TTAC

Perinatal and Early Childhood Mental Health Network

Training and Technical Assistance Center

Optimizing Foundations of Mental Health: A Perinatal Prevention Targeting Offspring Neurodevelopment During Pregnancy and the First Year of Life

Presented by
Joan Luby, MD

Samuel and Mae S. Ludwig
Professor of Psychiatry (Child)

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.

TTAC Perinatal and Early Childhood Mental Health Network Training and Technical Assistance Center | NEW YORK CENTER FOR CHILD DEVELOPMENT | McSILVER INSTITUTE FOR POVERTY POLICY AND RESEARCH NEW YORK UNIVERSITY

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- View upcoming and archived content, trainings, and resources on the **Trainings page.**
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Training and Technical Assistance Center

NEW YORK CENTER FOR CHILD DEVELOPMENT

McSILVER INSTITUTE
FOR POVERTY POLICY AND RESEARCH
NEW YORK UNIVERSITY

Washington University in St. Louis
School of Medicine

OPTIMIZING FOUNDATIONS OF MENTAL HEALTH: A PERINATAL PREVENTION TARGETING OFFSPRING NEURODEVELOPMENT DURING PREGNANCY AND THE FIRST YEAR OF LIFE

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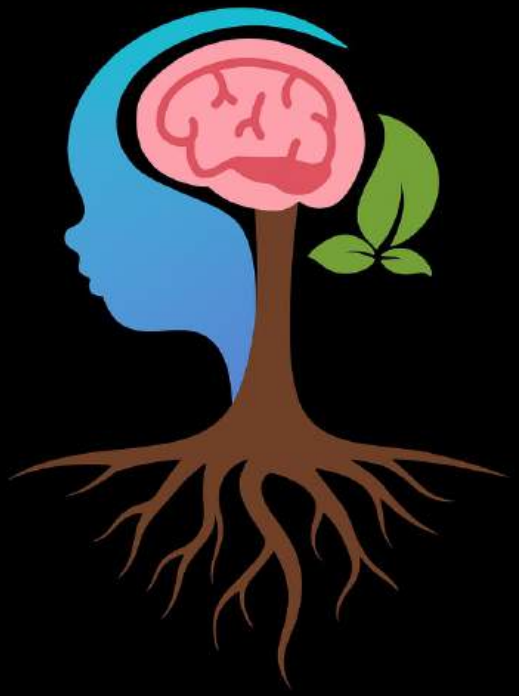
EARLY EMOTIONAL DEVELOPMENT PROGRAM



WashU Medicine

EARLY EMOTIONAL DEVELOPMENT PROGRAM

Focus on earliest identification of mental disorders.

Earlier intervention provides a window of opportunity for more effective treatments.

Using a dyadic approach can facilitate enduring changes in parenting across early development

The New York Times

Magazine

WORLD | U.S. | N.Y. / REGION | BUSINESS | TECHNOLOGY | SCIENCE | HEALTH | SPORTS | OPINION

Can Preschoolers Be Depressed?

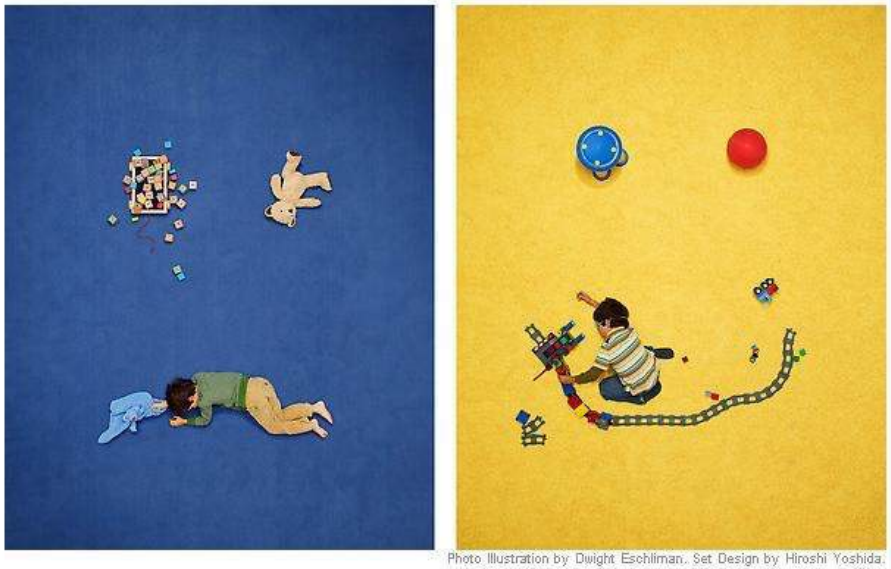


Photo Illustration by Dwight Eschliman. Set Design by Hiroshi Yoshida.

By PAMELA PAUL
Published: August 25, 2010

Kiran didn't seem like the type of kid parents should worry about.

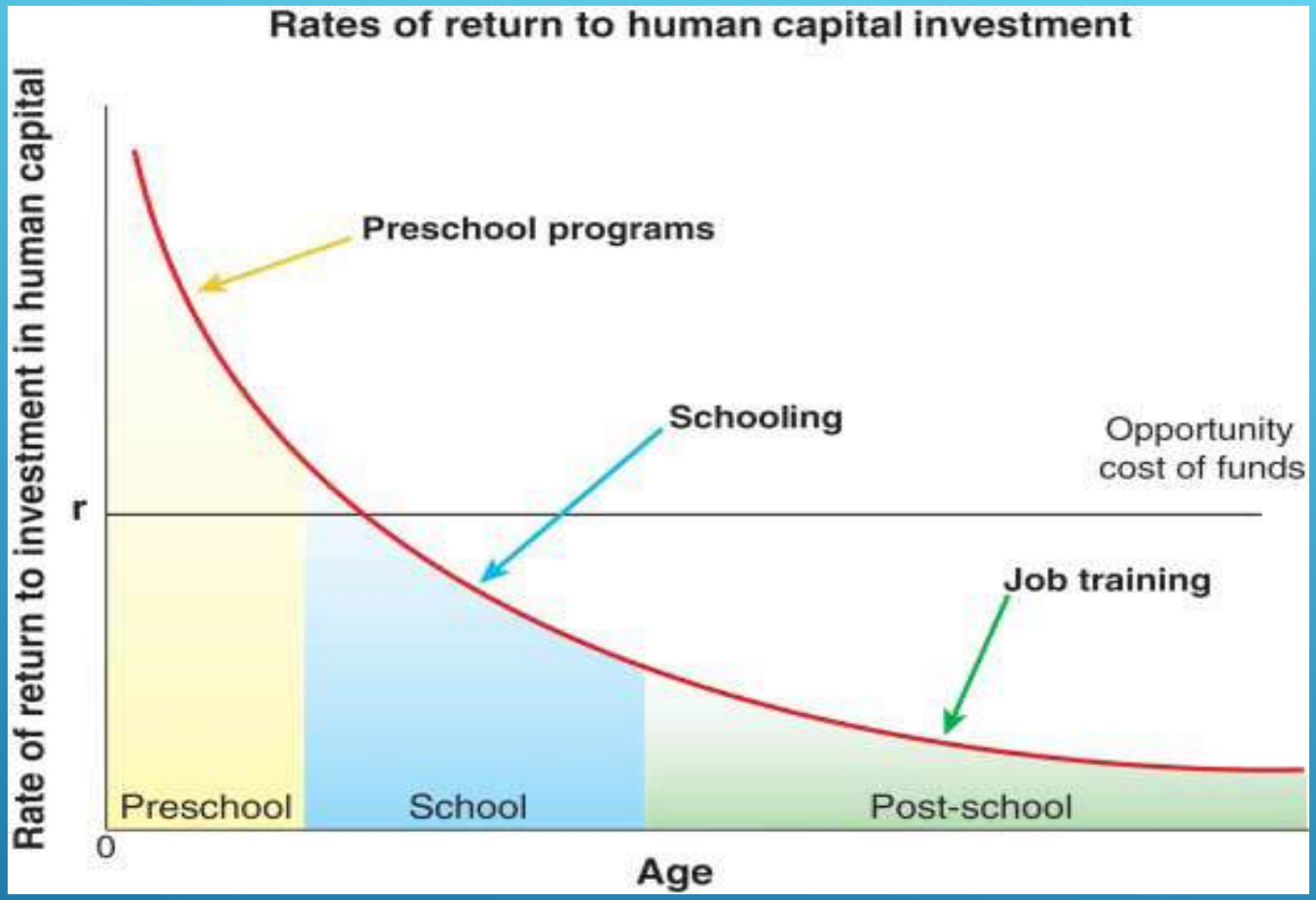
Paul, P. New York Times Magazine, August 25, 2010

Can we invest in/prioritize growing children who have higher IQ's, better emotional adaptation and larger brains?

- Empirical data shows us the key ingredients to helping every developing child achieve their potential.
- This can be done by attending to 5 basic human needs/ resources.
- This can be done more effectively when they are provided beginning in utero and through early in life during sensitive periods of brain development.

KEY PRINCIPLE: NEUROPLASTICITY

- Psychosocial experience materially influences or sculpts brain development through a process known as experience dependent plasticity. We know this because:
  - Strong associations between experience and brain development have been demonstrated in longitudinal studies of humans
  - Causality has been demonstrated in animal models
  - Causality in humans has been shown in several "enhancement" studies in institutionalized samples
- The impact of experience on brain is particularly powerful early in development during early life windows of very high neuroplasticity known as "sensitive periods"
- Harnessing neuroplasticity could revolutionize interventions in brain and neurodevelopmental disorders.
- It can also be used to optimize neurodevelopment.

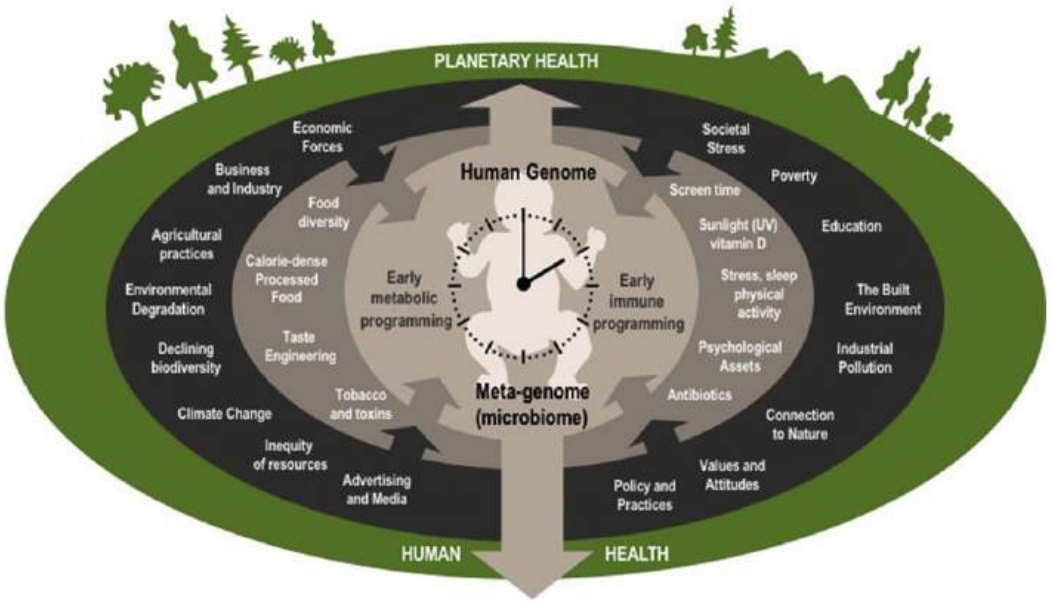


Heckman, J. (2006). Skill Formation and the Economics of Investing in Disadvantaged Children. *Science*. 312(5782); 1900-1902.

PSYCHOSOCIAL ENVIRONMENT, BRAIN DEVELOPMENT AND RISK FOR PSYCHOPATHOLOGY

- Numerous empirical studies have demonstrated negative associations between early adversity on structural brain outcomes in childhood (Farah, Noble, McLaughlin etc.)
- Studies have also documented associations between exposure to adversity and brain structure and function.
- Adoption studies (e.g., Bucharest Early Intervention Study) have documented casual effects of nurturing caregiving on cognitive, brain and psychopathology outcomes as well as sensitive periods for these effects prior to age 2.
- New studies (including data from an ongoing study at WUSM) suggest that these effects begin in utero when the fetal brain is at maximal neuroplasticity.

