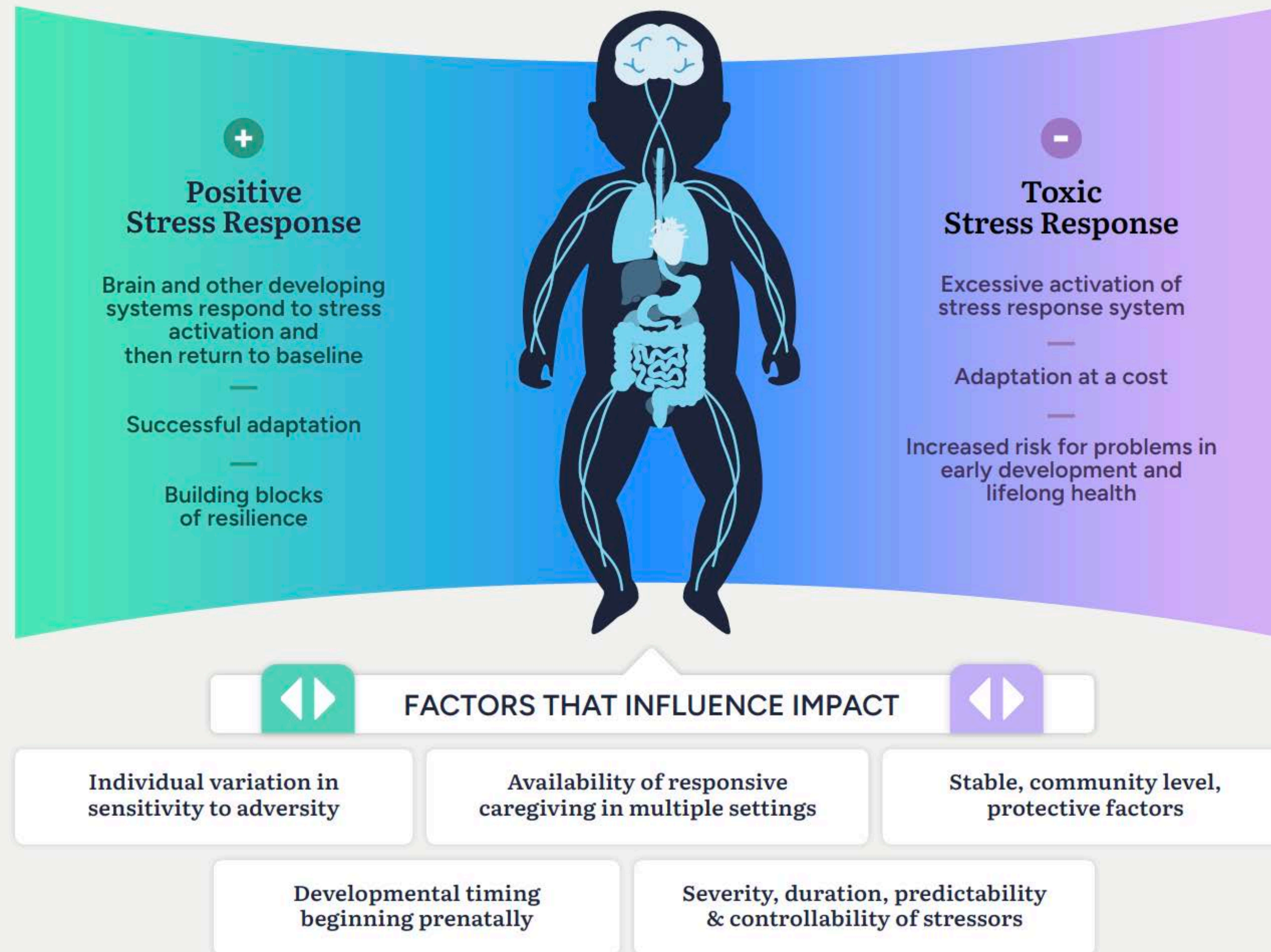
Source: Meaney et al. (2005)

How Experience Influences Genes



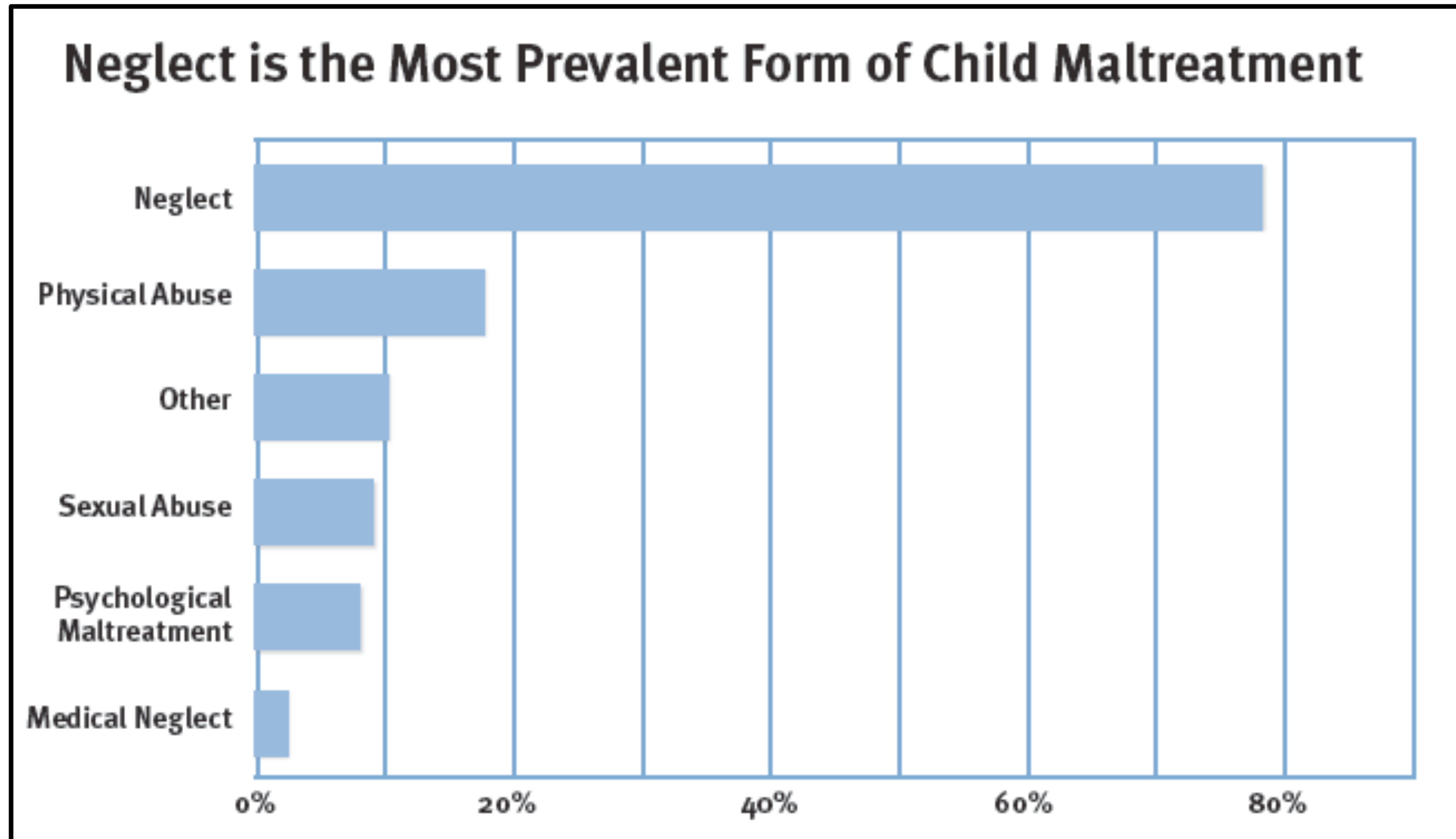
**Powerful experiences,
no matter what kind (+/-), matter**

Understanding The Broad Range of Responses to Adversity



We know that (0-18 yrs):

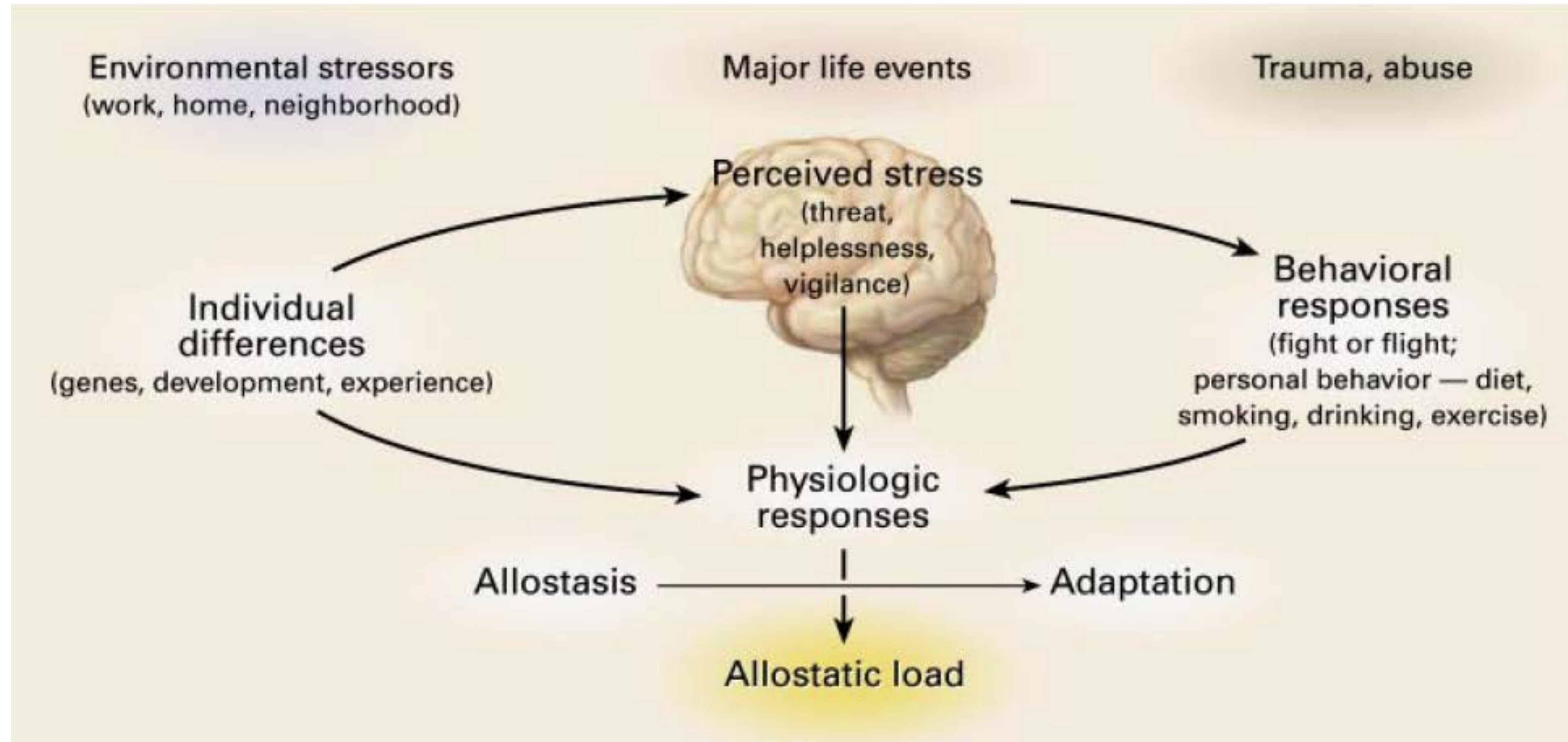
In 2022 78% Neglect; 25% < 1yr old



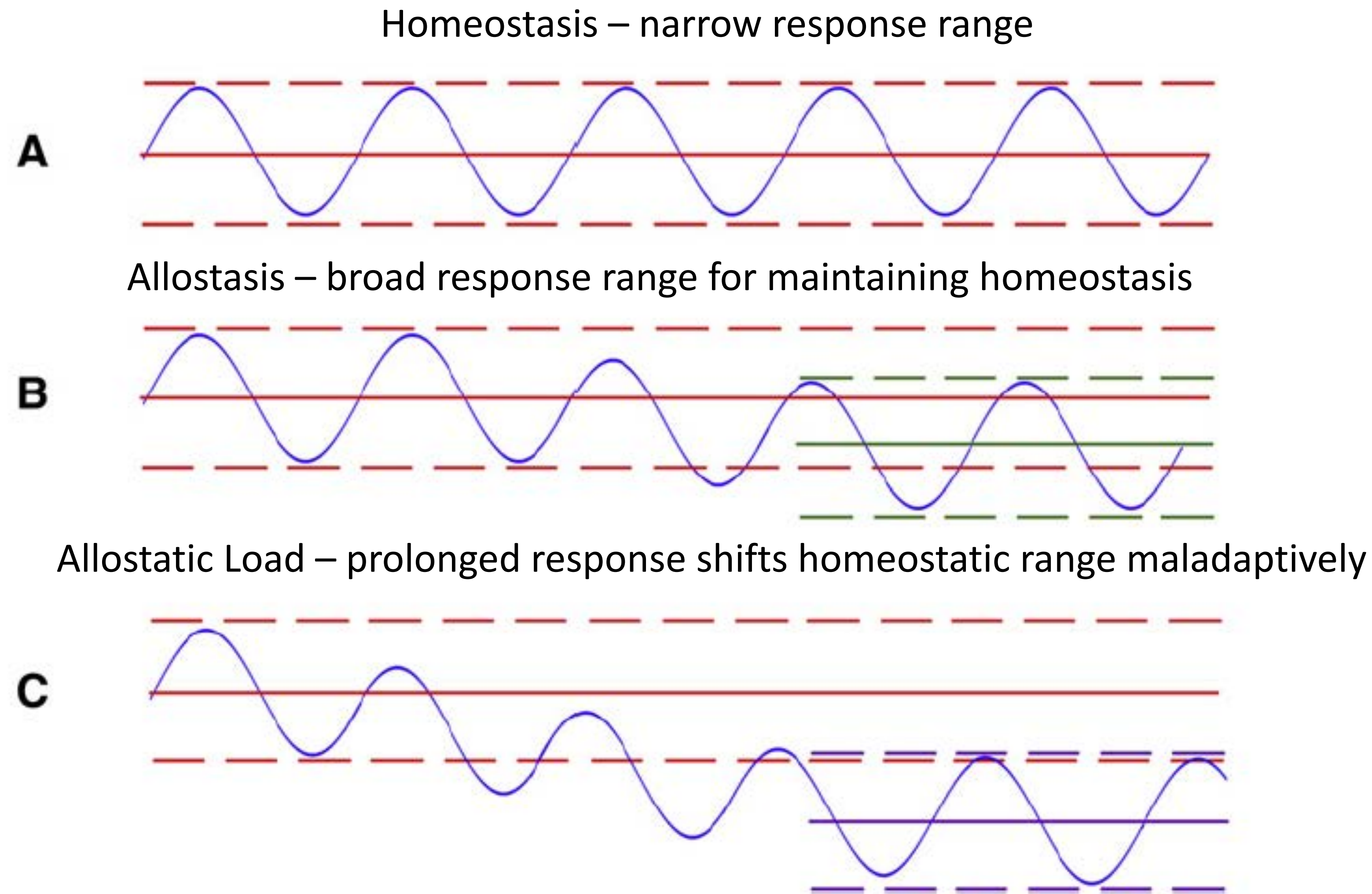
U.S. Dept. Health and Human Services, 2010

Neglect Video

Harvard Center on the Developing Child:
<https://developingchild.harvard.edu/>



Responses to Cellular and Physiological Challenges - Developmental Allostasis (chemo-physiological 'wear and tear')