The Exposome Across the Life Course and Around the Clock

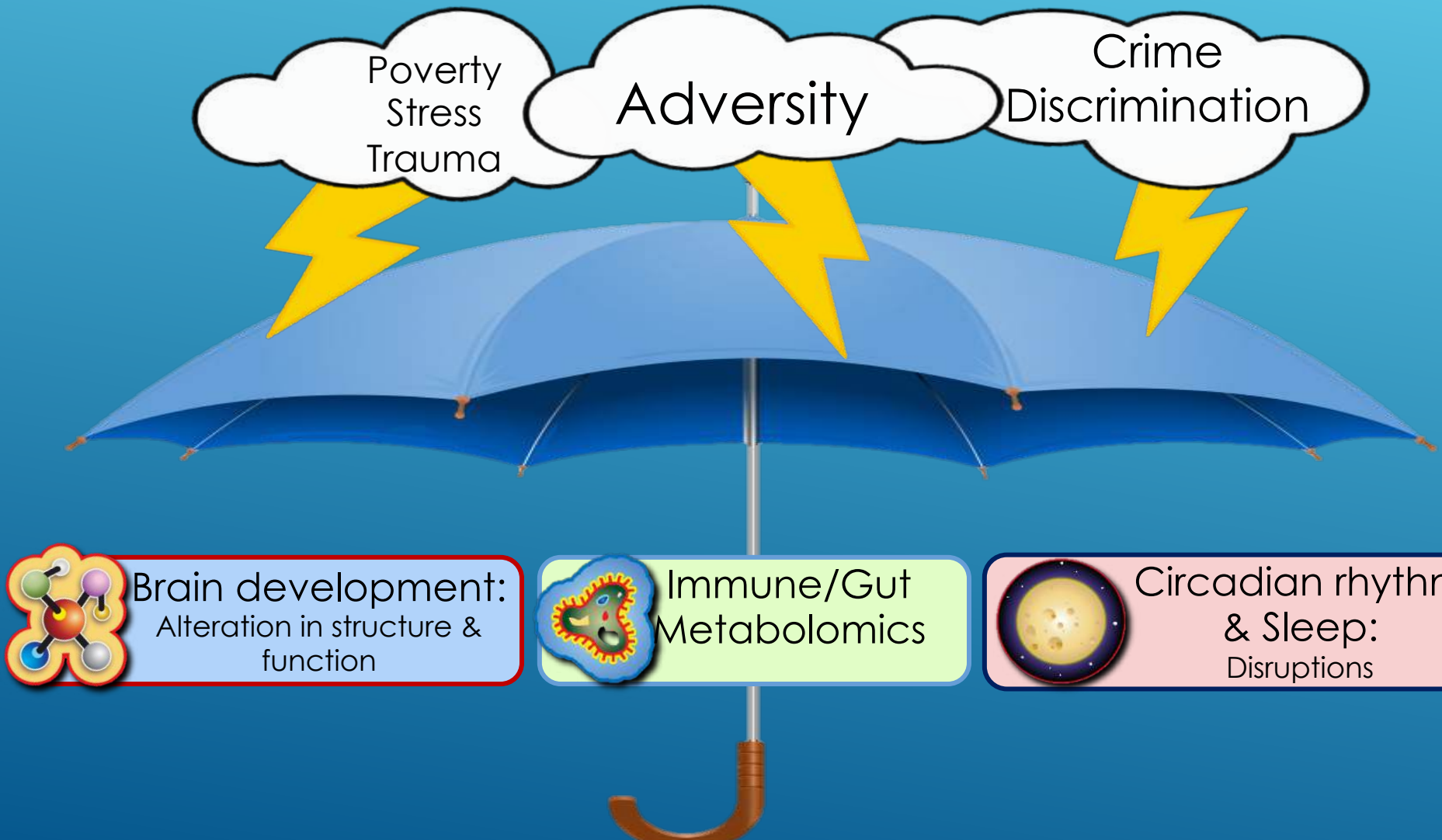


Predisposition to inflammation, metabolic and immune dysregulation
Effect on all organ systems across the life span – increase in early and later onset NCDs

FIG 1. The metaexposome is defined as the total environmental exposures affecting all living systems and their genomes. This occurs in a bidirectional manner within the ecological theatre in which all life resides. From an anthropocentric viewpoint, this includes the policies and practices that illuminate the theatre. As well as addressing the adverse exposures eroding health, we need to promote exposures or resiliency, which extend from biological influences to psychological assets and value systems. (Image: Susan Prescott)

Renz, H., Holt, P. G., Inouye, M., Logan, A. C., Prescott, S. L., Sly, P. D. (2017). An exposome perspective: Early-life events and immune development in a changing world. *Journal of Allergy and Clinical Immunology, 140*(1), http://dx.doi.org/10.1016/j.jaci.2017.05.015

MECHANISTIC MODEL : HOW PSYCHOSOCIAL FORCES INFLUENCE HEALTH AND DEVELOPMENT (THRIVING)



BIOLOGICAL EMBEDDING OF ADVERSITY: NEUROIMMUNE NETWORK HYPOTHESIS

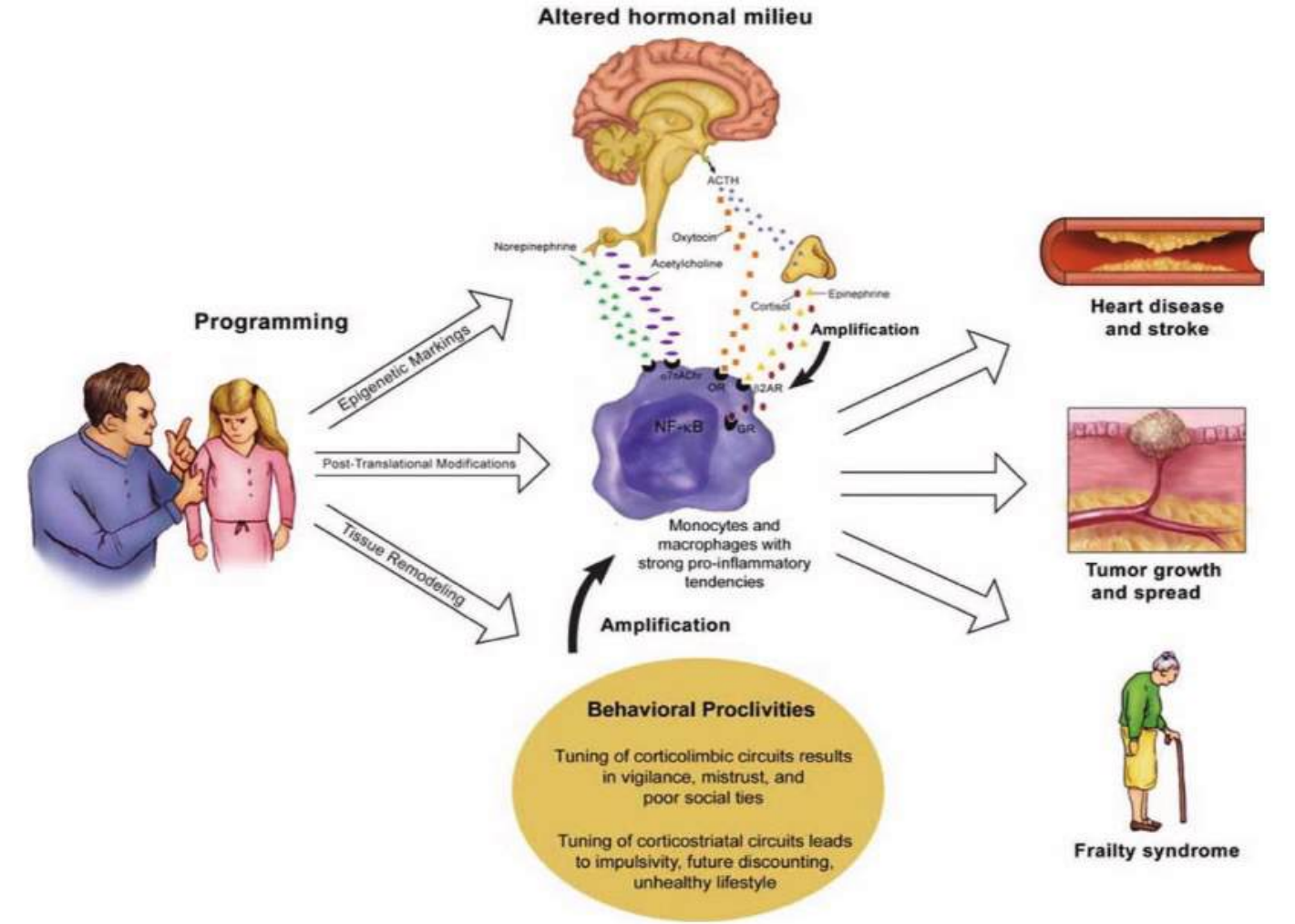


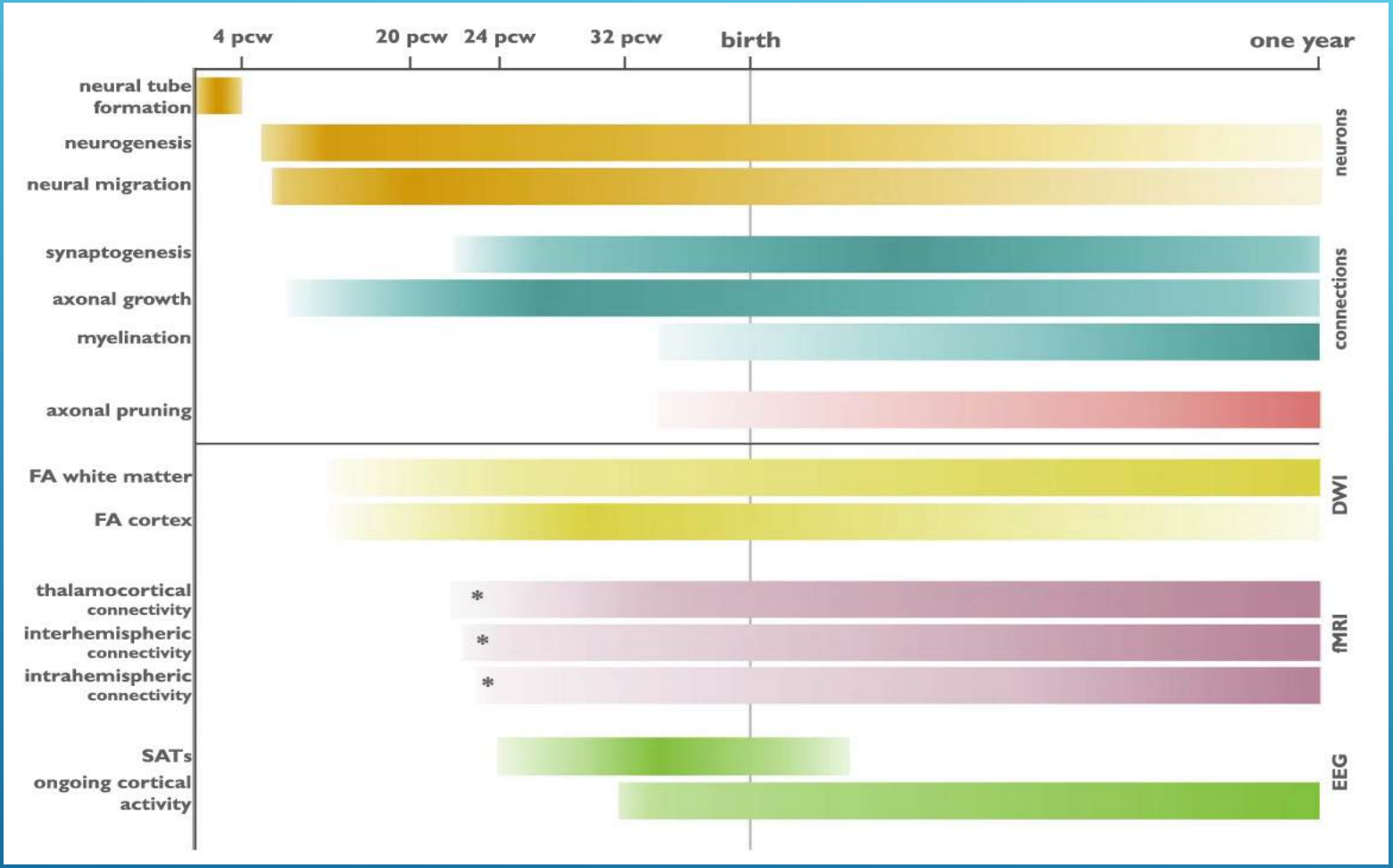
Figure 1. The biological embedding of childhood adversity model. ACTH = adrenocorticotropic hormone; α7nAChr = α7 subunit of nicotinic acetylcholine receptor; β2AR = β2 adrenergic receptor; GR = glucocorticoid receptor; OR = oxytocin receptor.