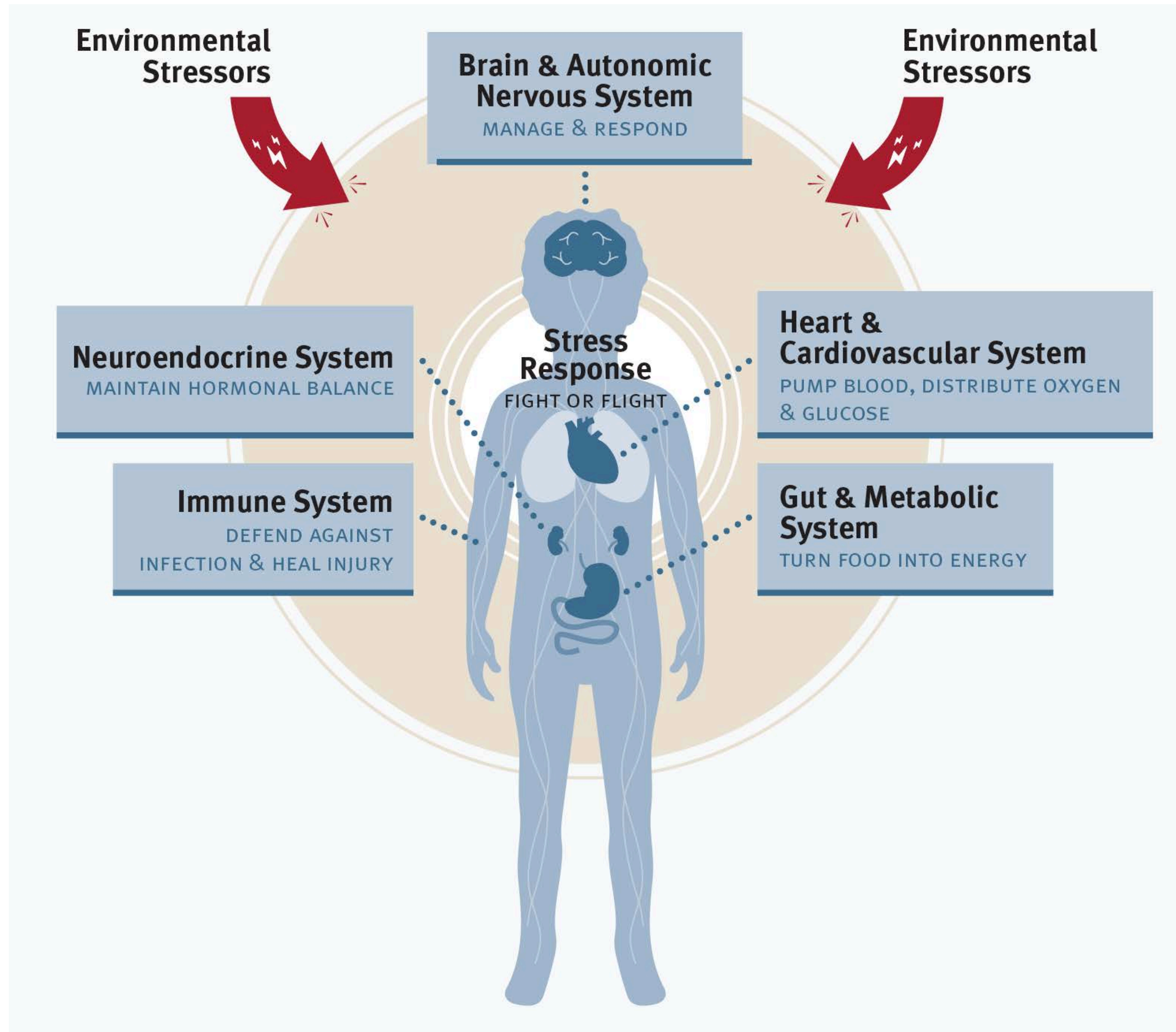


Acquired Biological Disruption

Connecting the Brain to the Rest of the Body: Early Childhood Development and Lifelong Health Are Deeply Intertwined

WORKING PAPER 15

NATIONAL SCIENTIFIC COUNCIL ON THE DEVELOPING CHILD



Time of Exposures (matter says the Hatter)



ELA Changes the Profile of the Oral and Gut Microbiome - Which Impacts Immune System Functions



International Journal of
Molecular Sciences

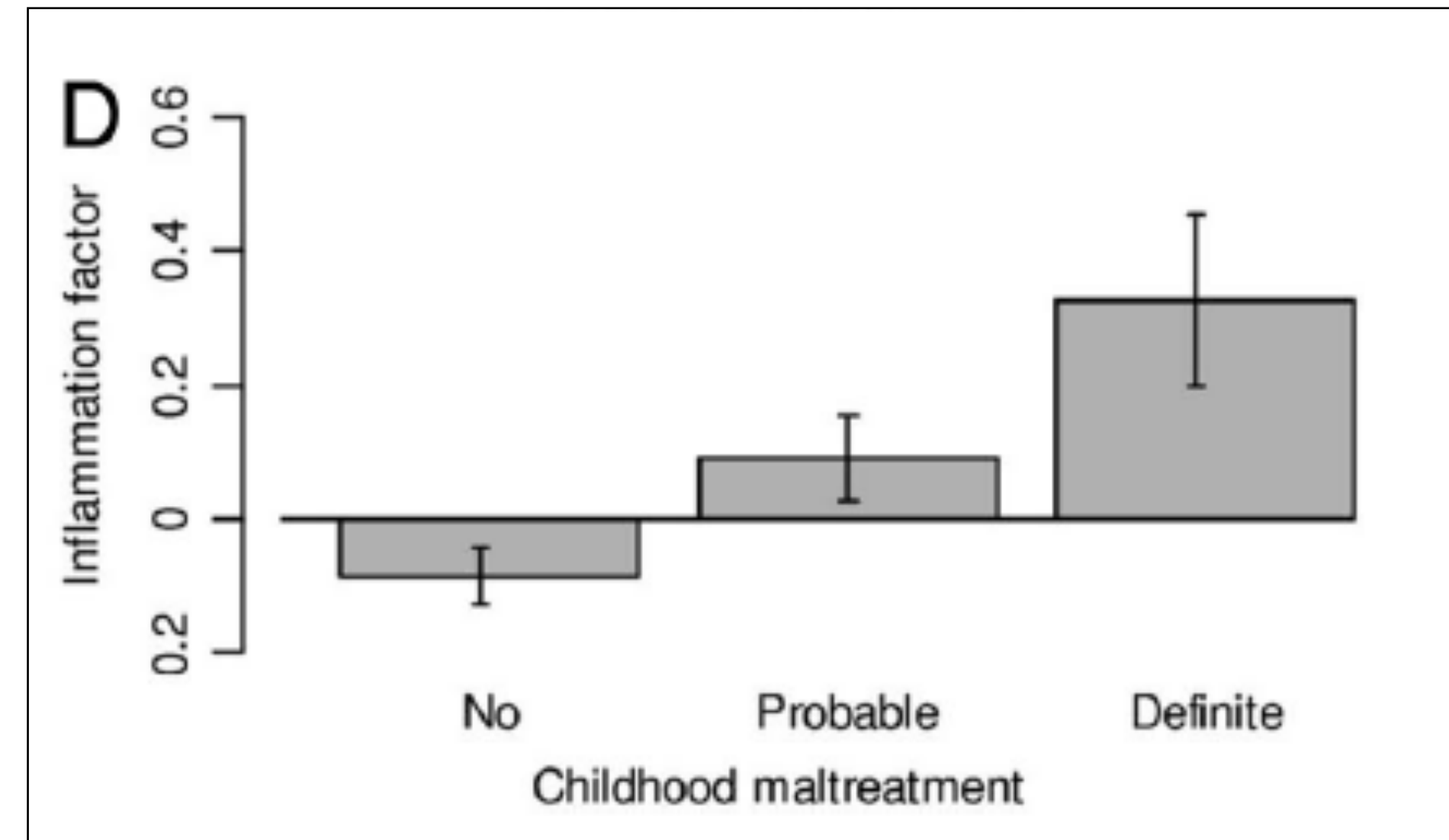
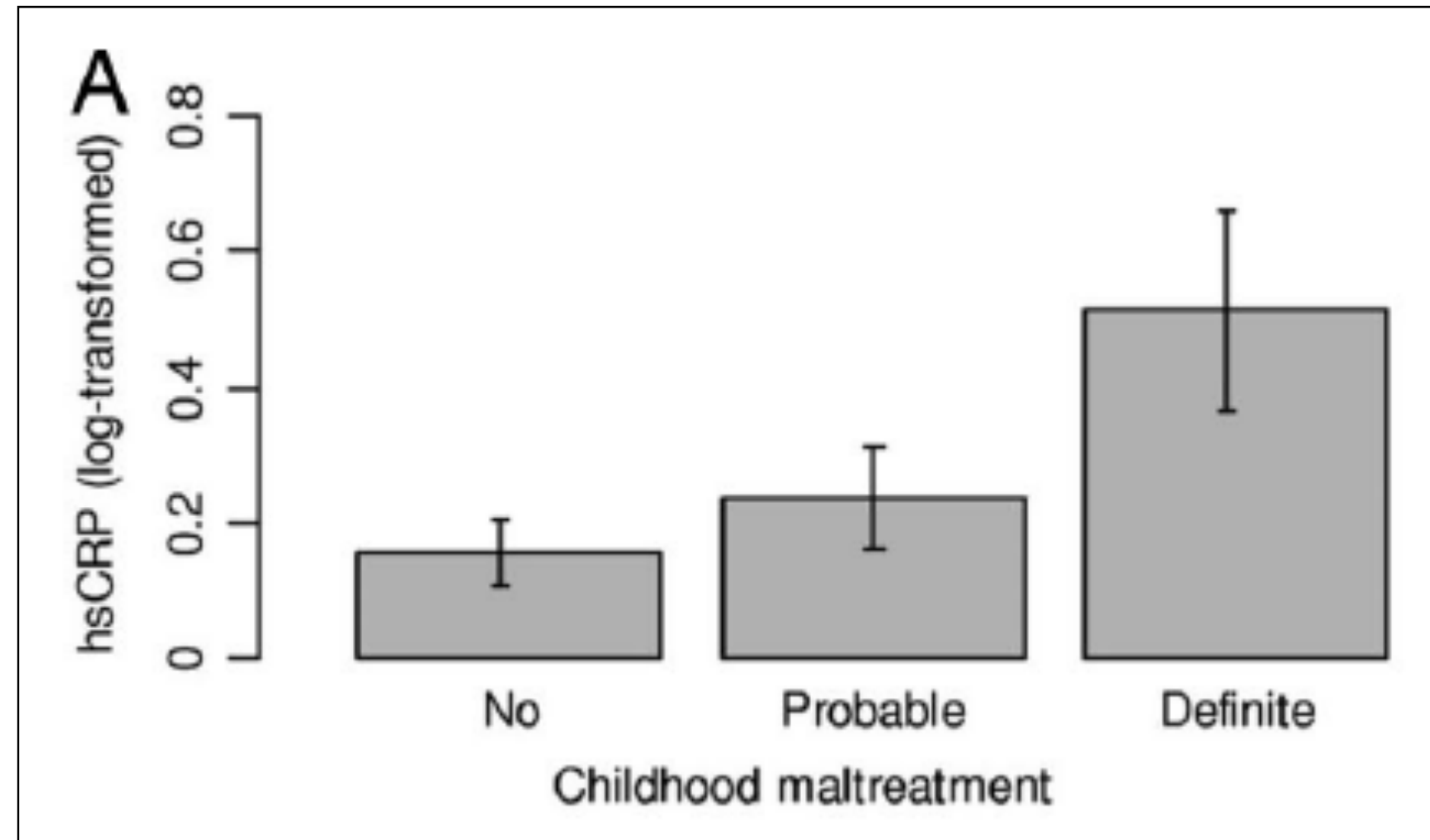


Article

Early-Life Adversity Leaves Its Imprint on the Oral Microbiome for More Than 20 Years and Is Associated with Long-Term Immune Changes

Eleftheria G. Charalambous ^{1,2} , Sophie B. Mériaux ¹, Pauline Guebels ¹, Claude P. Muller ¹, Fleur A. D. Leenen ¹, Martha M. C. Elwenspoek ¹, Ines Thiele ^{3,4,5,6}, Johannes Hertel ^{3,7} and Jonathan D. Turner ^{1,*} 

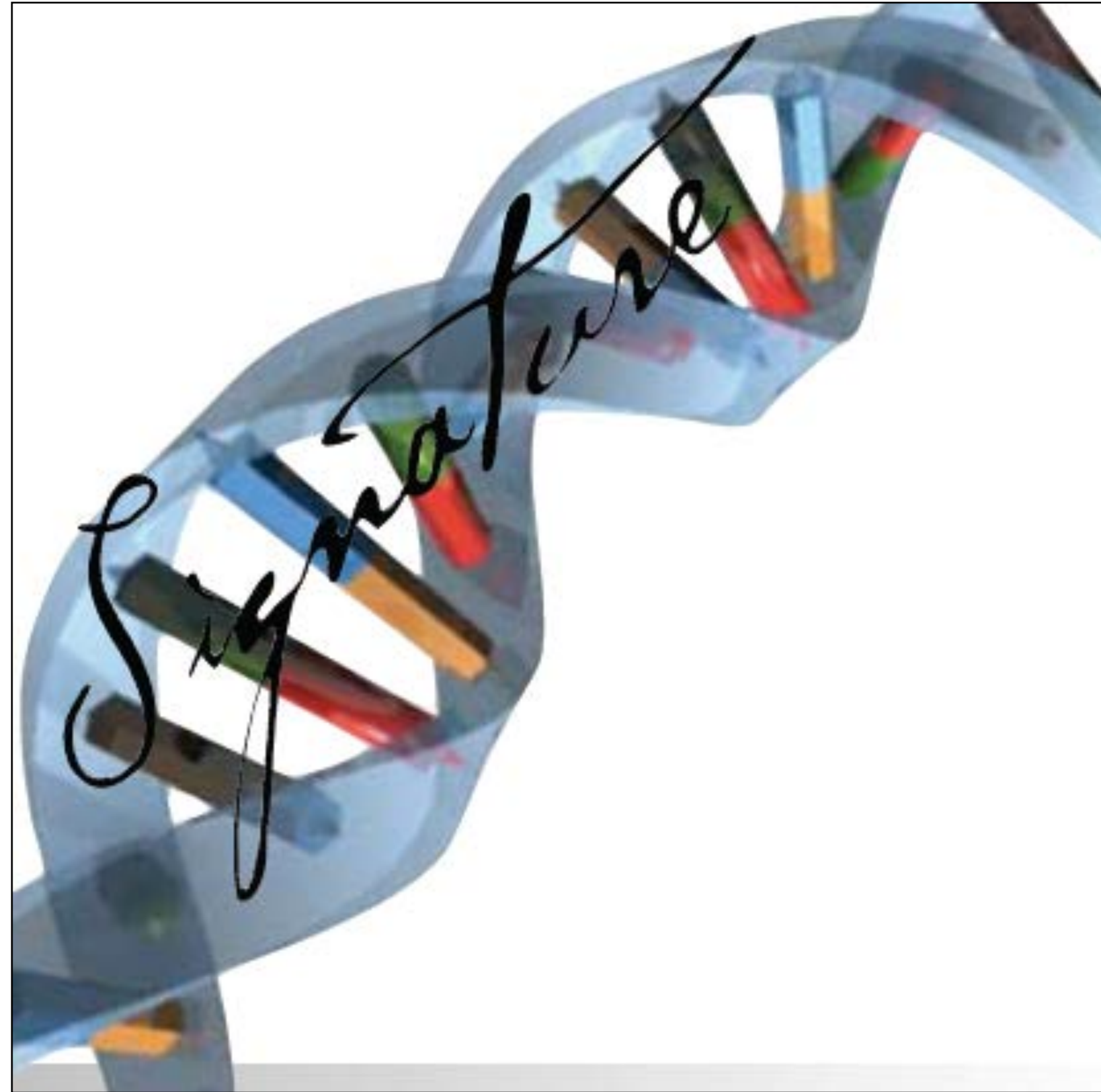
Early Life Adversity - Sustained Inflammatory State (Dunedin NZ Study)



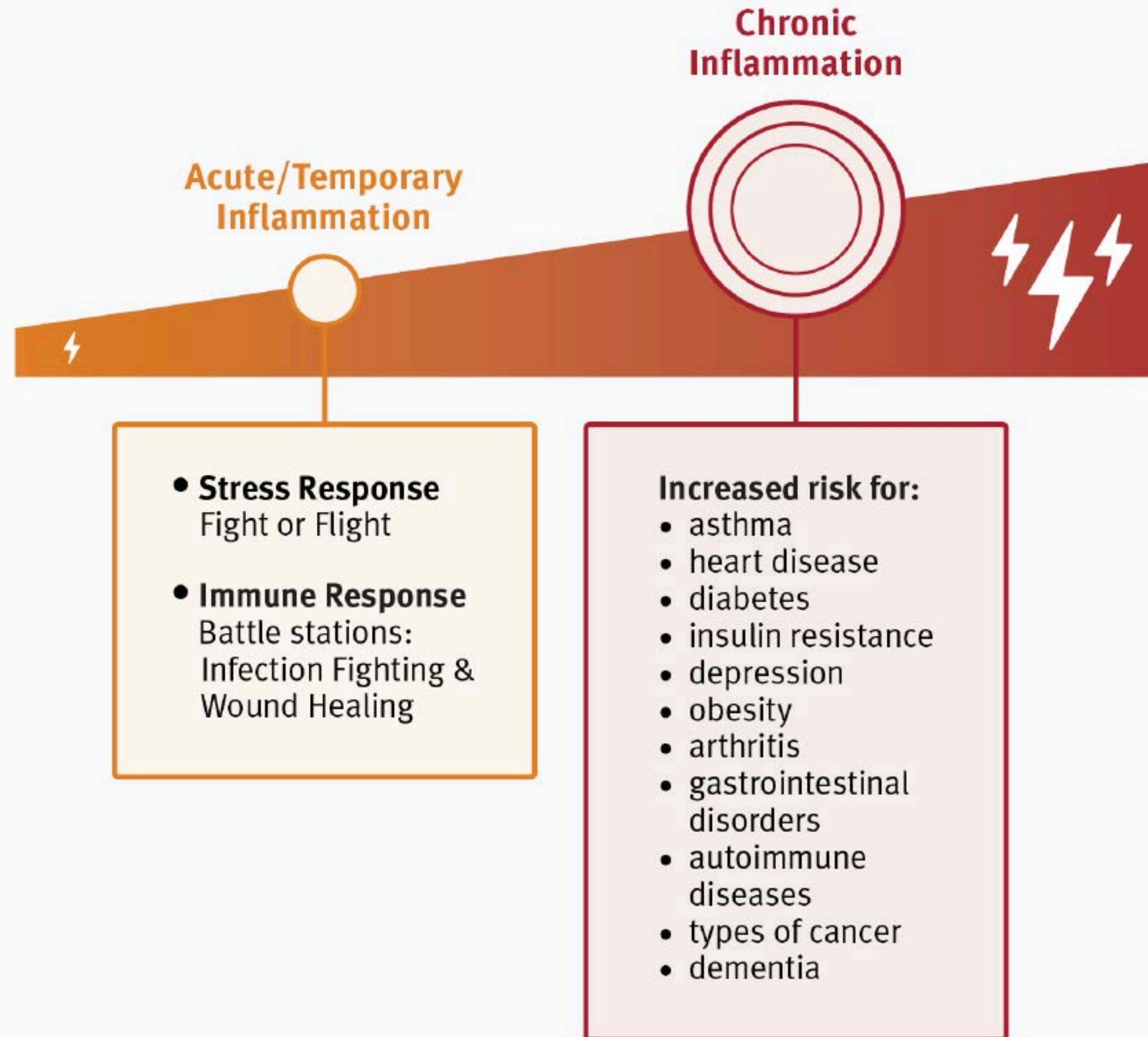
Danese et al 2007 PNAS

(Physical Abuse Associations Stronger - Baumeister et al 2016 Mol. Psychiatry)

Recall Epigenetics

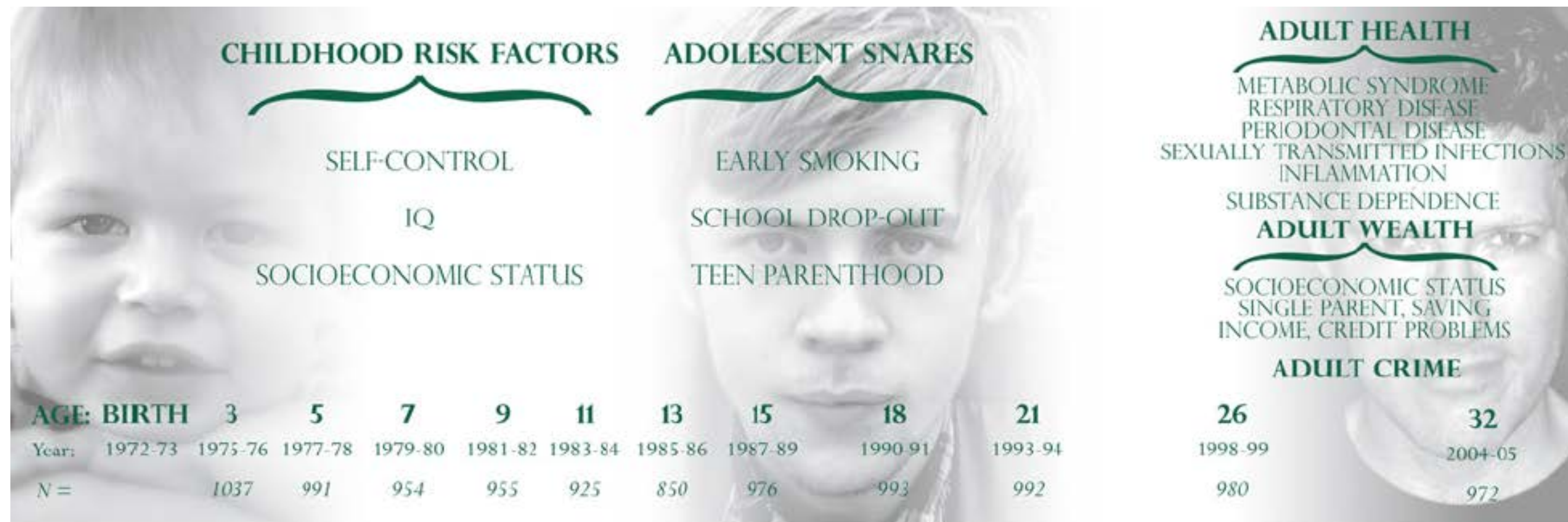


Acute to Chronic Inflammation

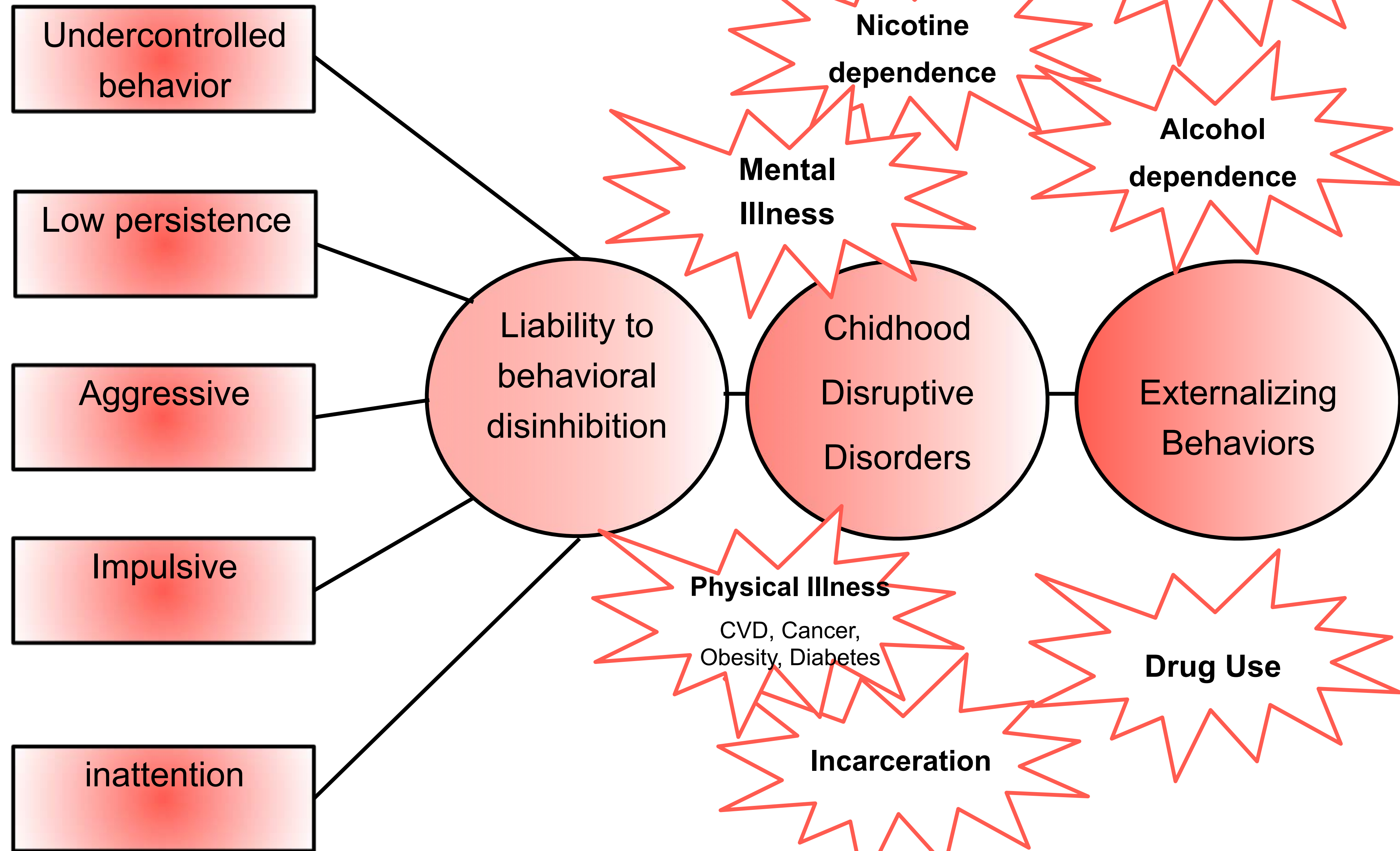


Early Executive Function Disruption - Predictor of At-Risk Adolescents and Adults

The Dunedin Study



Signs of Early Executive Function Disruption



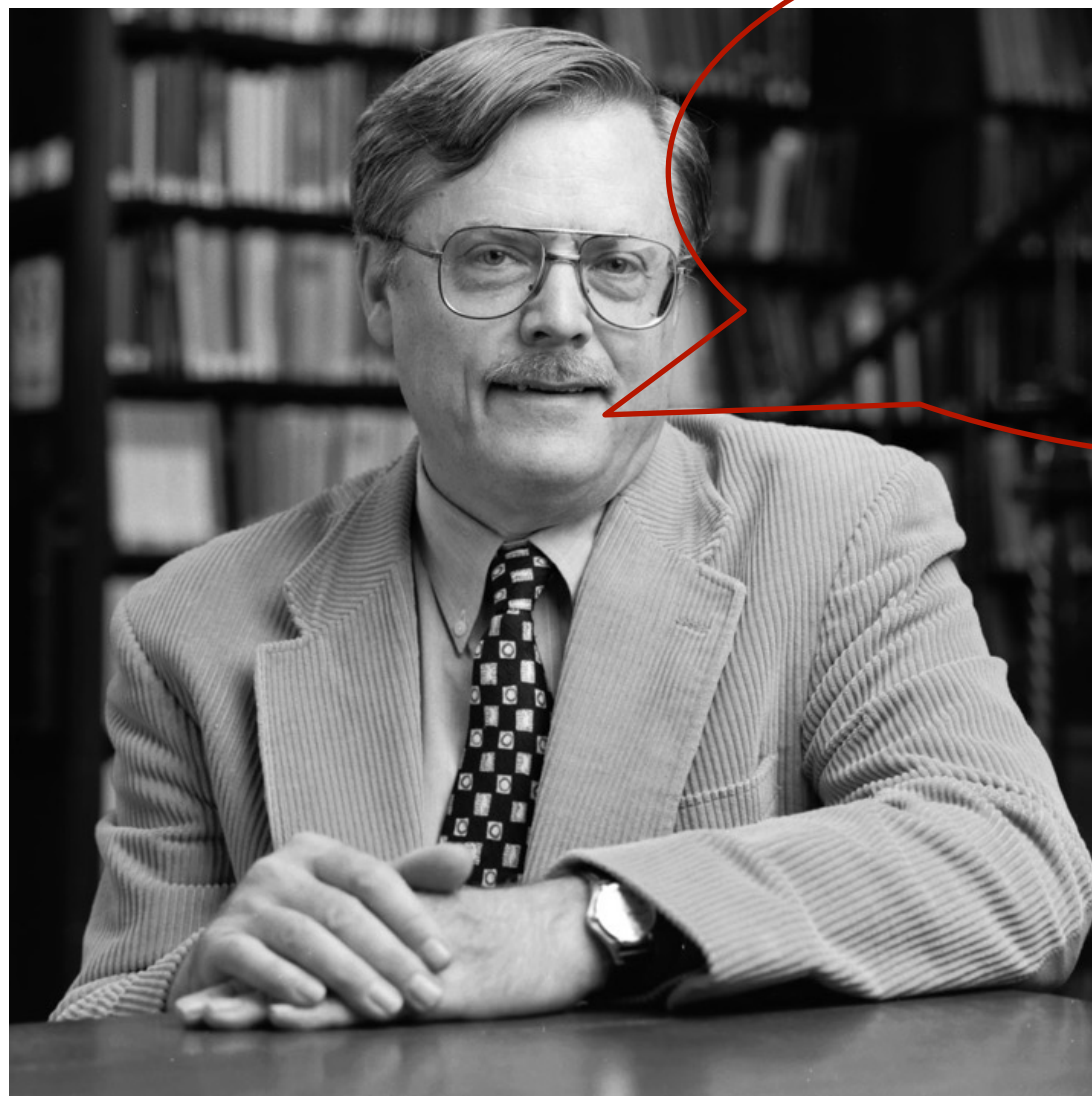
INBRIEF

Finding the Balance: Transforming How We Think About the Body's Response to Stress in Early Childhood

For the full paper on which this InBrief is based, see *Finding the Balance: Transforming How We Think About the Body's Response to Stress in Early Childhood*, Working Paper 18 (2026) from the National Scientific Council on the Developing Child