Miller, G. E., Chen, E., & Parker, K. J. (2011). Psychological stress in childhood and susceptibility to the chronic diseases of aging: moving toward a model of behavioral and biological mechanisms. *Psychological bulletin*,*137*(6), 959.

SENSITIVE PERIODS IN EARLY CHILDHOOD:

- Periods of heightened **neuroplasticity** when the effects of experience on brain architecture are enhanced.
- These are neurobiological phenomena involving the timing and balance of processes at the molecular, cellular, and circuit levels that control sensitive period opening and closing.
- Sensitive periods represent closing windows of opportunity or vulnerability (early in development) when the brain is more receptive/able to be informed/influenced or shaped by experience.

Pregnancy is a sensitive period for fetal neural growth



Keunen et al., 2017

INTERVENTION/PREVENTION POINTS WITH GREATEST OPPORTUNITY FOR IMPACT:

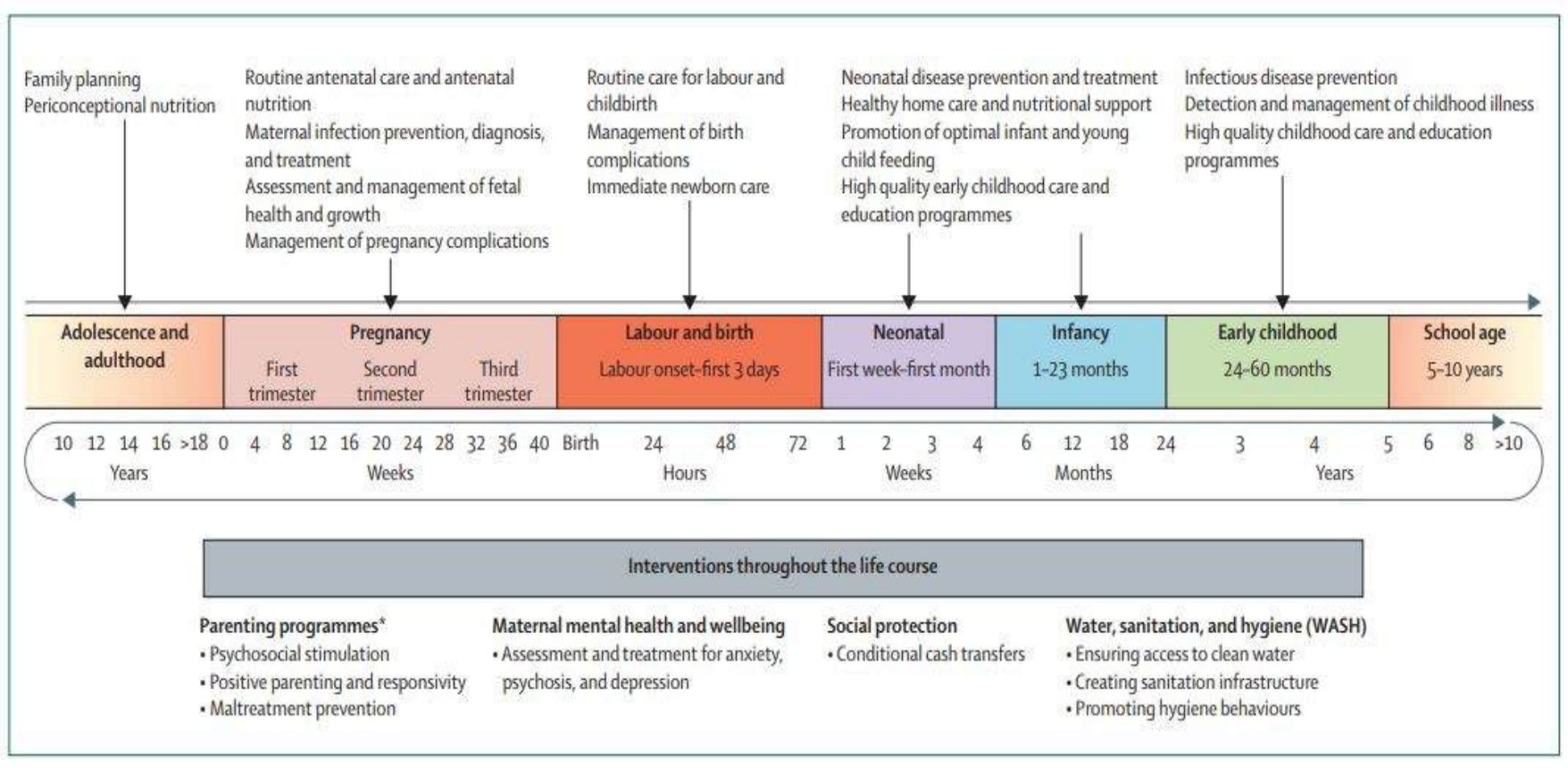


Figure: Evidence-based interventions that affect aspects of nurturing care

Britto, P. R., Lye, S. J., Proulx, K., Yousafzai, A. K., Matthews, S. G., Vaivada, T., ... & Bhutta, Z. A. (2017). Nurturing care: promoting early childhood development. *The Lancet*, *389*(10064), 91-102.

CLINICAL TRANSLATION AND DEVELOPMENTAL OPPORTUNITIES :

Given what is known about the impact of the prenatal environment on fetal brain development---it is necessary and highly feasible to protect/provide basic supports for pregnant women and their developing fetus to optimize neurodevelopment in utero.

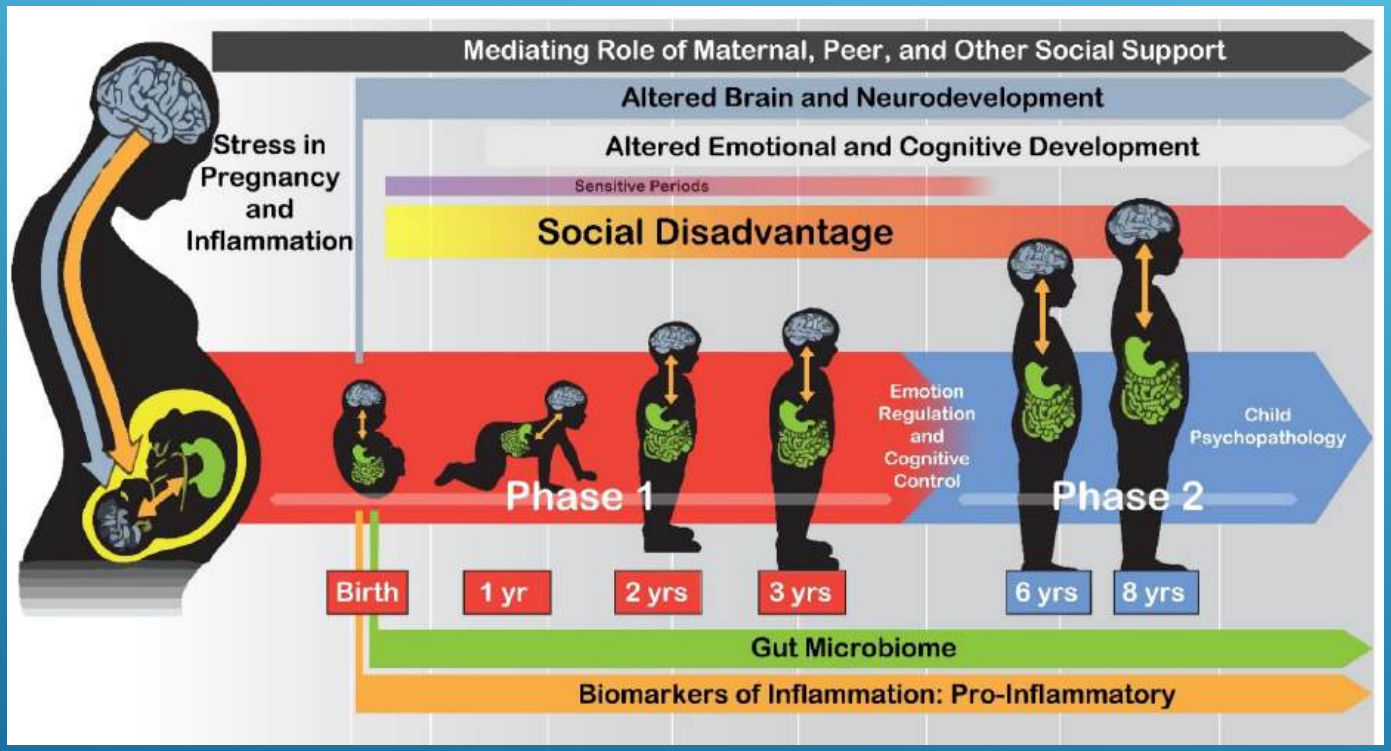
A highly feasible, relatively low-cost public health goal that could have longstanding effects--

Not currently a major focus of standard care

PRENATAL PROGRAMMING:

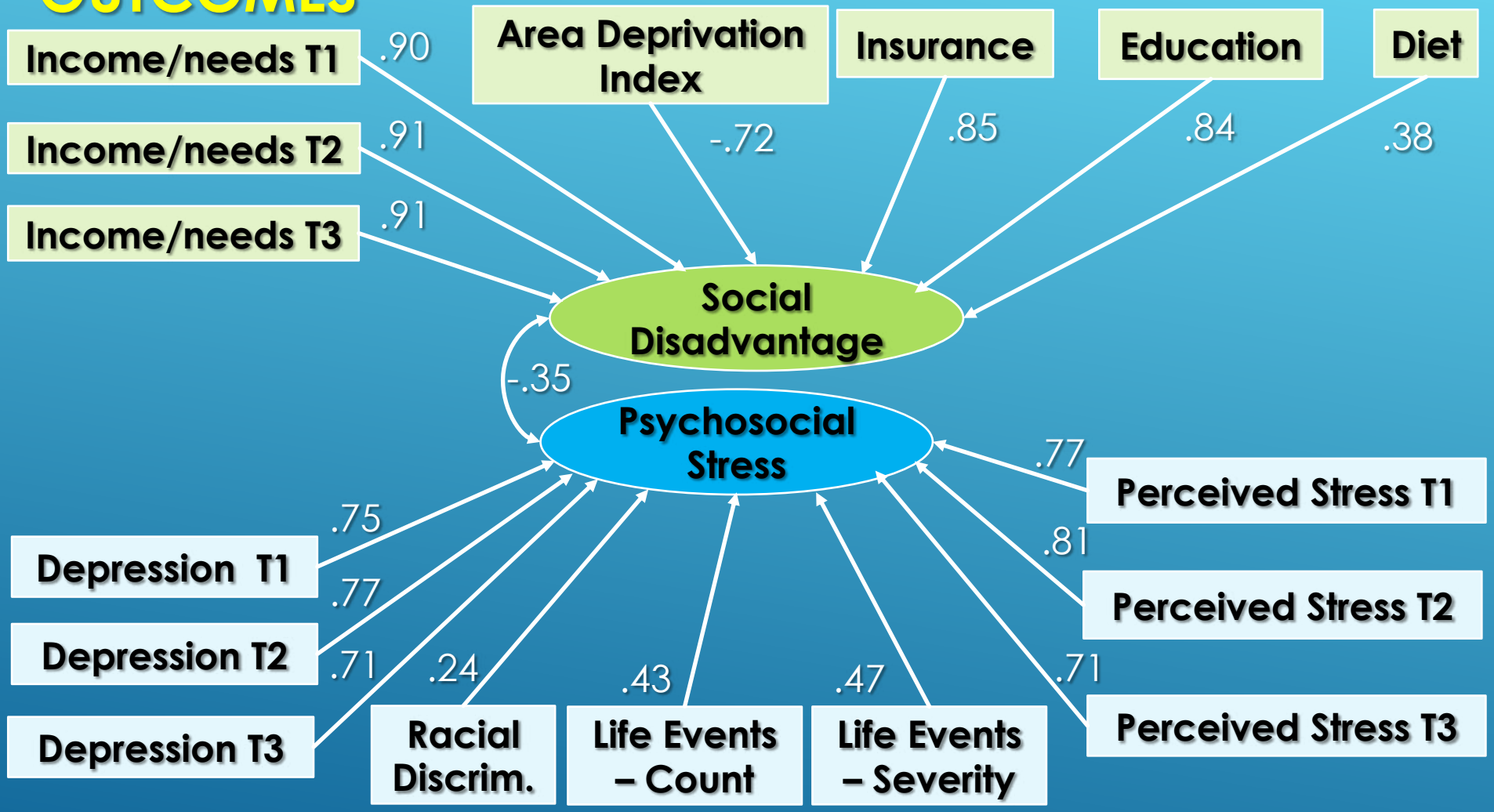
- Experiences in utero prepare the fetus for the expected post-natal environment.
  - Maternal Stress/Adversity
  - History of maternal maltreatment in childhood (epigenetic mechanisms)
  - Maternal mental health
  - These factors may influence maternal stress hormones, cytokines and metabolomics and gene expression--- all forces that influence fetal brain development.