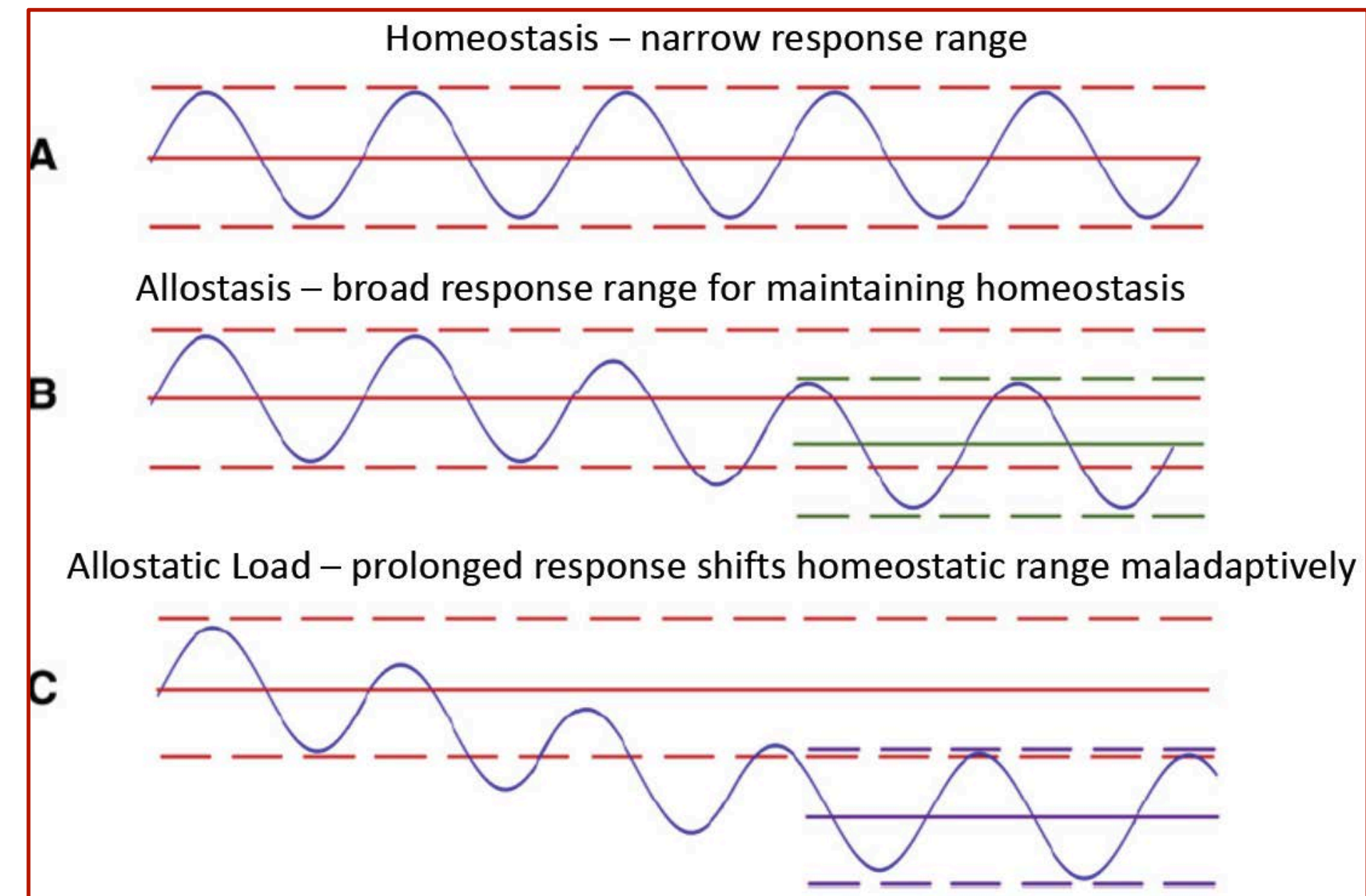
Working Paper #18

Can We Identify Mechanisms?



"For me, it's
simple -Energy
adaptation is the
#1 indicator of
allostatic load"

See Picard, M. & McEwen, B.S.
Psychosom Med 80, 126-140 (2018)



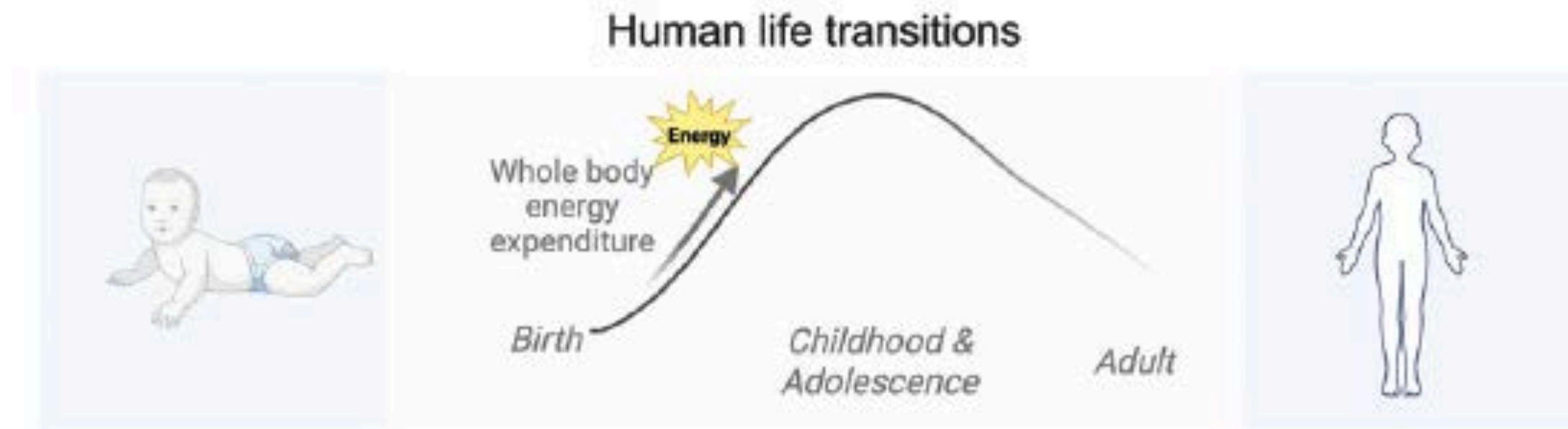
Thompson & Levitt, Neuron, 2010
McEwen & Gianaros, Ann Rev Med, 2011

During Development, Energy Expenditures
Are Required to Support Transitions

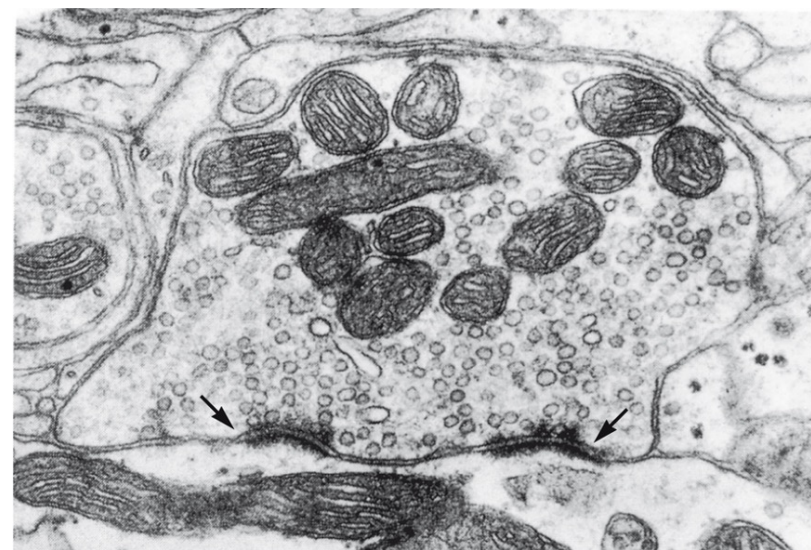
The Rippling impact of Disrupting Energy

a

Stressful (life) transitions



Brain Development Postnatally Has High Energy Demands



Synaptogenesis

Heuser and Reese in Kandel, Principles in Neural Science 5th edition

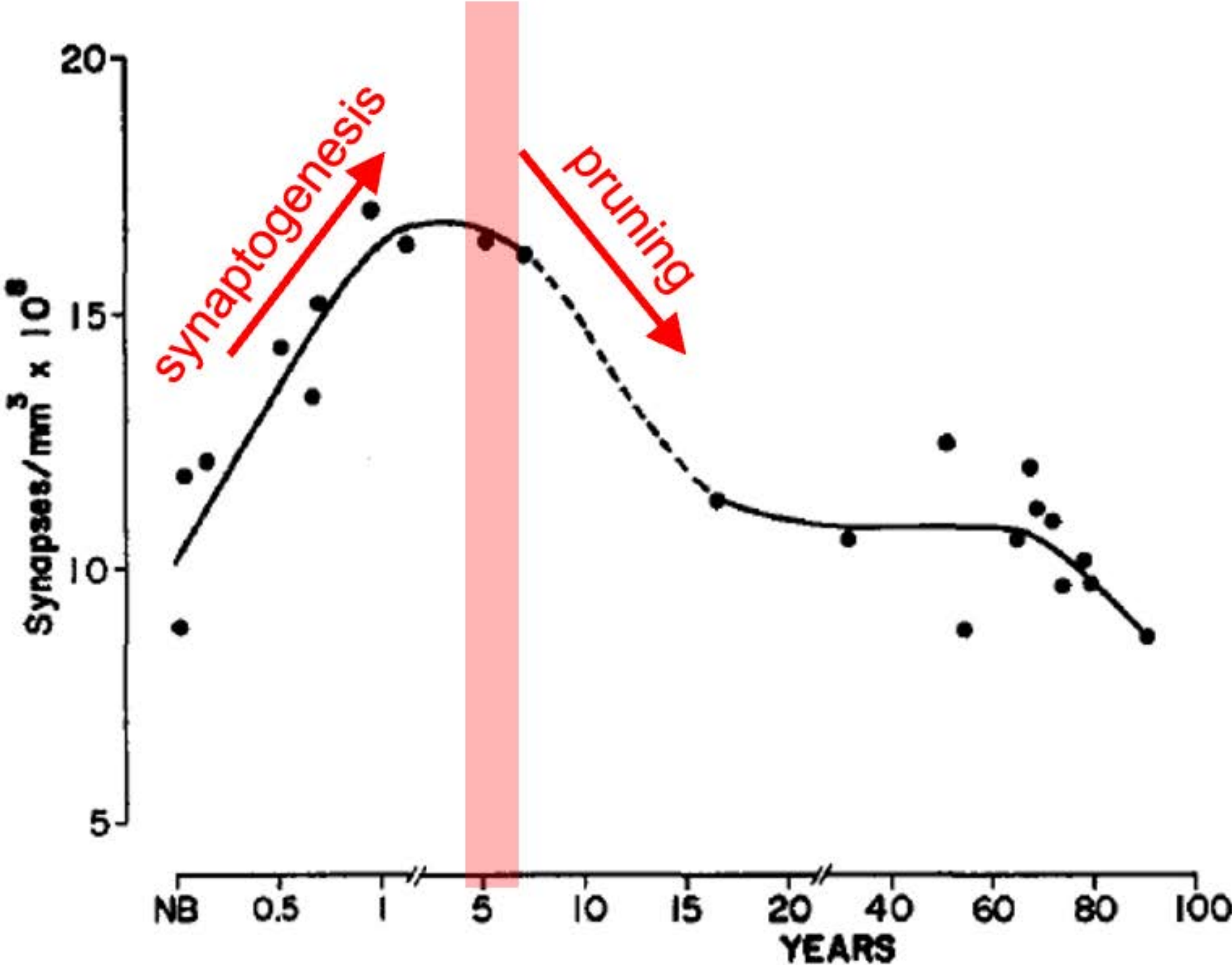
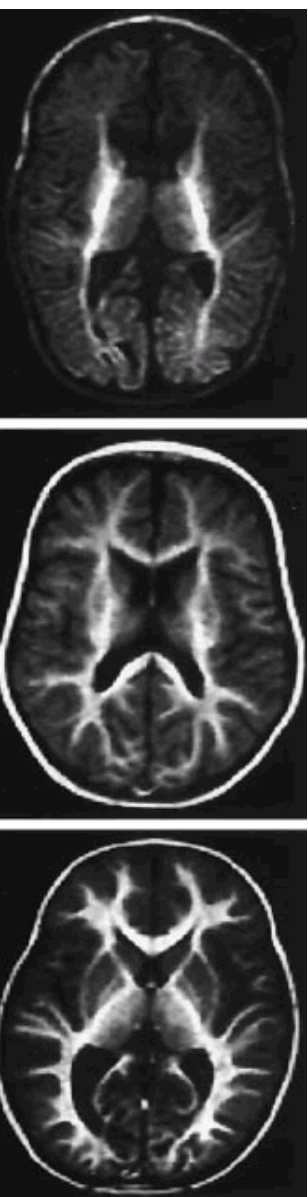
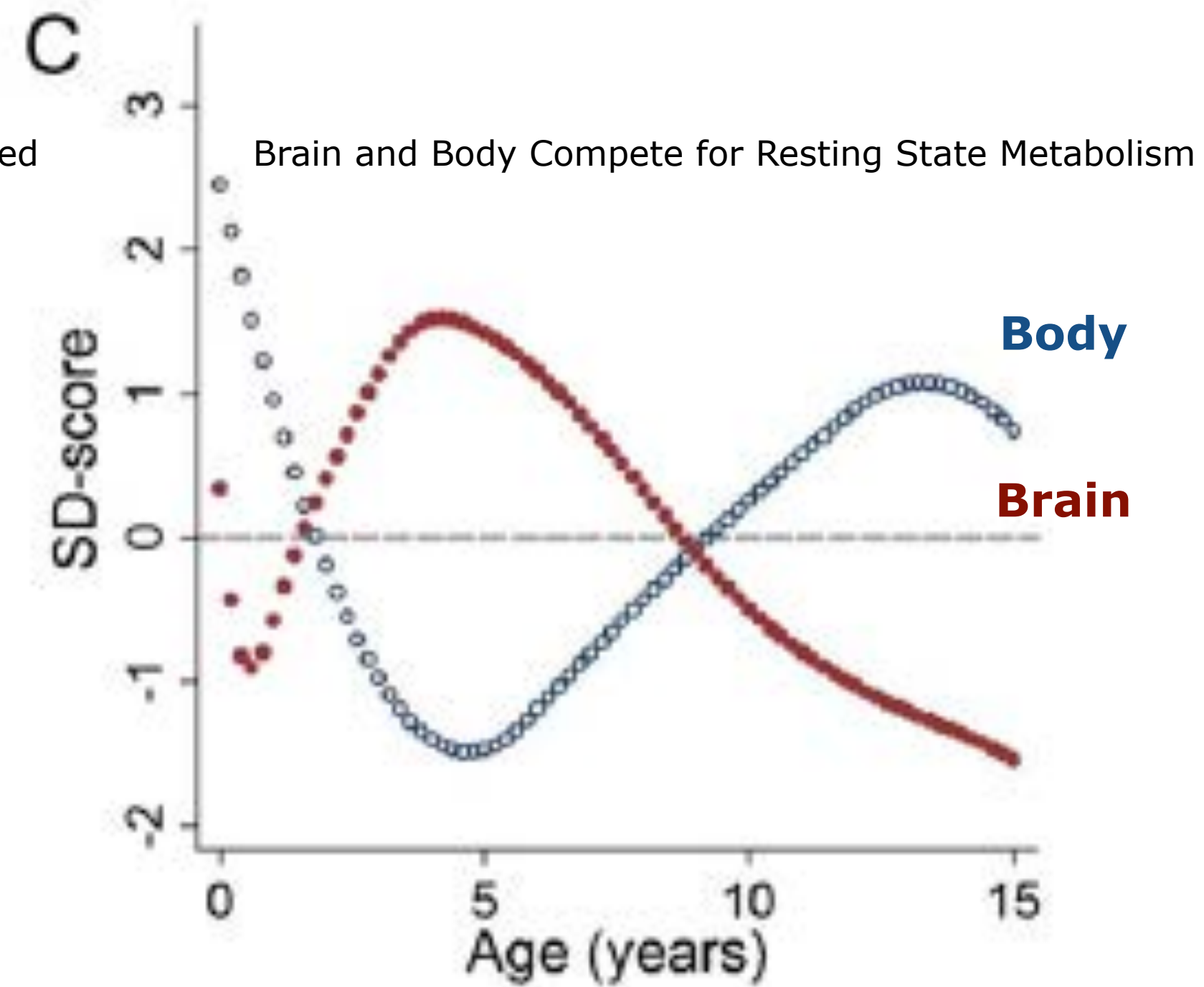
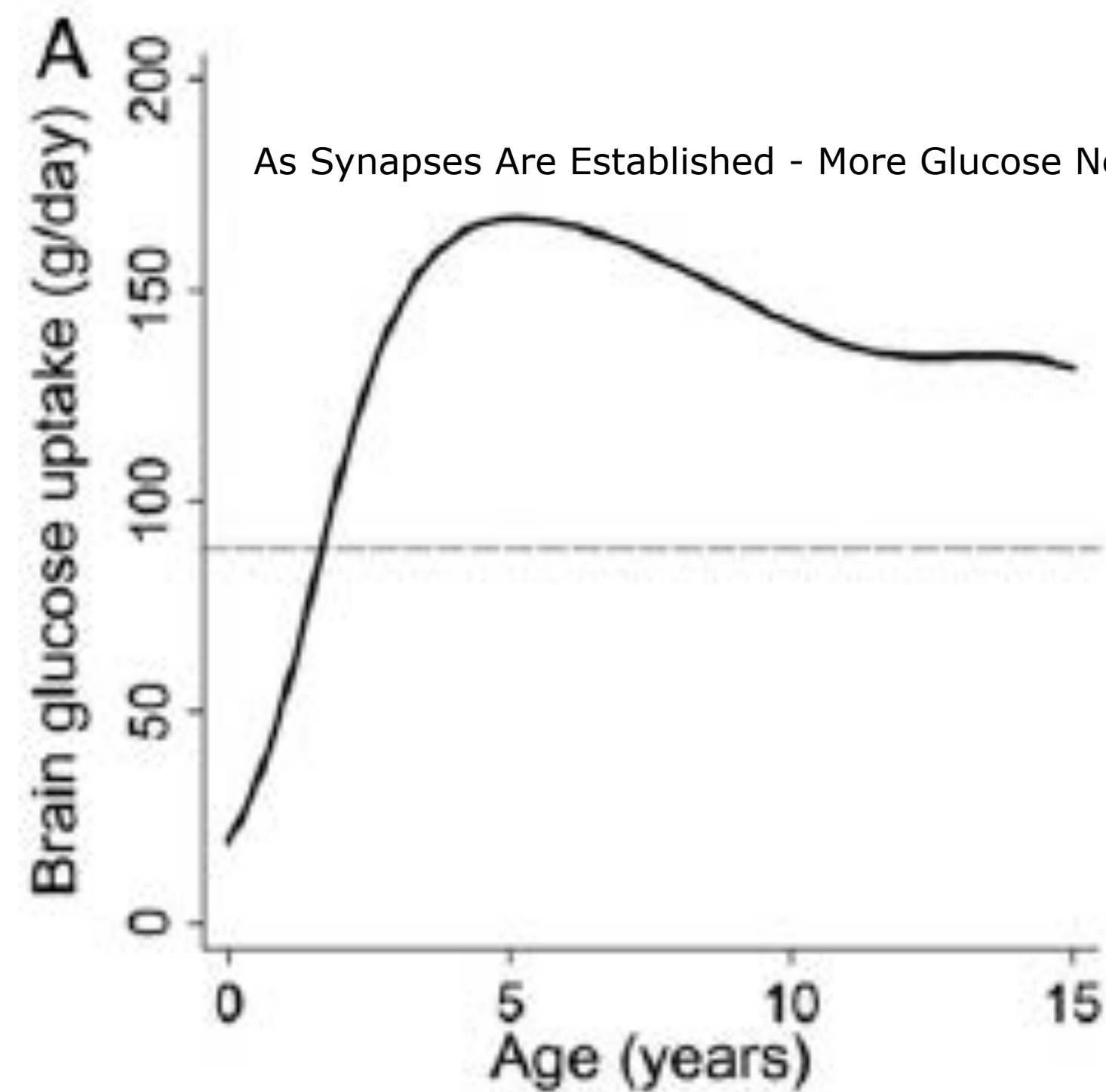


Fig. 3. Synapse counts in layer 3 of middle frontal gyrus as a function of age.

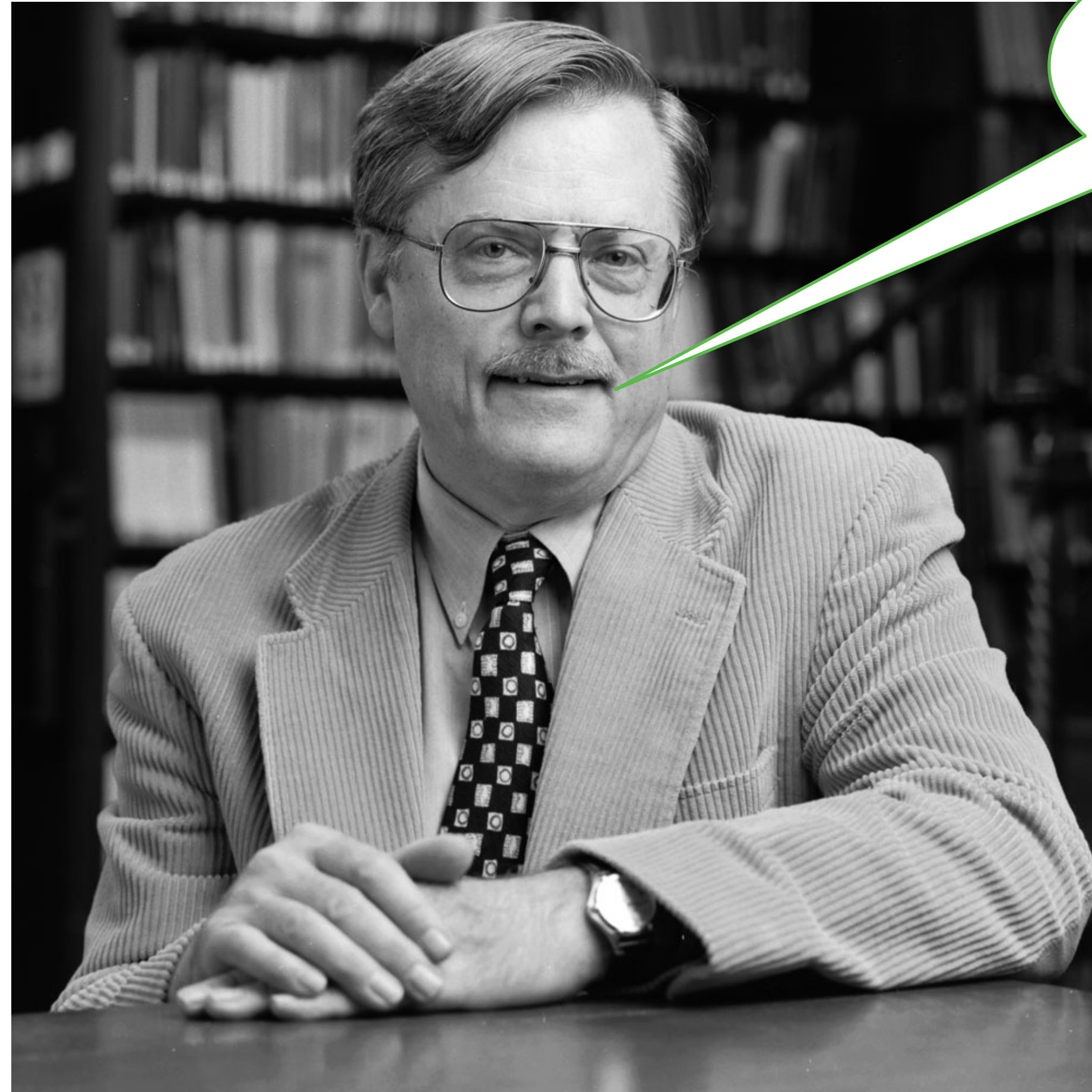


Myelination

Brain Glucose Use and Resting Metabolic Rate for Brain and Body - a Balance



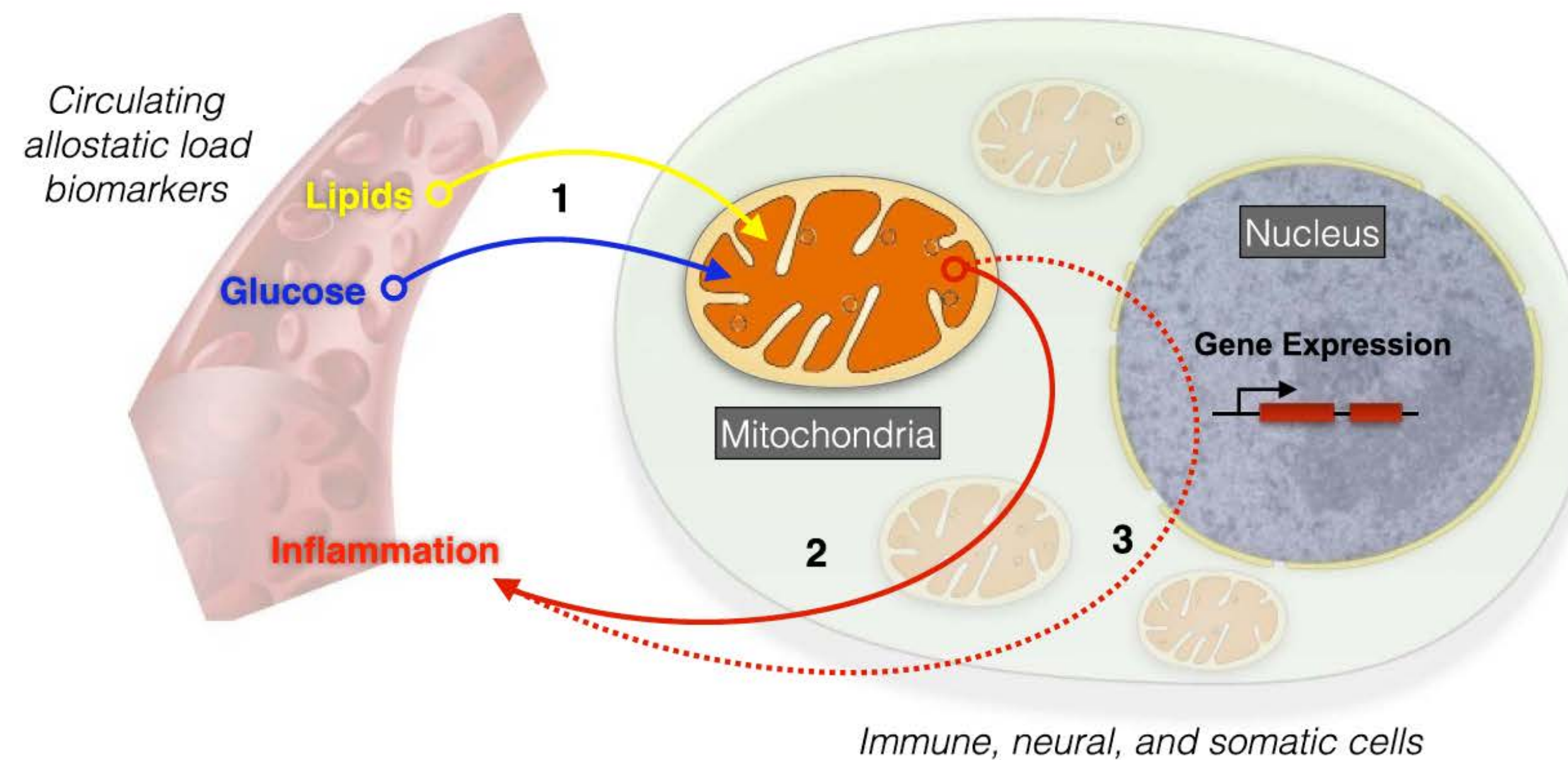
Bruce McEwen – stress, allostasis and adaptive processes



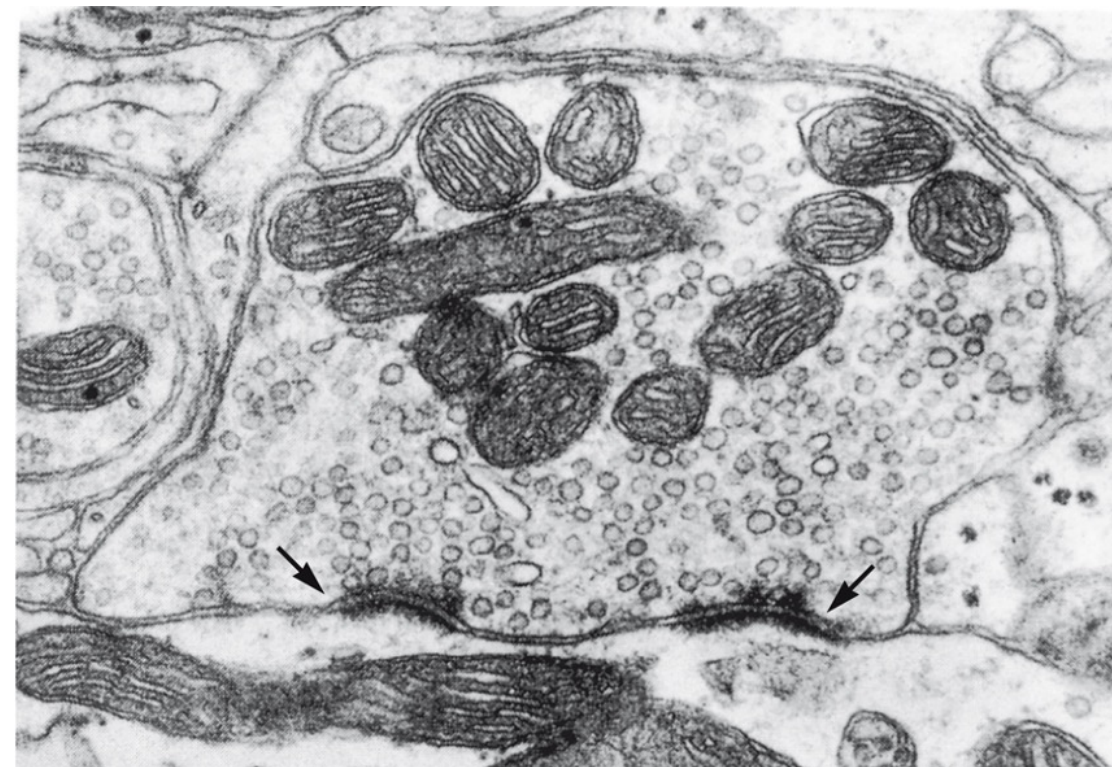
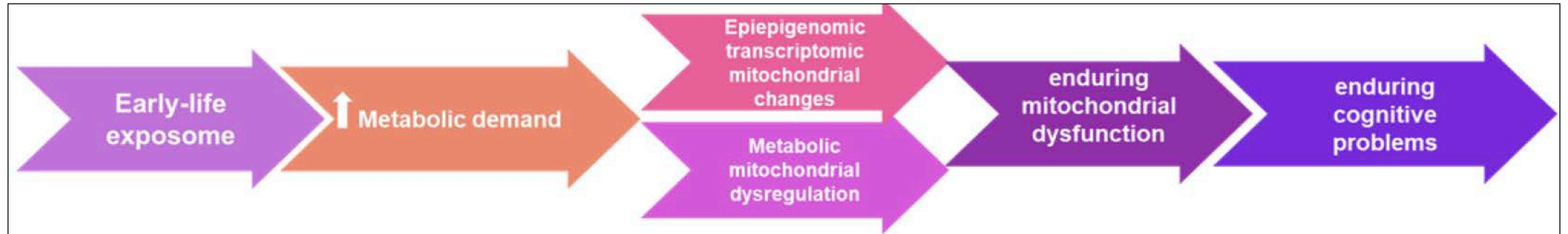
Mitochondria
keep track of
ELA

Mitochondrial Function As Node For Allostatic Load

(Picard and McEwen, Psychosomatic Medicine 2016)