EARLY LIFE ADVERSITY AND BIOLOGICAL EMBEDDING



P.I.'s: Luby, Warner and Smyser
Co-I's: Barch and Rogers

ELABE – PRENATAL DISADVANTAGE & INFANT OUTCOMES



N = 399 pregnant mom recruited and followed through pregnancy, offspring imaged at birth or shortly after.

Luby et al. (J of Perinatology, 2023)

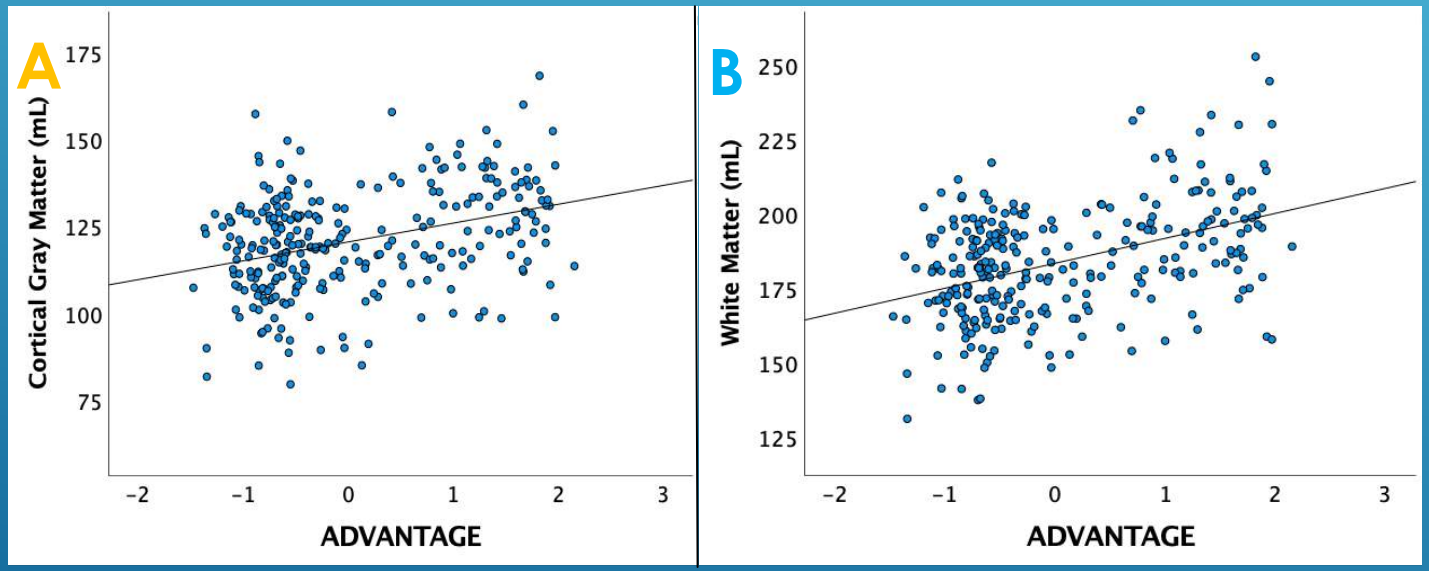
Washington University in St. Louis

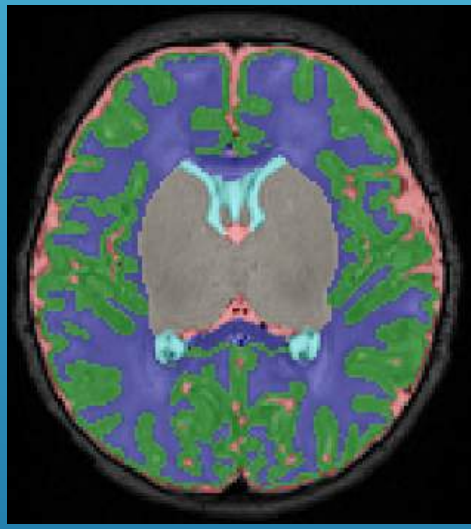
MOTHERS WITH LOWER SOCIOECONOMIC ADVANTAGE HAVE INFANTS WITH SMALLER BRAIN VOLUMES

Regina Triplett, M.D.
JAMA Open, 2022

N = 280 healthy, full term infants

Stepwise Linear Regression controlled for infant sex, PMA at scan, birthweight, maternal PSYCH.





R2 = 0.56

ADVANTAGE **β** = 0.14, p = 0.004

R2 = 0.36

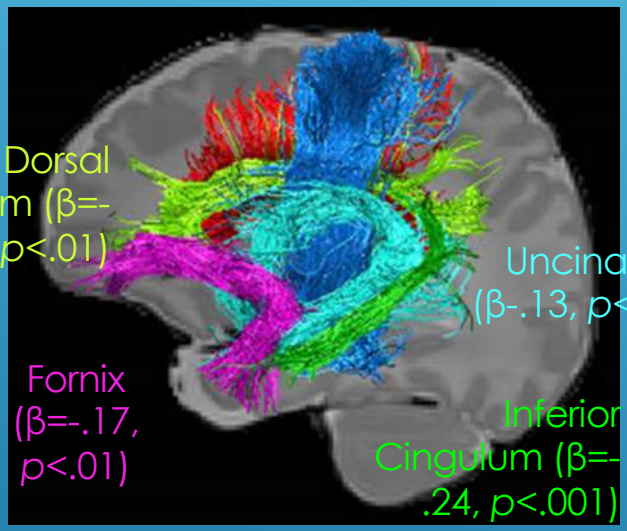
ADVANTAGE **β** = 0.30, p < 0.001

Triplett RL, Lean RE, Parikh A, Miller JP, Alexopoulos D, Kaplan S, Meyer D, Adamson C, Smyser TA, Rogers CE, Barch DM, Warner BB, Luby, JL, Smyser, CD. JAMA Open (2022). Prenatal Exposure to Early Life Adversity and Neonatal Brain Volumes at Birth.

Prenatal Adversity and White Matter Microstructure at Birth

Rachel Lean, PhD

- Social Disadvantage and lower mean diffusivity:

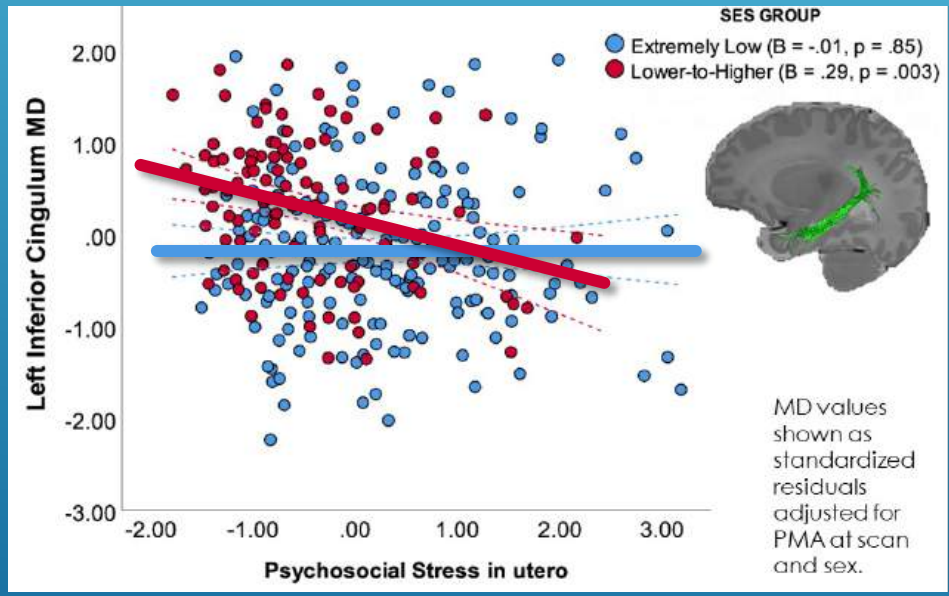


- Maternal Psychosocial Stress and lower mean diffusivity in the left inferior cingulum (β=-.13, p<.01)

↓

Attenuated after accounting for Social Disadvantage

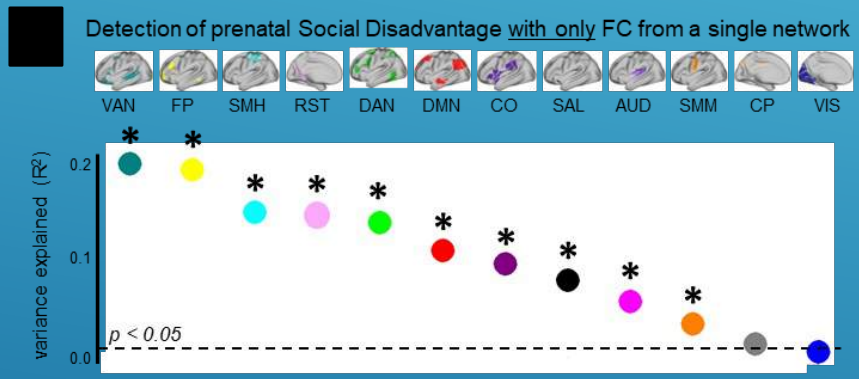
Stronger Relationship between Psychosocial Stress and Cingulum Microstructure in Lower SES (INR

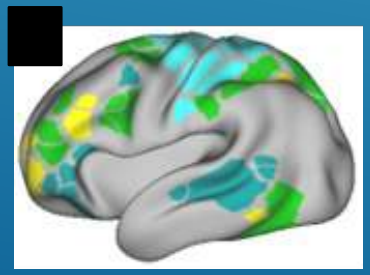


Lean, R.E., Smyser, C.D…….Barch, D.M., **Luby, J.L.**, Warner, B.B., & Rogers C.E. (2022). Prenatal exposure to maternal social disadvantage and psychosocial stress and neonatal white matter connectivity at birth. *Proceedings of the National Academy of Sciences*, *119*(42), e2204135119.

Prenatal social disadvantage is associated with alterations in functional connectivity (FC) at birth

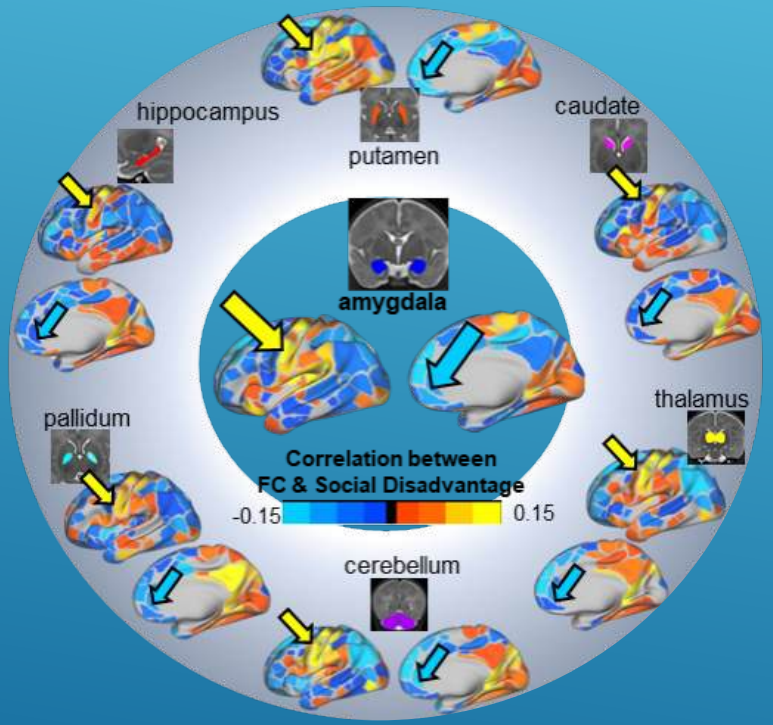
Alterations occurred brain-wide & were most pronounced in association networks



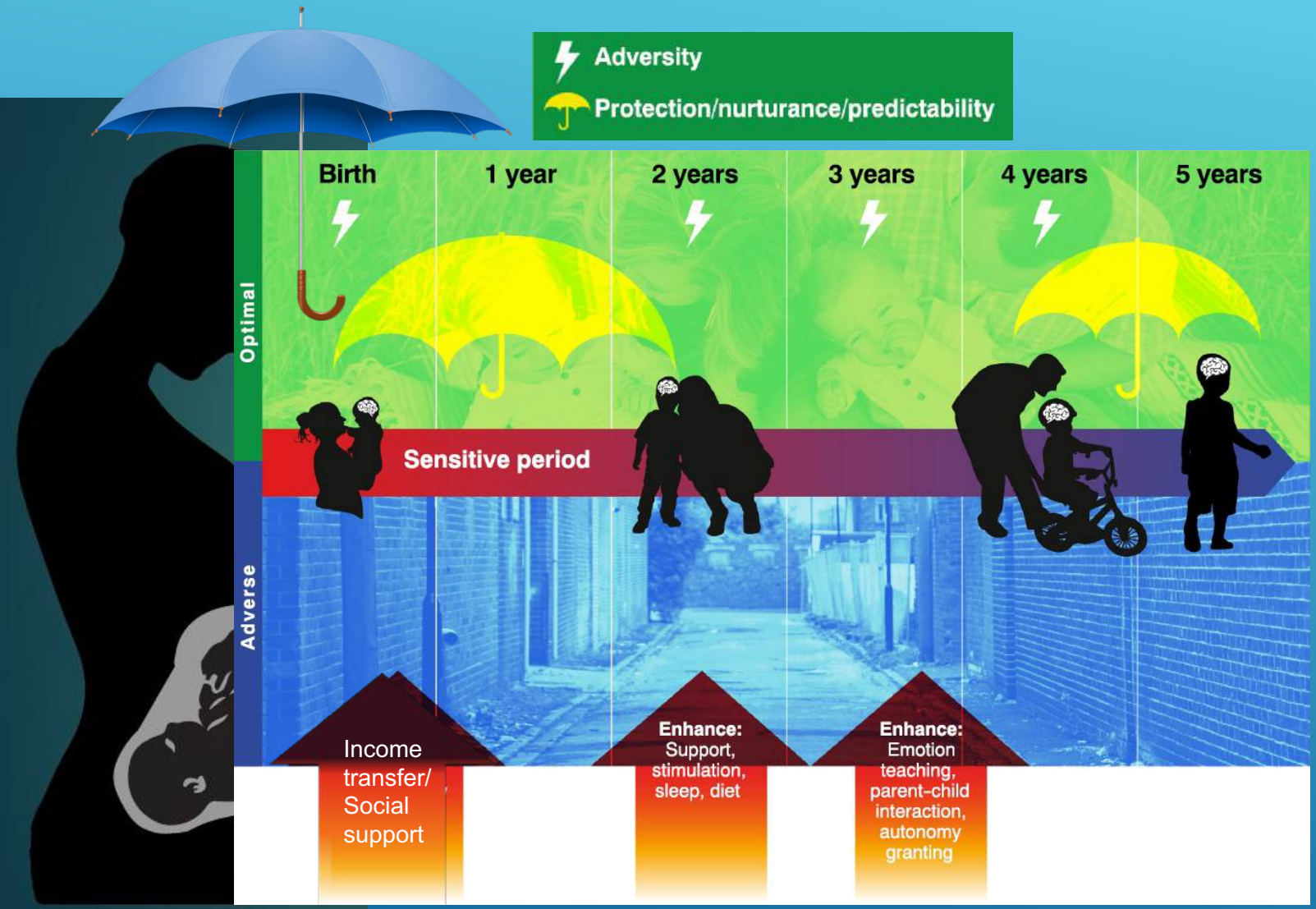


Association Networks
Frontoparietal
Dorsal attention
Ventral attention

Amygdala FC was altered at birth, with a pattern shared across subcortical structures



Nielsen, A.N., Triplett, R.L., Bernardez, ….A., Raichle, M., Sylvester, C.M., Barch, D.M., **Luby, J.L.**, Smyser, C.D. (2024) Prenatal social disadvantage is associated with alterations in functional networks at birth. *Proceedings of the National Academy of Sciences*. PMID: 39621900


Adversity
Protection/nurturance/predictability
Birth
1 year
2 years
3 years
4 years
5 years
Optimal
Adverse
Sensitive period
Income transfer/ Social support
Enhance: Support, stimulation, sleep, diet
Enhance: Emotion teaching, parent-child interaction, autonomy granting

FOUNDATIONAL ELEMENTS OF THE ABILITY TO THRIVE:

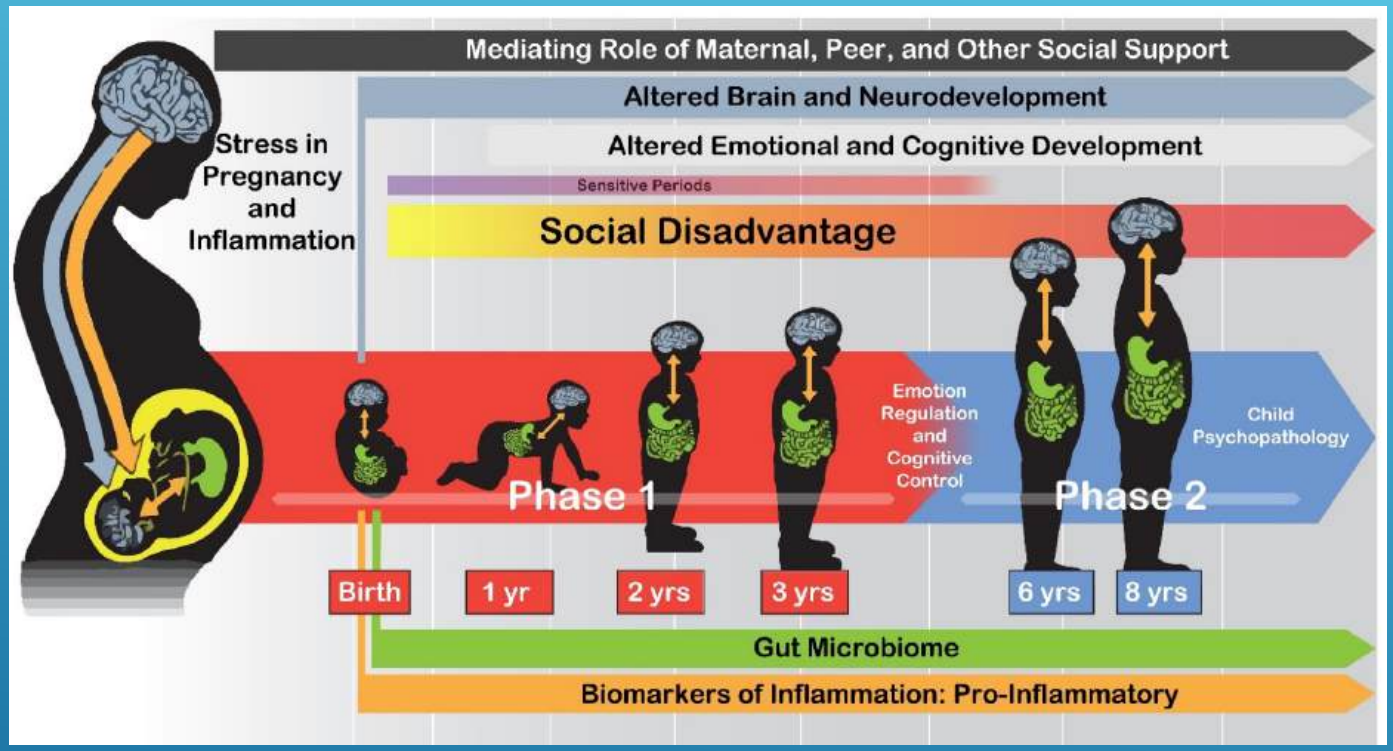
- **Nurturance/support from an available primary caregiver**
- Nutrition/Healthy food
- Shelter/protection from danger
- **Ability to have sufficient, regular and good quality sleep**
- **Stimulation**

Exposure to early adversity/poverty is the single most robust risk factor for poor developmental and health outcomes.

THE SCIENCE OF GROWING VEGETABLES:

- Well informed by scientific principles—
- Clear methods and procedures to maximize growth and productivity
- Based on exposure to sun and water and nutrients at specific times in the life cycle that considers epigenetic effects.
- A clear scientifically informed science of thriving
- Driven by motivation for profit/capital and ease of experimentation.