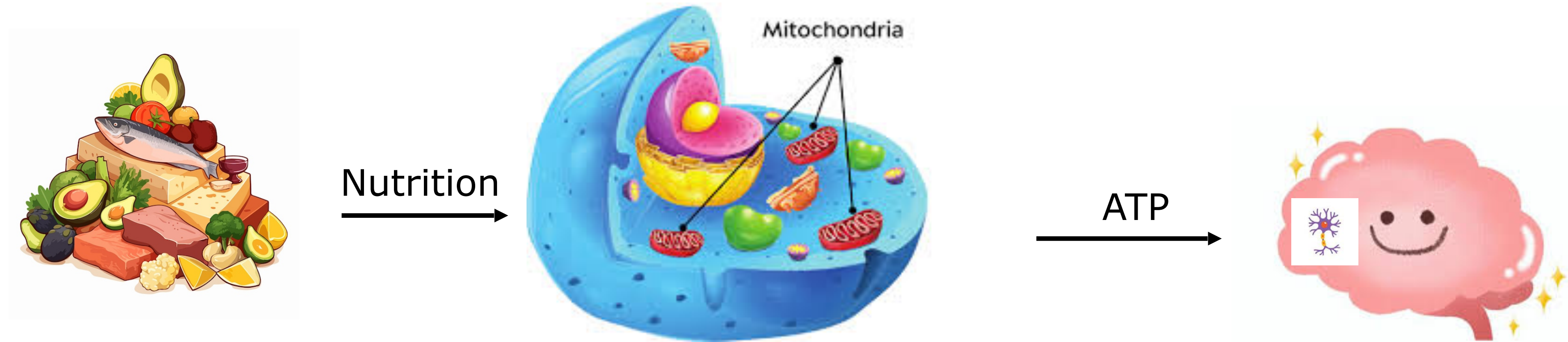


Metabolic System Vulnerability to ELA

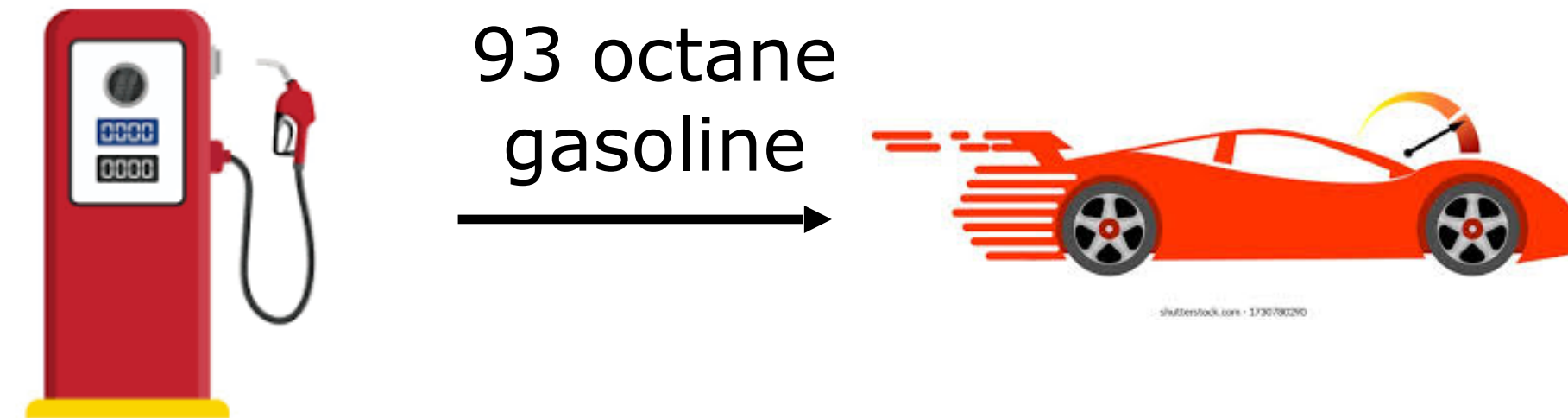


Look how many mitochondria in just 1 synapse!!

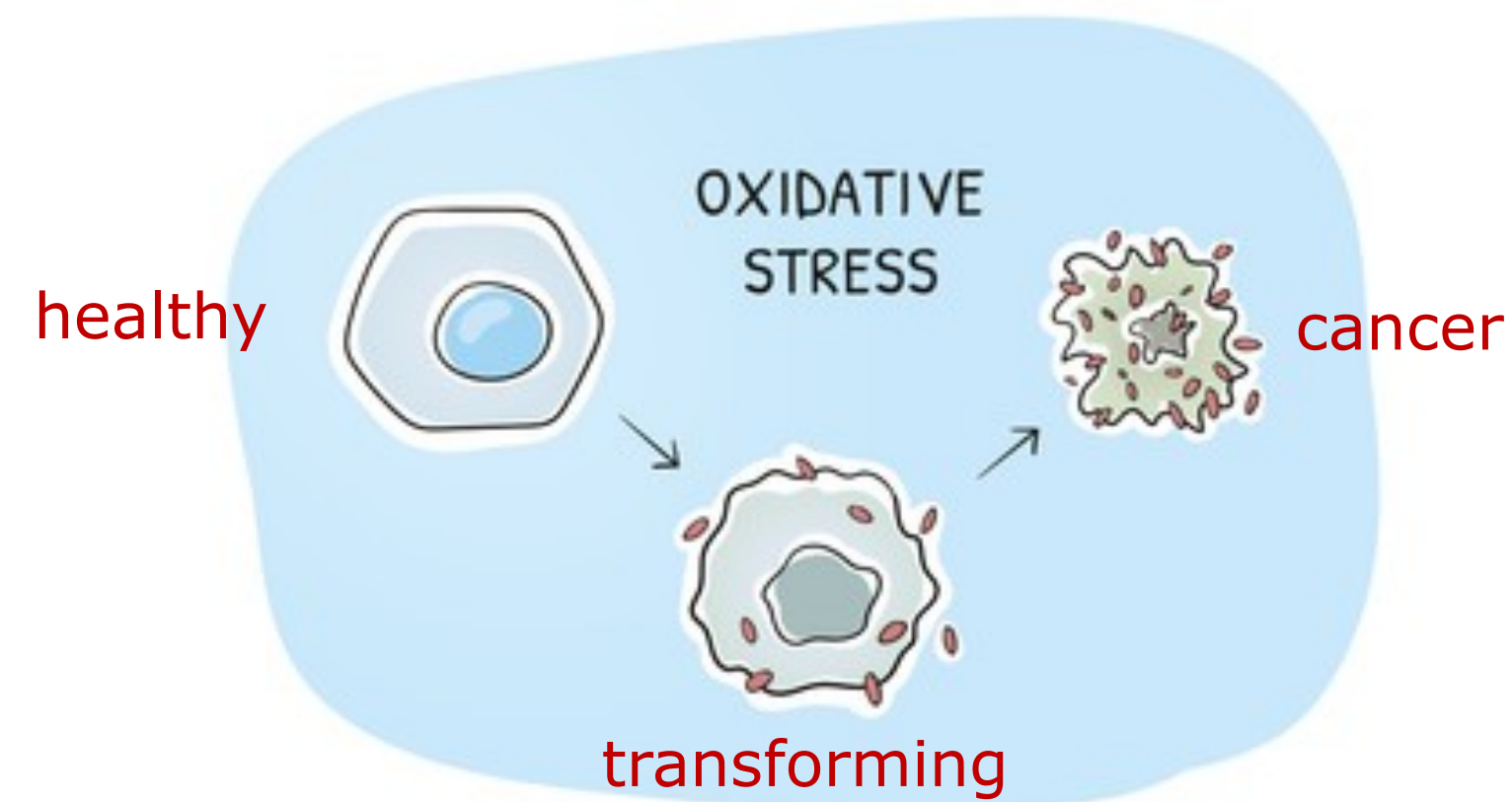
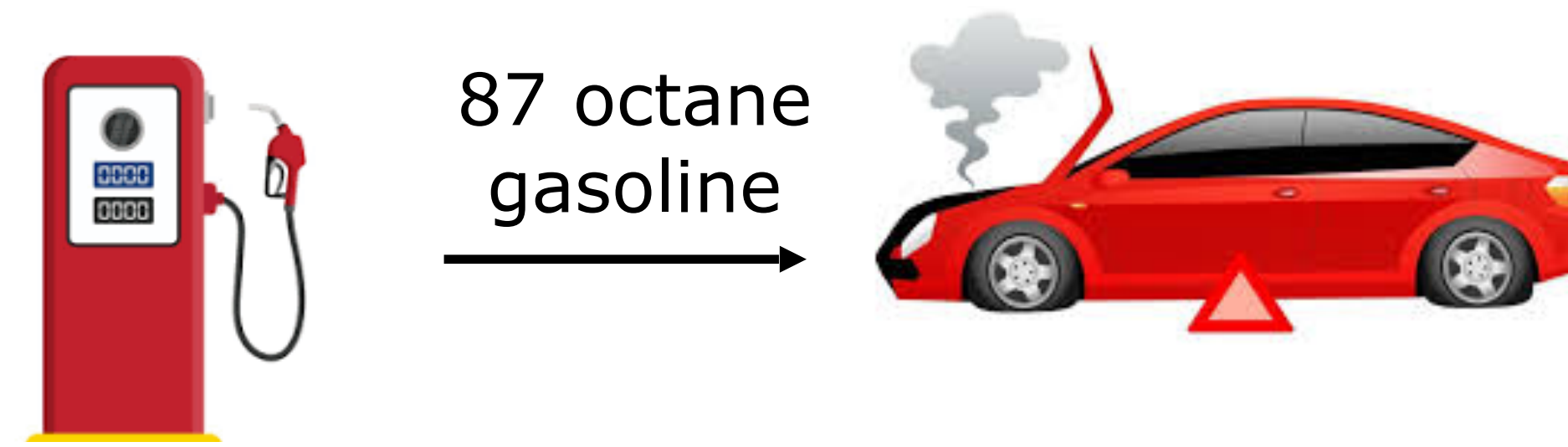
Like Cars, Your Cells Require Chemical Energy to Function – The Brain has the Highest Demand



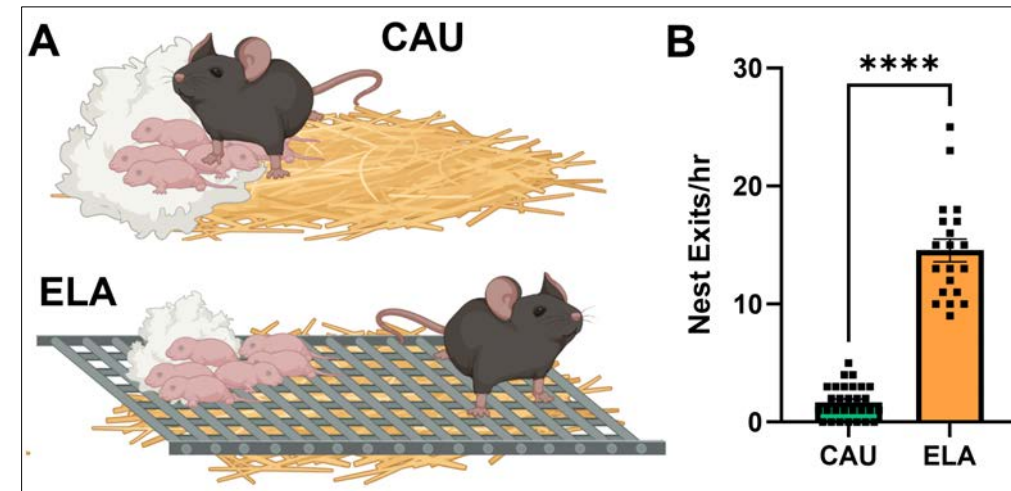
Mitochondria – the powerhouse of the cell!



Chronic Stress Generates a Toxic Stress Response That Targets The Metabolic Machinery of Cells

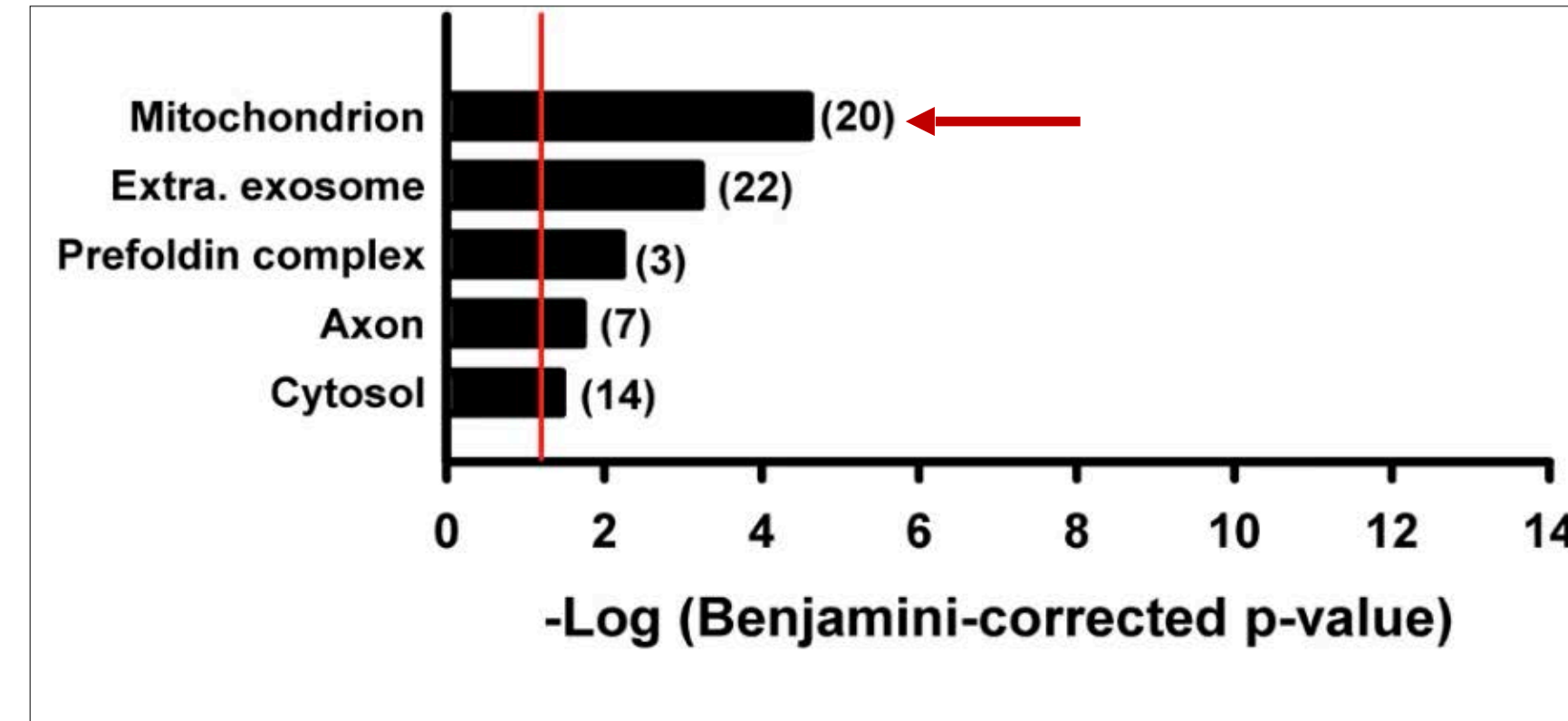


Modeling 'what to measure?'