EARLY LIFE ADVERSITY AND BIOLOGICAL EMBEDDING



P.I.'s: Luby, Warner and Smyser
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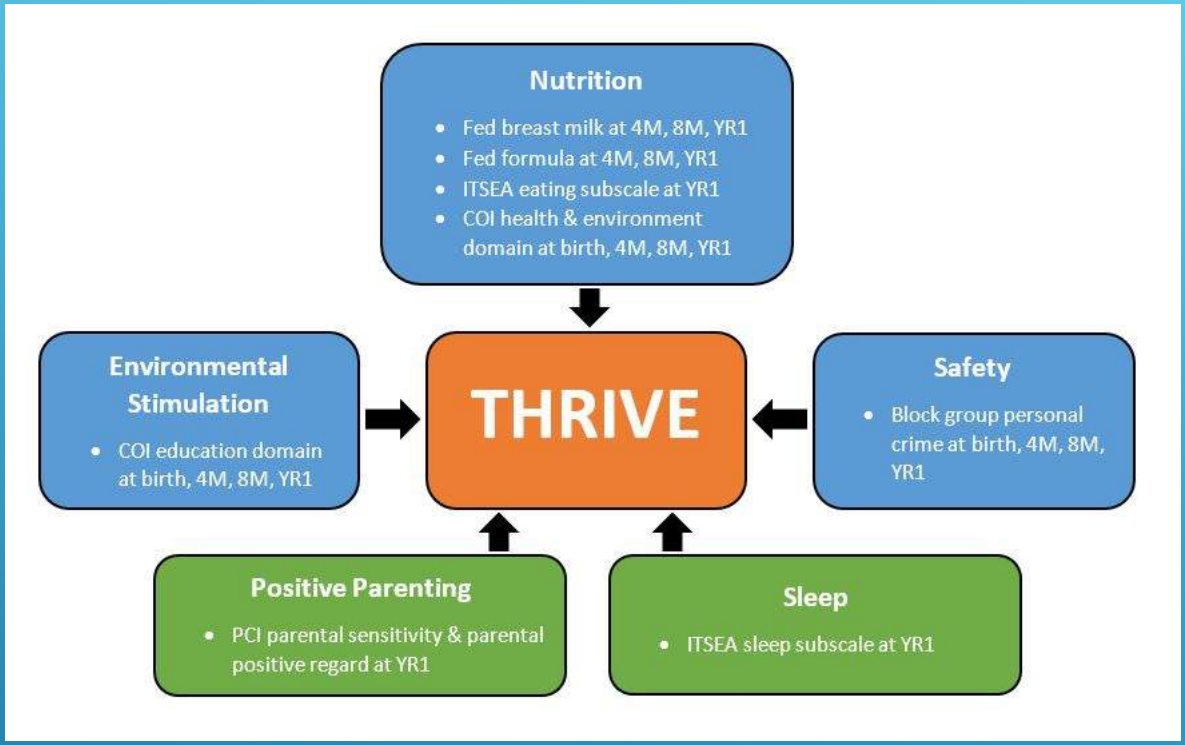
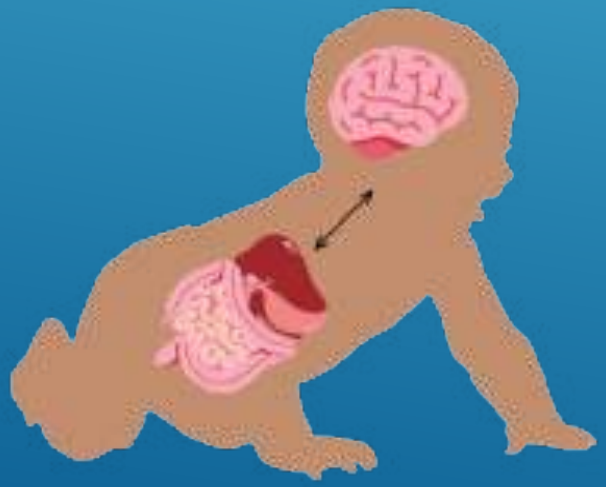

Nutrition
Fed breast milk at 4M, 8M, YR1
Fed formula at 4M, 8M, YR1
ITSEA eating subscale at YR1
COI health & environment domain at birth, 4M, 8M, YR1
Environmental Stimulation
COI education domain at birth, 4M, 8M, YR1
THRIVE
Safety
Block group personal crime at birth, 4M, 8M, YR1
Positive Parenting
PCI parental sensitivity & parental positive regard at YR1
Sleep
ITSEA sleep subscale at YR1


Good nutrition


Nurturing caregiver


Environmental stimulation


Safe home environment




Restorative sleep and regular circadian rhythms

INFANTS FAIL TO THRIVE DESPITE ADEQUATE NUTRITION WITHOUT CAREGIVER NURTURANCE (RENEE SPITZ):

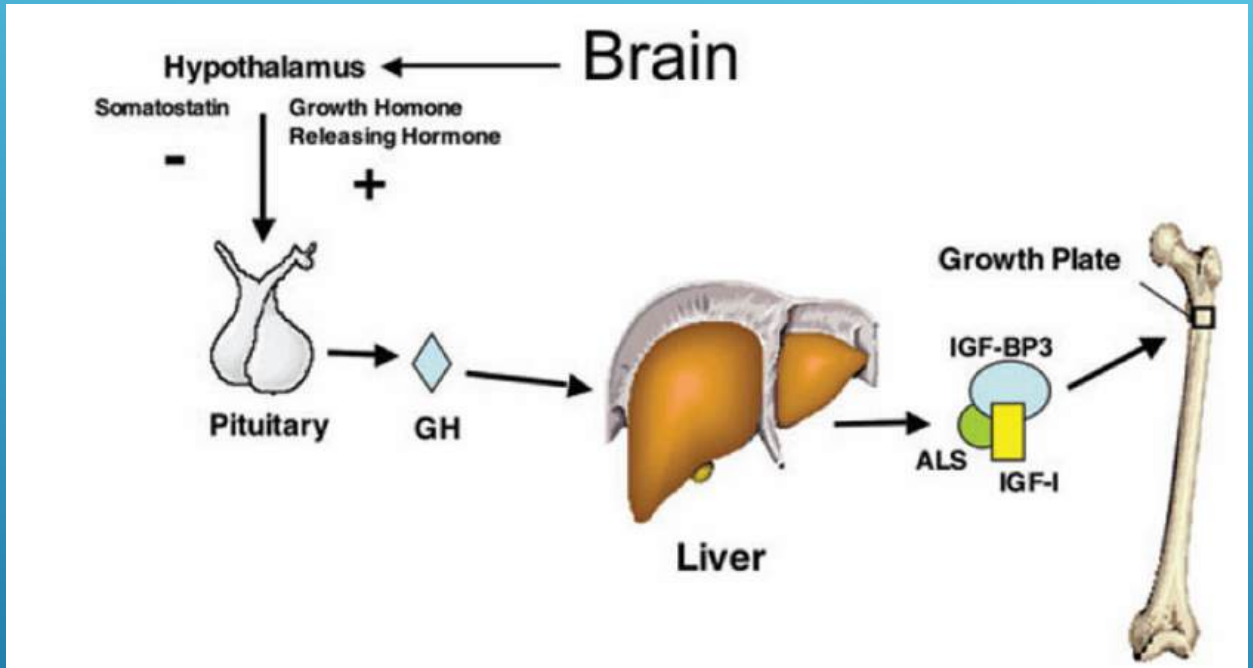


Figure 1.
Simplified diagram of the growth hormone–insulin-like growth factor axis. GH = growth hormone, IGF-1 = insulin-like growth factor 1, IGF-BP3 = insulin-like growth factor binding protein-3, ALS = acid labile subunit.

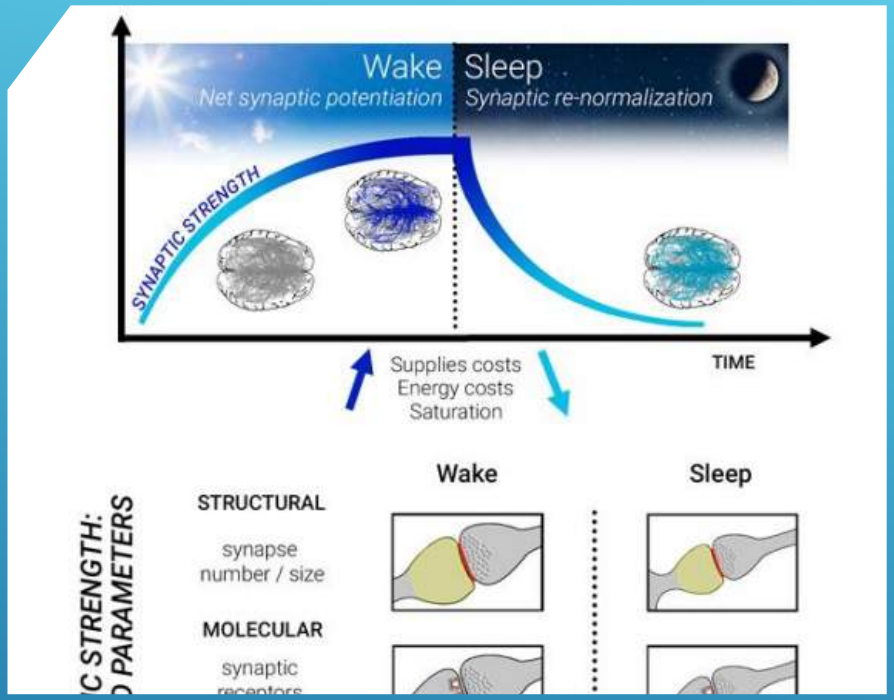
Johnson, D. E., & Gunnar, M. R. (2011). IV. Growth Failure in Institutionalized Children. *Monographs of the Society for Research in Child Development*, *76*(4), 92–126. https://doi.org/10.1111/j.1540-5834.2011.00629.x

SLEEP, CIRCADIAN RHYTHMS AND NEURODEVELOPMENT

- Sleep has very important effects on the brain. It restores synaptic function and homeostatic processes which are rapidly developing/organizing **in utero** the first 3 years of life (clearing of synaptic residue—sleep acts as the brain's Washing macine).

- Emerging evidence that sleep duration, timing and stages are very important for healthy brain development in early childhood (high sleep to wake ratios).

- Sleep staging changes markedly during early development underscoring likely role in neurodevelopment.

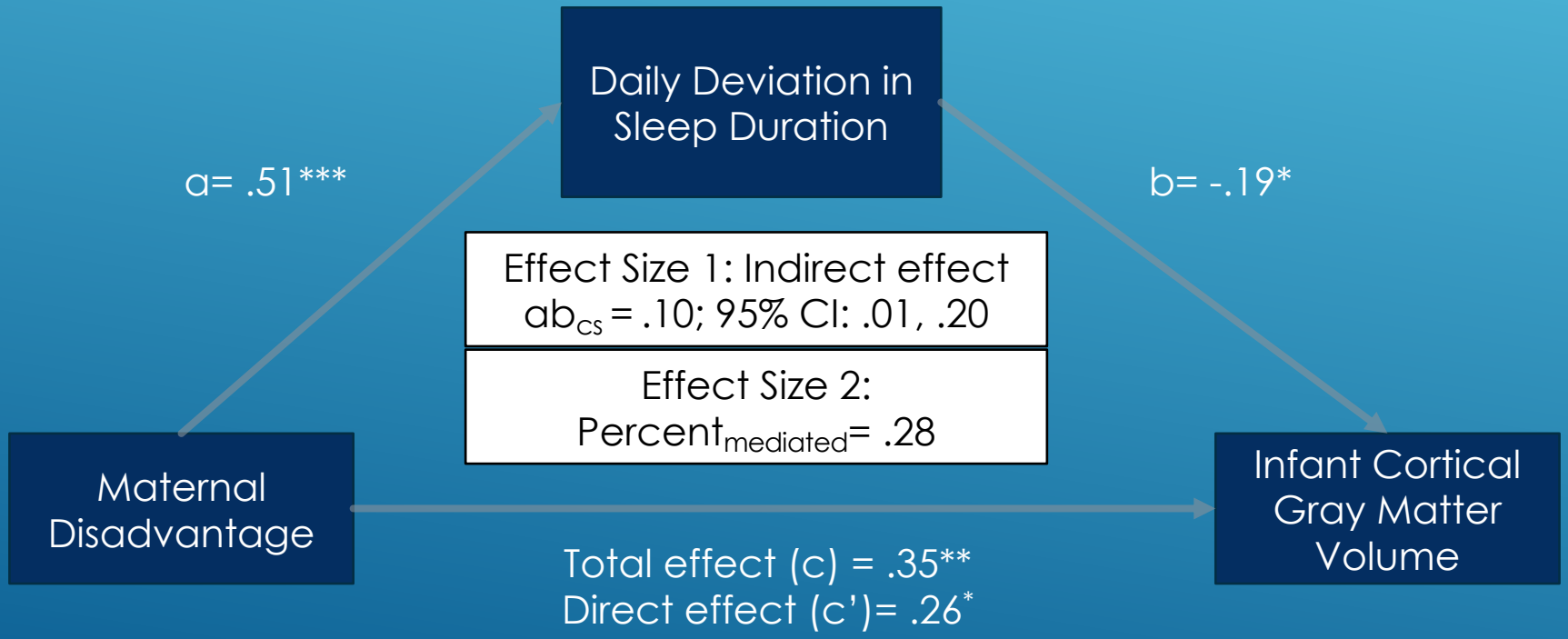

Wake
Net synaptic potentiation
Sleep
Synaptic re-normalization
SYNAPTIC STRENGTH
TIME
Supplies costs
Energy costs
Saturation
Wake
Sleep
STRUCTURAL
synapse
number / size
MOLECULAR
synaptic

WHY WE SLEEP:

The Effect of Maternal Disadvantage on Neonatal Cortical Gray Matter Volume is Mediated through Chronodisruption in Pregnancy:

Caroline Hoyniak, Ph.D

Diana Whalen, Ph.D

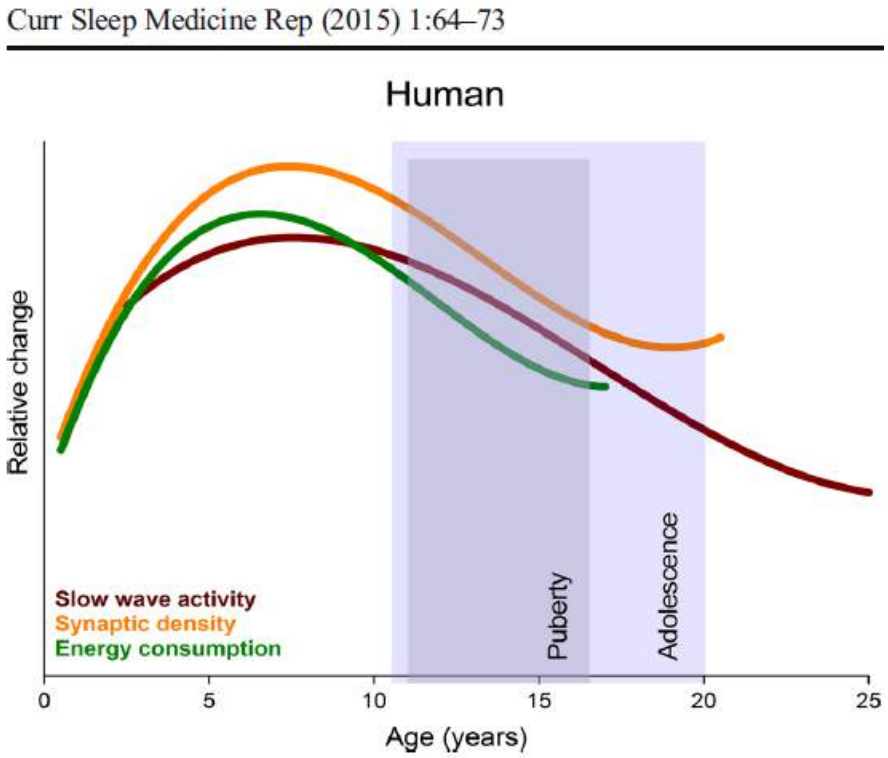


Hoyniak et al., 2024 Developmental Science

CRSD EARLY IN DEVELOPMENT, ALTERATIONS IN SENSITIVE PERIODS/PLASTICITY AND CRITICALITY: IMPLICATIONS FOR PSYCHOPATHOLOGY

- Stemming from data in rodents, we hypothesize that social adversity related to environmental disruptions of daily rhythms and sleep during sensitive periods impairs the mechanisms of homeostatic plasticity necessary for the emergence and maintenance of effective cortical computation "criticality".
- Alterations in this neurodevelopmental process may underlie increased risk for psychopathology.
- CRSD in mother and child are modifiable risk factors in pregnancy and early childhood.

SLEEP AND BRAIN DEVELOPMENT:



►Kurth, S., Olini, N., Huber, R., & LeBourgeois, M. (2015). Sleep and early cortical development. *Current sleep medicine reports*, *1*(1), 64-73.

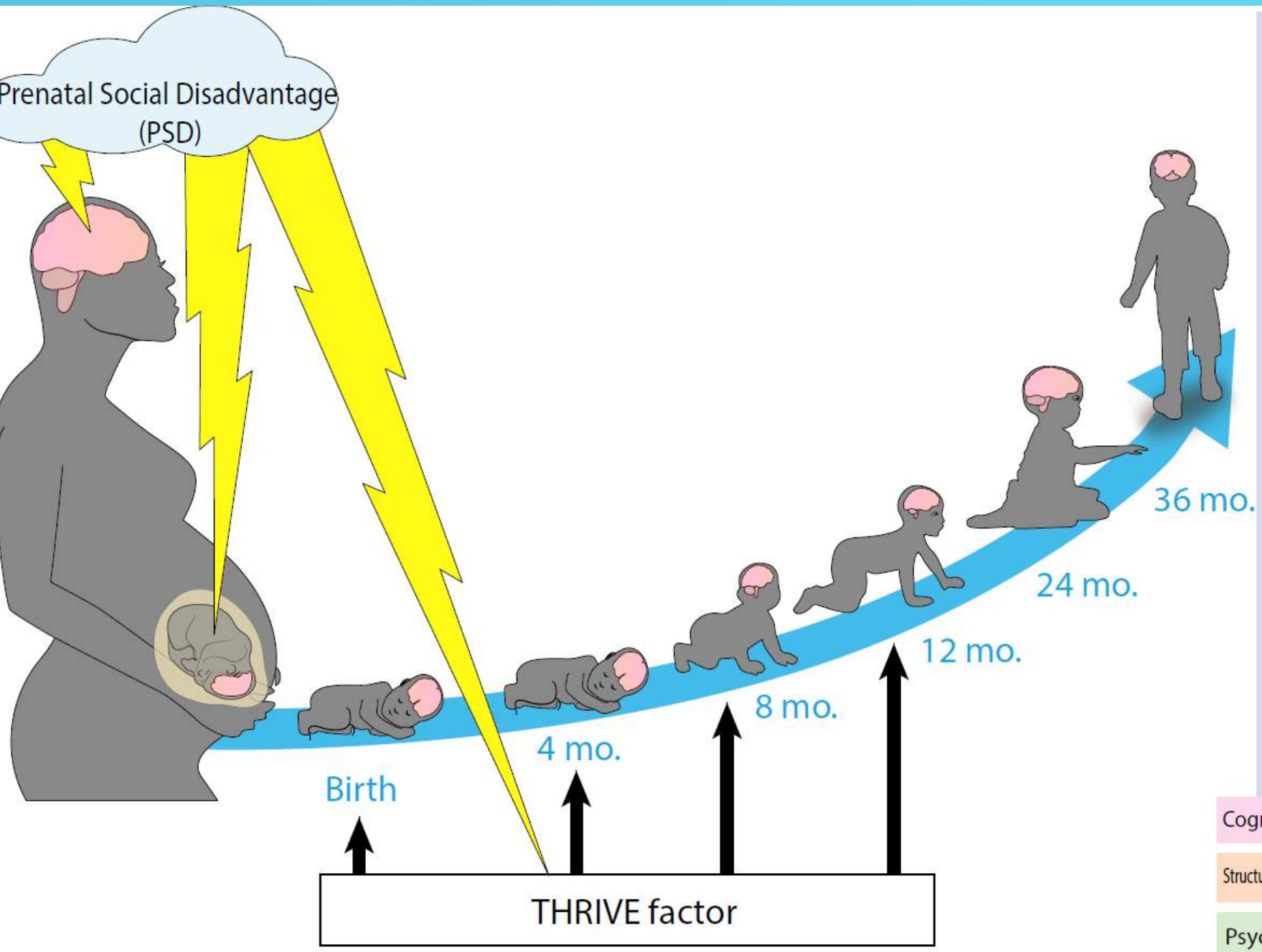

Prenatal Social Disadvantage (PSD)
Birth
4 mo.
8 mo.
12 mo.
24 mo.
36 mo.
THRIVE factor
Developmental Outcomes
Cognitive Outcor
Structural Brain Developm
Psychopatholo

Figure 4. Thrive Factor as a Mediator of the Association Between Prenatal Social Disadvantage and Year 3 Bayley Cognitive Composite and Total Gray Matter Volume

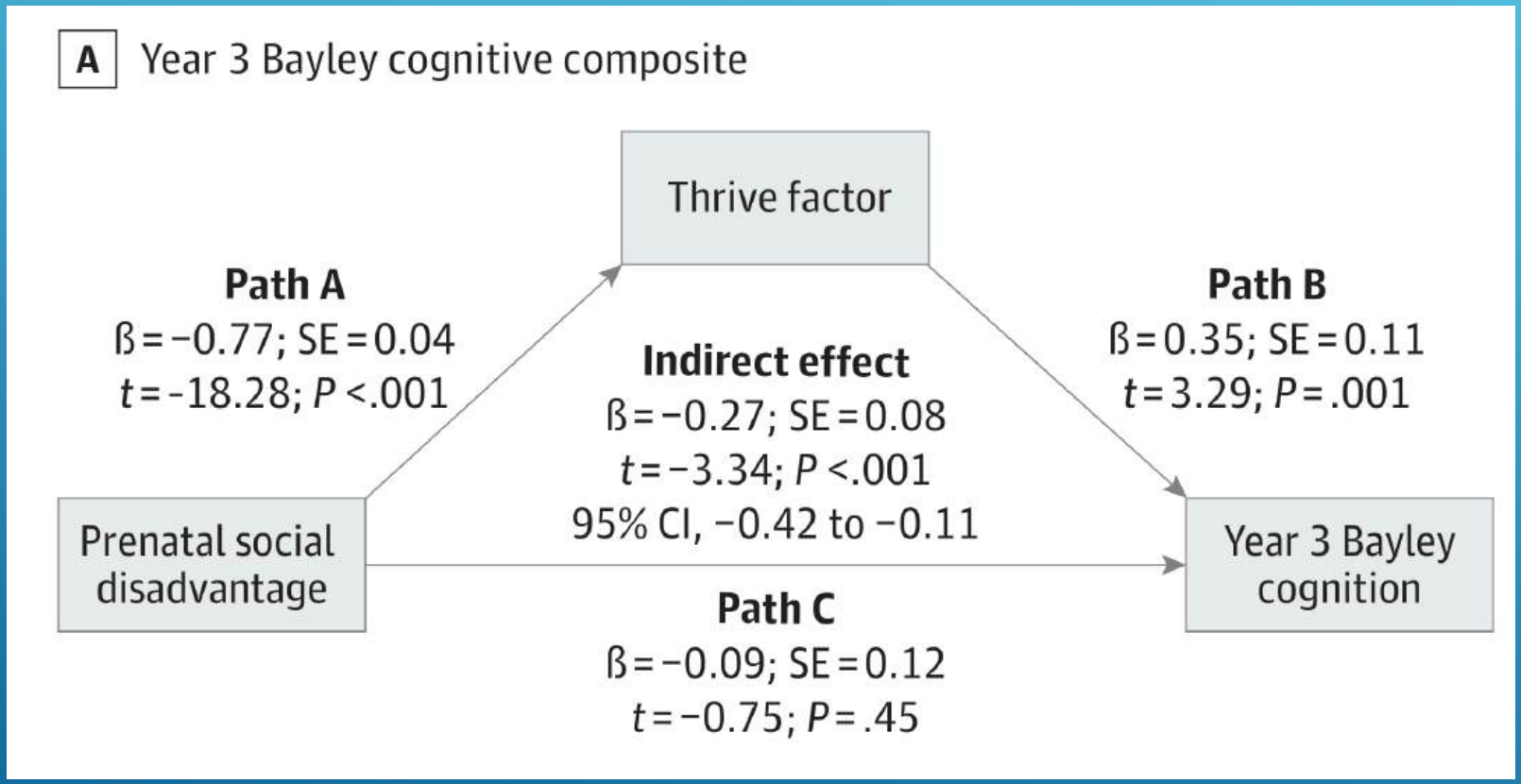
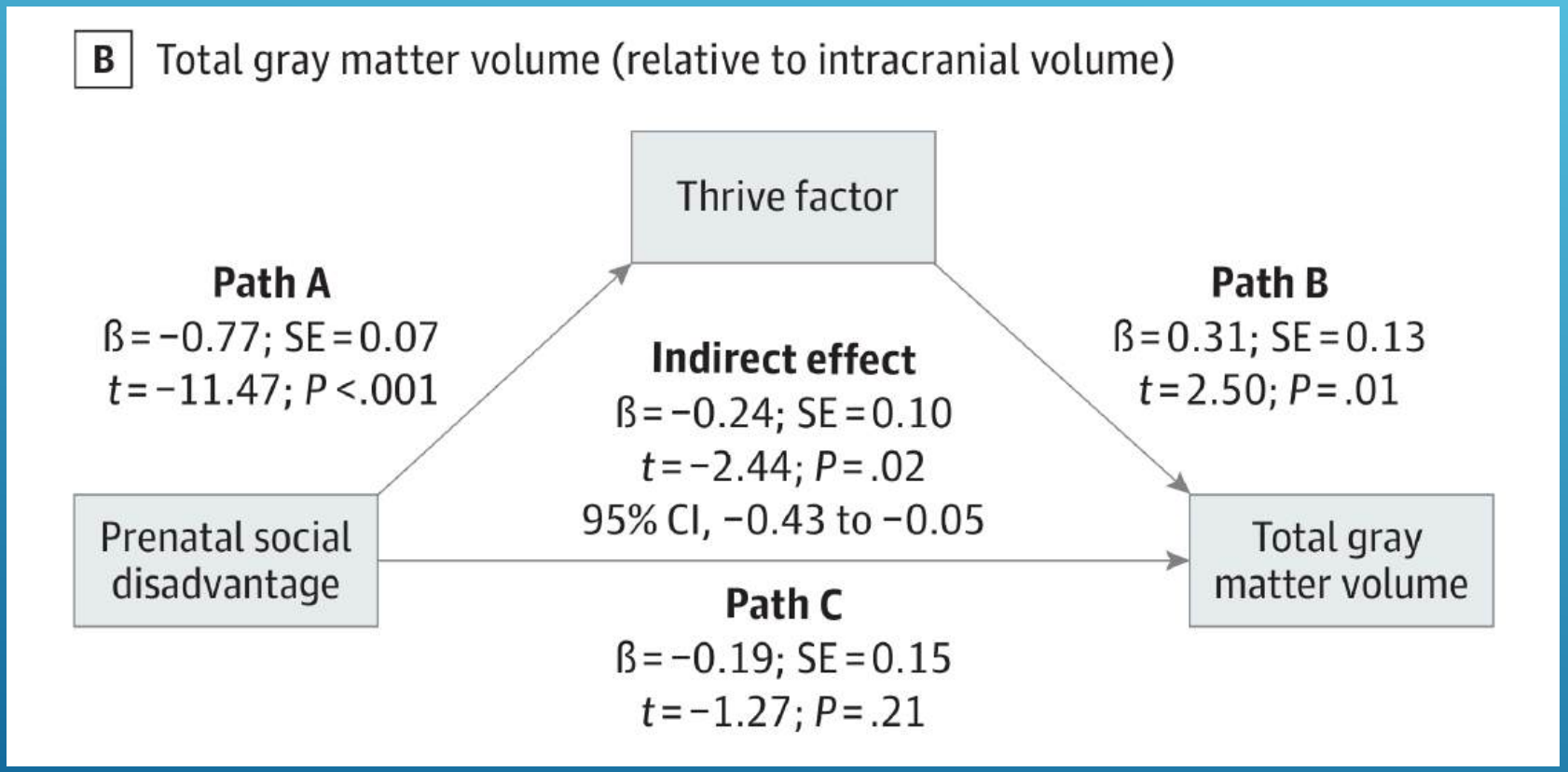