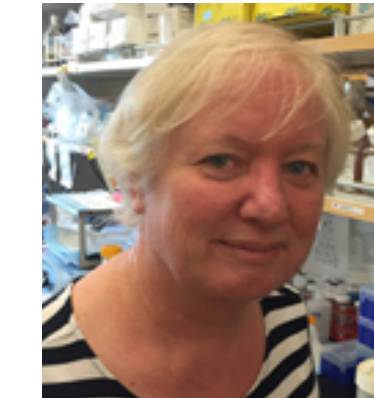


Walker, Claire-Dominique et al
Stress (2017)

hippocampus (cognitive)



Eagleson et al *Neurobiology of Stress* (2020)

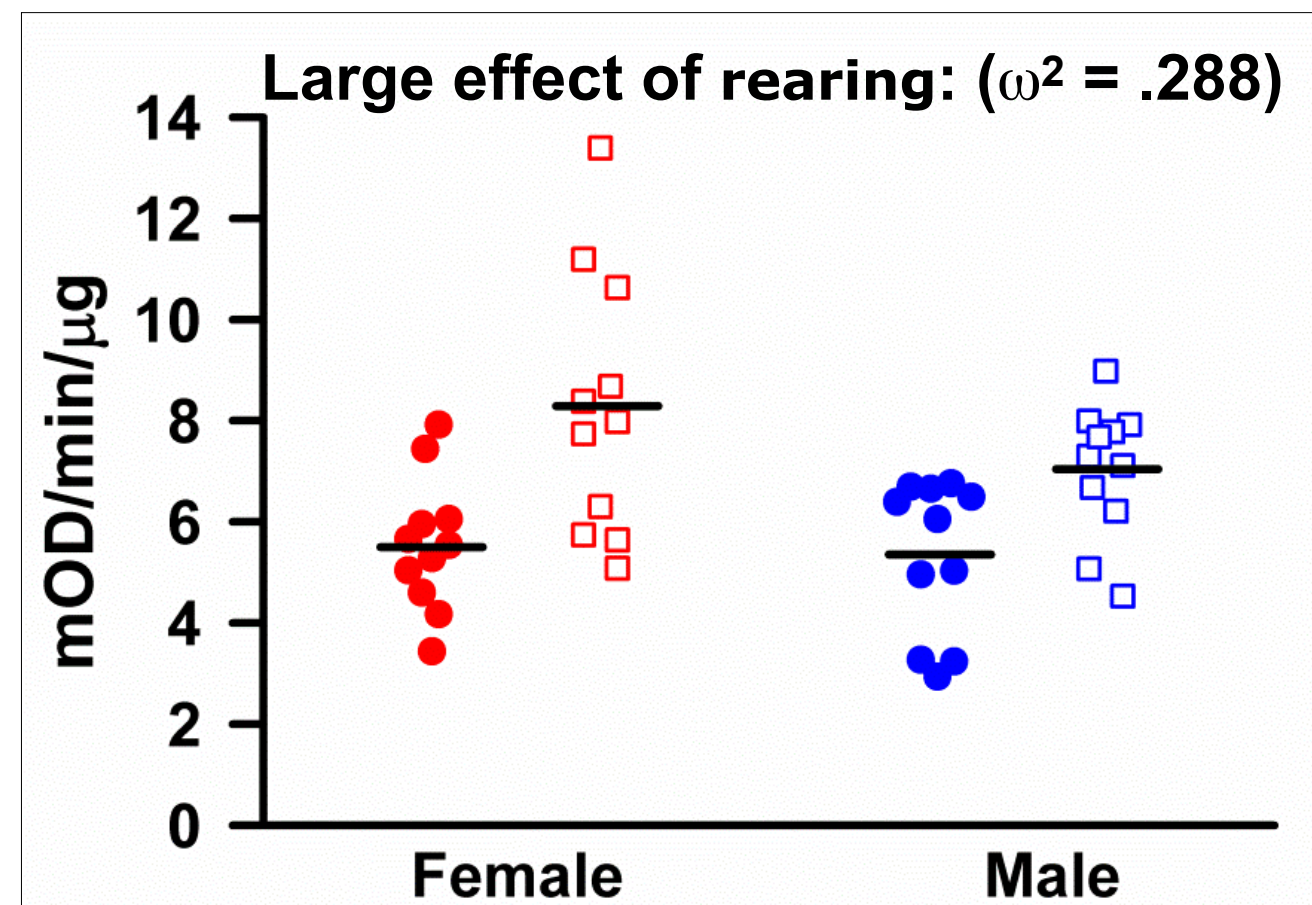


Kathie Eagleson

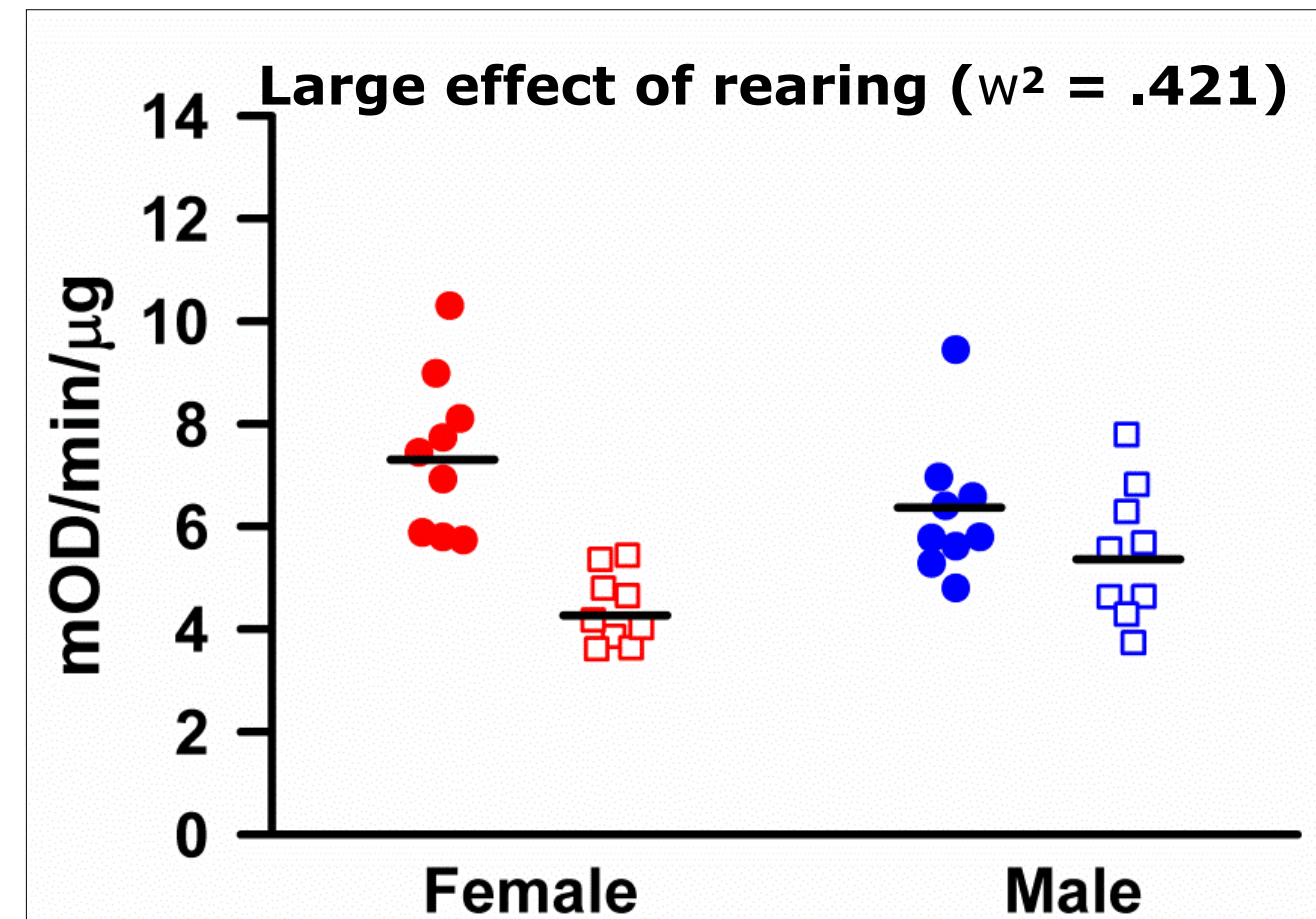


Complex I activity hippocampus

P21



P90



● Female control
□ Female ELS
● Male control
□ Male ELS

Cognitive and Reward Circuitry Disruptions

Infant Oxidative Stress Correlates with Poor Neurodevelopment

The Family First Study at CHLA

Gateau et al. *BMC Pediatrics* (2026) 26:368
<https://doi.org/10.1186/s12887-026-06702-z>

BMC Pediatrics

RESEARCH

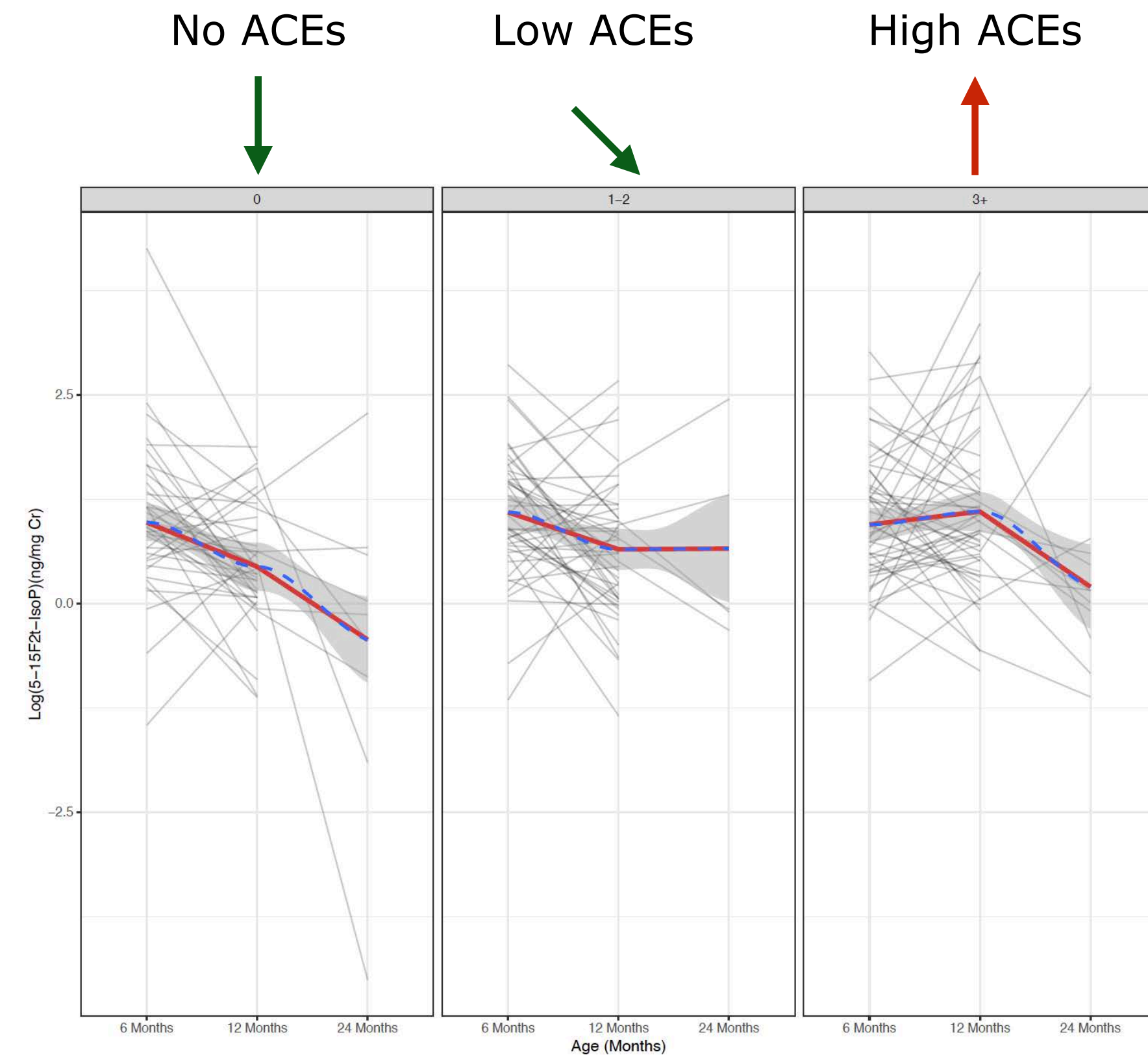
Open Access

Evaluating oxidative stress marker $F_{2\alpha}$ -
Isoprostanes relations to early life adversity
and as a predictor of neurodevelopment
in infants and toddlers

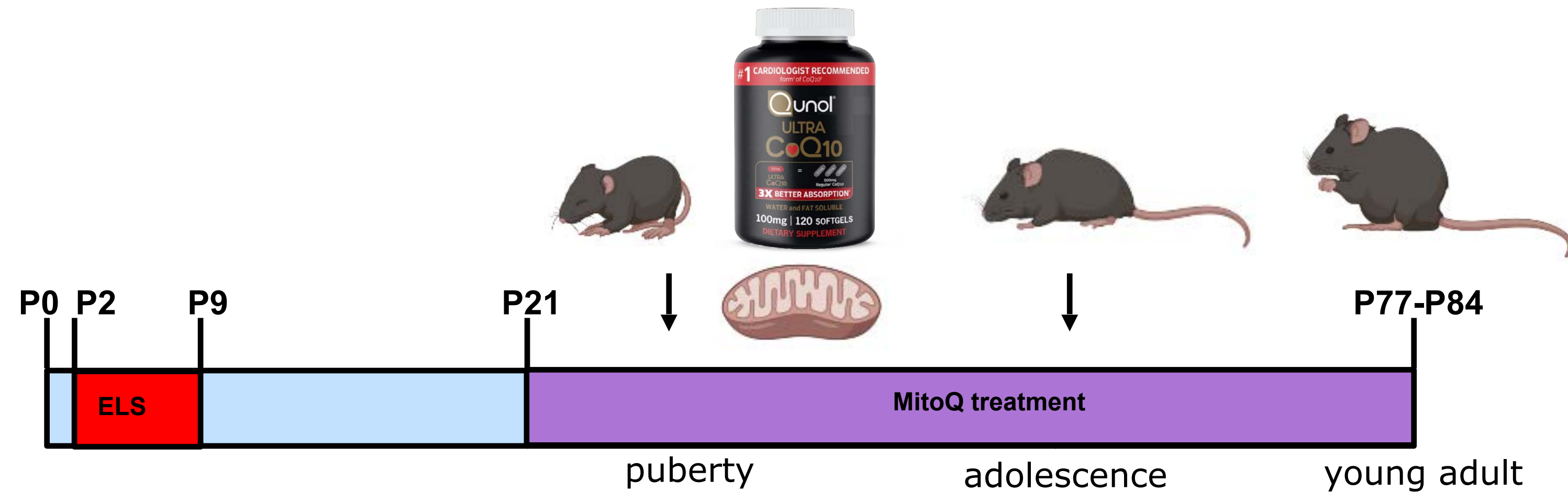


Kameelah Gateau^{1,3*}, Ramon Durazo-Arvizu^{2,3} and Pat Levitt^{2,3}

Oxidative Stress Change Over Time – (Maternal ACEs as a Moderator of Oxidative Stress Changes in their Child)

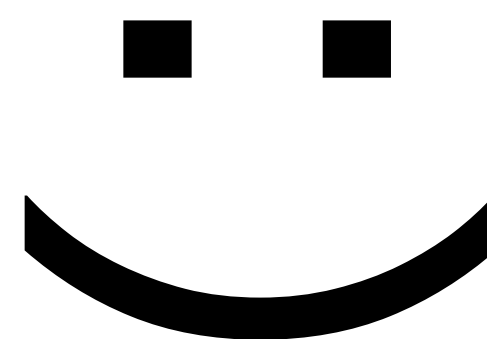


Can We Reverse Oxidative Stress to Improve Brain Function?



The Mice Normalize Their Energy Function and Rewarding Behaviors!





**It's a Good Thing That There are
Adaptive Processes.....**

Building Resilience is a Team Sport

[http://developingchild.harvard.edu/
resourcecategory/multimedia/](http://developingchild.harvard.edu/resourcecategory/multimedia/)

Neural Ingredients of Resilience

Executive Function: What is it?

[http://developingchild.harvard.edu/
resourcecategory/multimedia/](http://developingchild.harvard.edu/resourcecategory/multimedia/)

EF Develops Over Decades

Early Positive = Adaptive Skills

Early Negative = Later problems

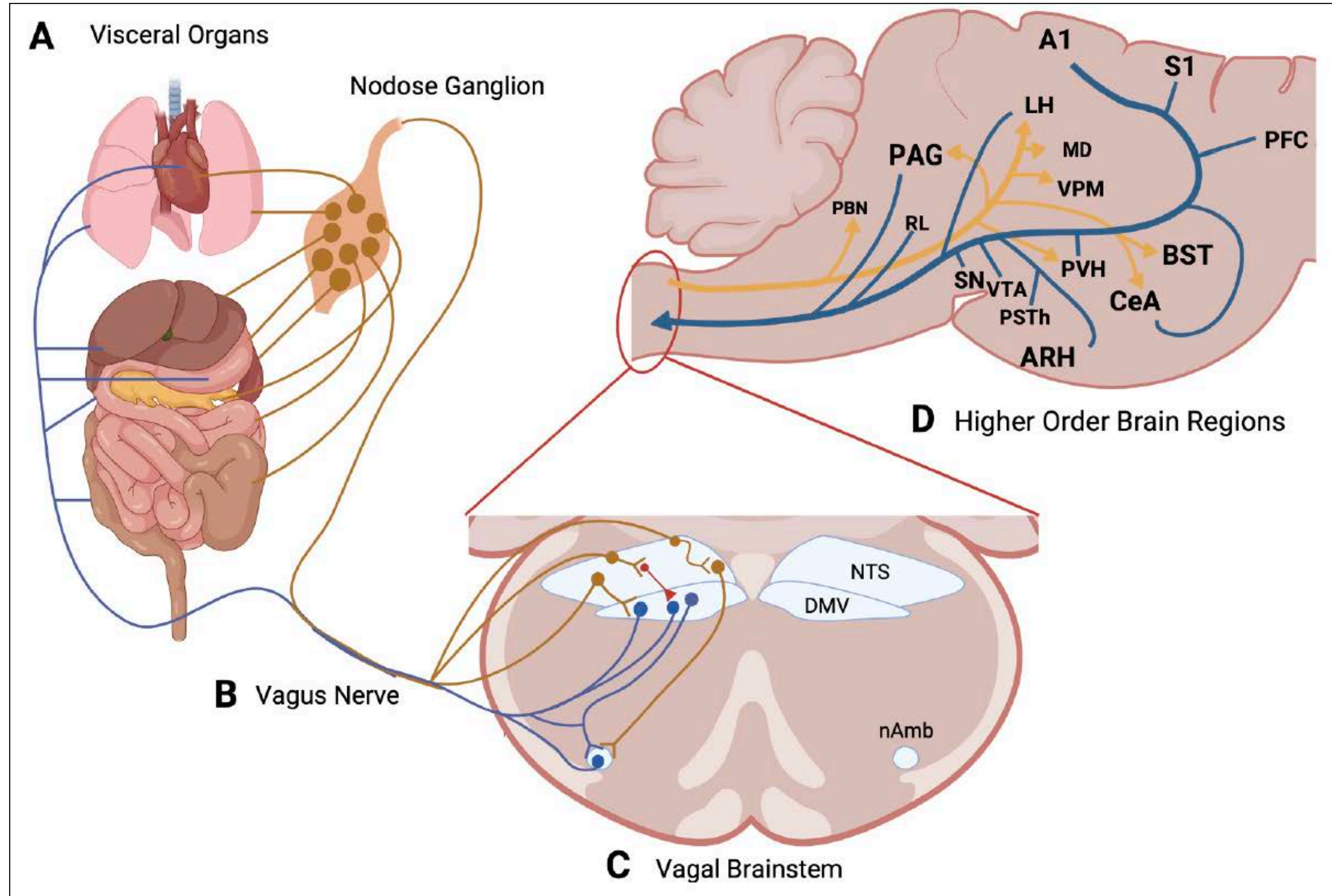
The Brain-Body Bridge: Vagal Resilience/Adaptive Capacity



Source: UpStreet Pittsburgh, info@upstreetpgh.org

Rest and Digest – Vagus nerve is active

Vagal Circuits: At the Center of the Action





Source: UpStreet Pittsburgh, info@upstreetpgh.org

Vagus nerve toggles between activation states to appropriately respond to acute stressors – adaptive response

A Final Thought

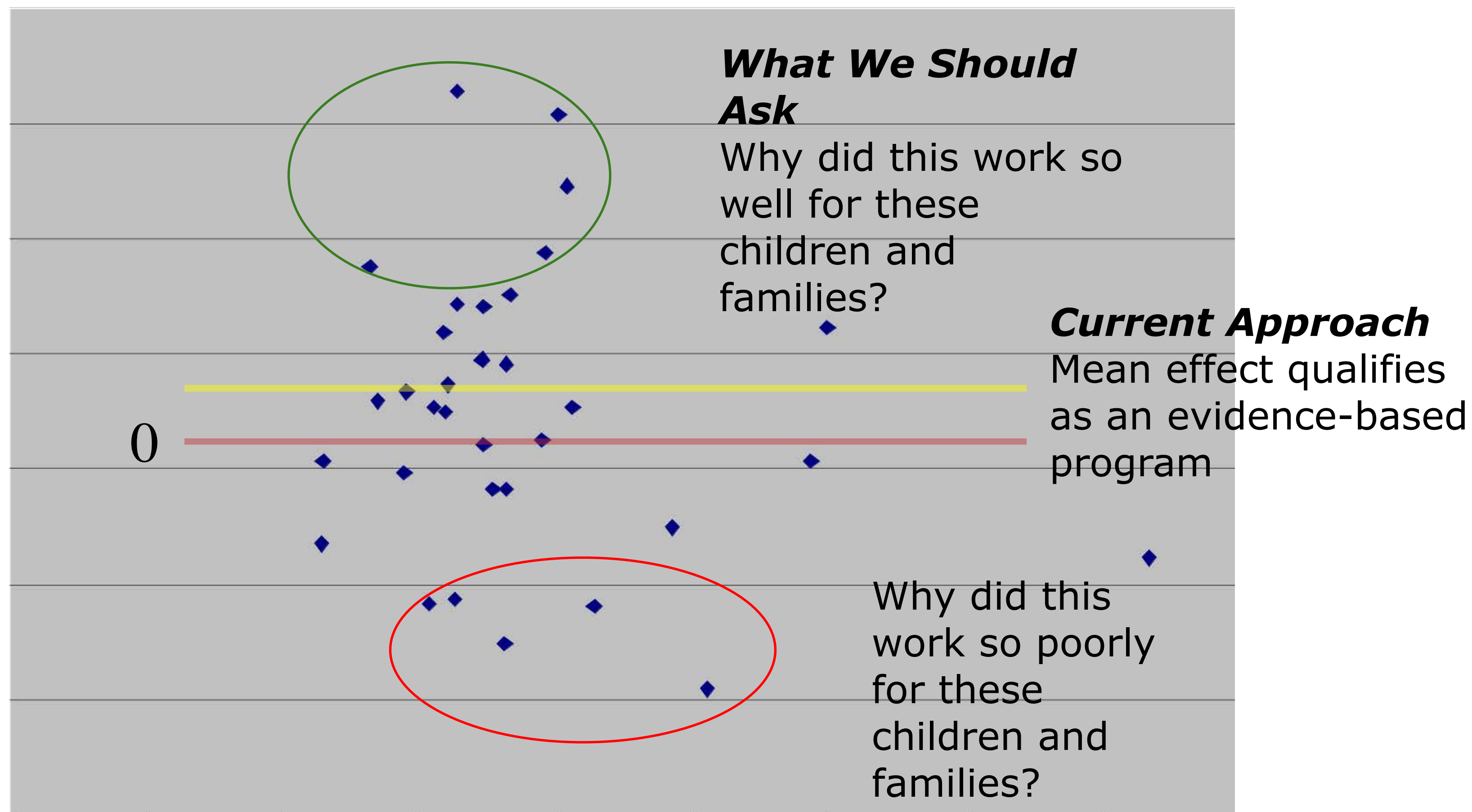
NATIONAL SCIENTIFIC COUNCIL ON THE DEVELOPING CHILD

A World of Differences: The Science of Human Variation Can Drive Early Childhood Policies and Programs to Bigger Impacts

WORKING PAPER 17

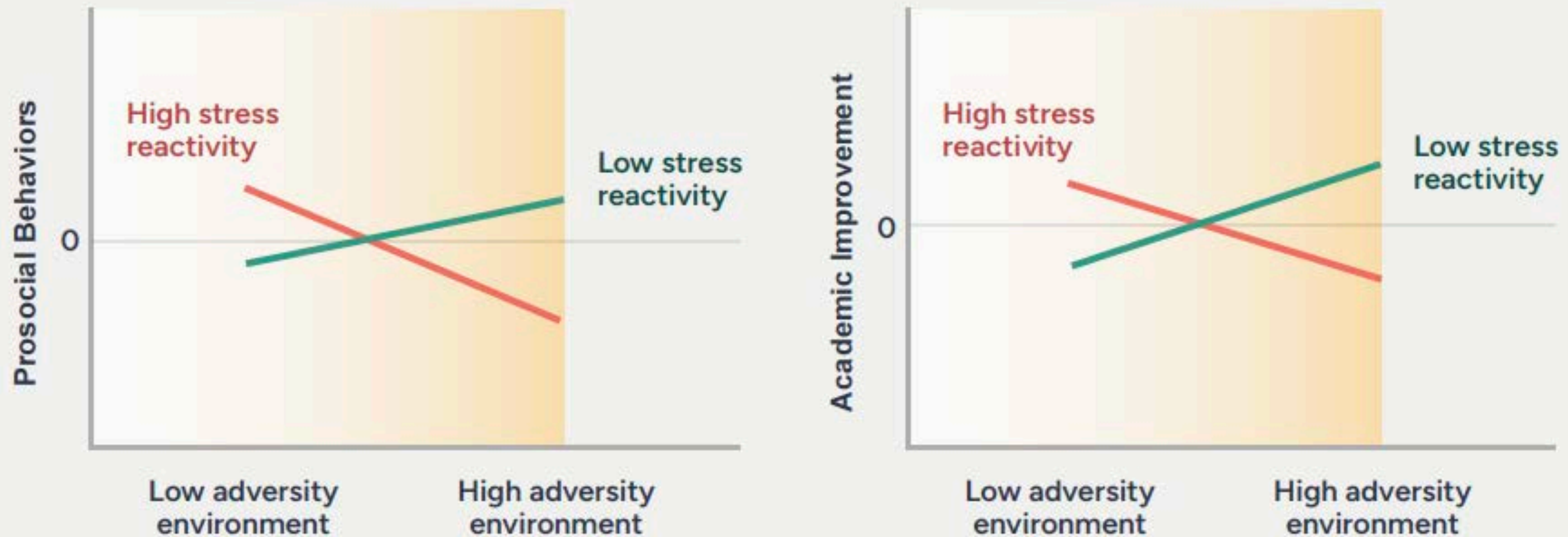


The Key to Larger Impacts at Scale: Greater Specificity About What Works for Whom and Why

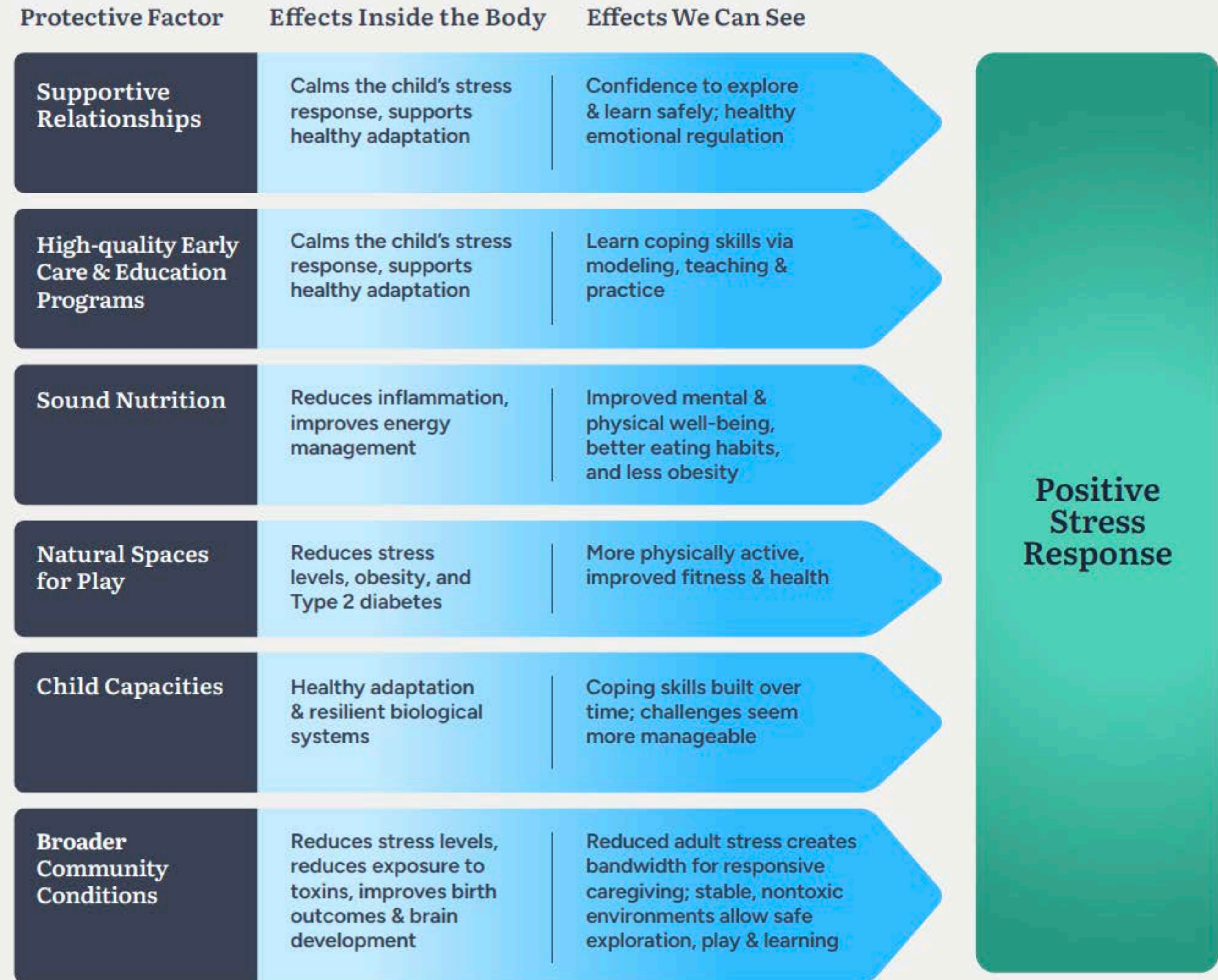


.....And Context Matters – A lot – Because
of Epigenetics!

Some Children Are More Sensitive to their Environment— For Better or Worse



How Protective Factors Support Healthy Child Development



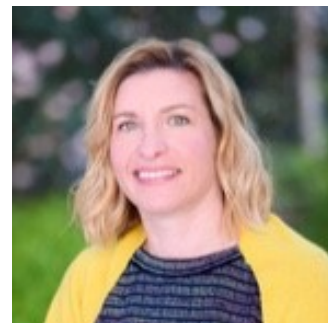
The Family First Study Ecosystem – An Interdisciplinary Collaboratory



Xiaowu Gai – MCW/CPM



Alex Markovitz- CPM



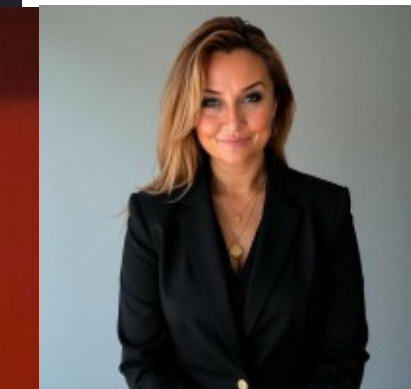
Gigi Ostrow - CPM



Hesam Hakimjavadi- CPM



Ginger Milne - VU



Angelica Pontuga - Tec



Ramon Durazo-Arvizu - Biostats

- CHLA Developmental Neuroscience and Neurogenetics Program
- CHLA Biostatistics, Data Management and Informatics Core
- USC Viterbi Computer Science – Social Robotics Laboratory
- CHLA Center for Personalized Medicine
- UAB Eicosanoid Laboratory
- Tecnológico de Monterrey + FEMSA - Centro de Primera Infancia

plevitt@chla.usc.edu

<https://www.chla.org/profile/pat-levitt-phd>

<https://firstplace.gse.harvard.edu/national-scientific-council/>