Figure 4. Thrive Factor as a Mediator of the Association Between Prenatal Social Disadvantage and Year 3 Bayley Cognitive Composite and Total Gray Matter Volume



FOUNDATIONAL PUBLIC HEALTH PRINCIPLES:

- Opportunity for healthy early development is the fundamental right of every child.
- The science is clear in general about the basic necessary conditions to support thriving.
- These basic conditions can be achieved at relatively low cost and are a clear productive social investment not only for developing children but also from a social financial perspective.

EARLY CHILDHOOD EXPERIENCE PREDICTS LATER LIFE OUTCOMES

Longitudinal studies of young children exposed to adversity show beneficial effects of early interventions/enhancements on adult:

- Educational attainment
- Competence
- Wage earnings
- Health biomarkers
- Reductions in violence

Black et al., Lancet 2017

POWERFUL AND SUSTAINED EFFECTS OF EARLY DYADIC PSYCHOTHERAPEUTIC INTERVENTION IN PRESCHOOL DEPRESSION

- **PCIT-ED:** Parent-child therapy that focuses on enhancing emotion development.
- Uses a "bug in the ear" and a teach and live coaching approach.
- Shown to have very large effects (based on a large scale RCT) with behavioral improvement and improvement in neural response (American Journal of Psychiatry 2019).
- Improvements are sustained into preadolescence.*
- Now applying these novel methods in virtual formats earlier in life.

*Dean's Medal for Research Excellence 2025

THRIVE PREVENTION:

- THRIVE is a shortened/prevention focused version of PCIT-ED.
- It utilizes the "teach and coach" approach. Teaches and coaches caregiver to become "the arm of the therapist."
- It can be delivered by zoom or in person.
- It focuses on emotion development and strengthening the parent child relationship
- Designed for children 3-7 and their primary caregivers.
- Showed significant effects in one high risk school in St. Louis.
- Currently being tested in 22 St. Louis area schools.

THRIVE Program Manual

A brief intervention to promote relilience and adaptive development in young children and their caregivers.

Katie A McLaughlin, Ph.D., Jennifer Pautsch, MSW, John Weisz, Ph.D., Joan Luby, M.D.

WHAT/WHEN IS THE BEST WAY TO DELIVER EARLY PREVENTIVE INTERVENTIONS?

In person is always best but this is hard for many families to access based on numerous barriers to care.

Digital health methods such as zoom provide easier access as long as families have cell phones or internet access.

Apps have become a common method for delivering information and providing input.

Starting at the earliest possible developmental point (in fetal development) may provide the best opportunity for more powerful effects.

Based on this we developed a perinatal prevention app—that has zoom based sessions. It starts in pregnancy and goes through the first year of life.

PARENTING APPS FOR EARLY CHILDHOOD

- Many apps have been developed for early childhood parenting.
- Few to none have been empirically tested.
- Most do not address all 5 THRIVE targets (particularly sleep/circadian rhythms).
- None have zoom sessions to augment the app.


Bebbo offers smart support
in the palm of your hand


BLOOM
FOR MOM · FOR BABY · FOR GOOD

BLOOM: BENEFITING THE LIVES OF OFFSPRING AND MOTHERS A HYBRID ZOOM/APP PERINATAL PREVENTION

Targets the "Thrive Factor" to enhance IQ and brain volume when applied prenatally through 2nd year of life.

Starts in pregnancy—provides personalized information and zoom sessions with a health worker who uses a teach and coach approach.

Continues into first year of life when teaching and coaching occurs during live mother-baby interactions.

Engages other caregivers in the app to widen support system.

Provides information about local resources based on mother's geocode

Provides sources for nutritious food, food benefits, other social supports

Provides information about green spaces nearby, other sources of safety

Requests feedback from users about whether the resource was accessible and helpful

BLOOM: AI ENHANCED INFORMATION ABOUT LOCAL RESOURCES TO ENHANCE THRIVE


09:47
Bloom
Logout
Welcome to Bloom
Supporting caregivers during pregnancy and the first year of life
Discover
What is important to know in this new phase?
Activities
Taking care of yourself and your baby
Connect
Let us and your community be there for you
Begin Tour

09:48

Development Wheel

The Hub

At the center of this wheel is **your interaction.** All five pieces (Sleep, Eye Contact, Motor, Language, and Eating) are supported by the security and stimulation you provide.

ZOOM SESSIONS PRENATALLY

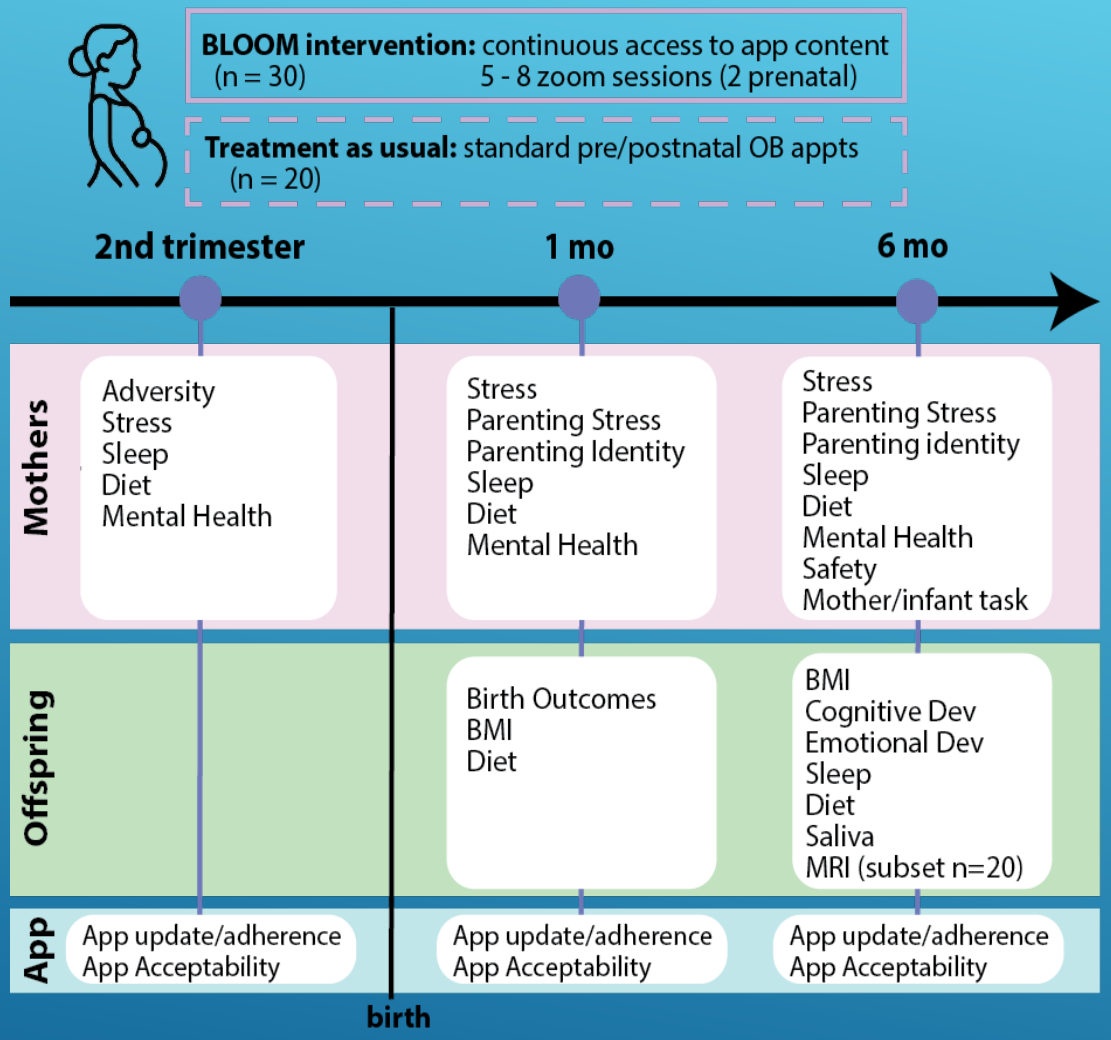
- Focus on history of attachement and how this might impact parenting role
- Focus on developing identity as a caregiver
- Focus on maternal well-being, self-care and stress reduction.
- Focus on safety and preparation for birth
- Focus on developing a support system

ZOOM SESSIONS POSTNATALY

- Focus on parental attunement and reading baby's cues and understanding their needs
- Focus on managing stress of parenting
- Focus on reciprocal interactions and serve and return
- Focus on enhancing baby safety and stimulation
- Focus on nurturing care

Pilot study

2026-2027



BLOOM: LARGE SCALE RCT FOR BROAD DISSEMINATION—INVESTIGATE COGNITIVE, BEHAVIORAL, BRAIN AND HEALTH OUTCOMES:

- App to deliver the intervention (with zoom to community health worker, nurse, social worker for teach and coach elements).
- Begin BLOOM intervention during pregnancy and continue through the first year of life.
- Ascertain N=600 women during pregnancy
- RCT: Randomize to BLOOM or prevention as usual (PAT).
- Assess infant behavioral, cognitive and brain outcomes.
- Assess quality of parent child relationship/ maternal attunement and nurturance

The Ballmer Institute

for Children's Behavioral Health

Winner of the 2023 Distinguished Friend to Behavior Therapy Award

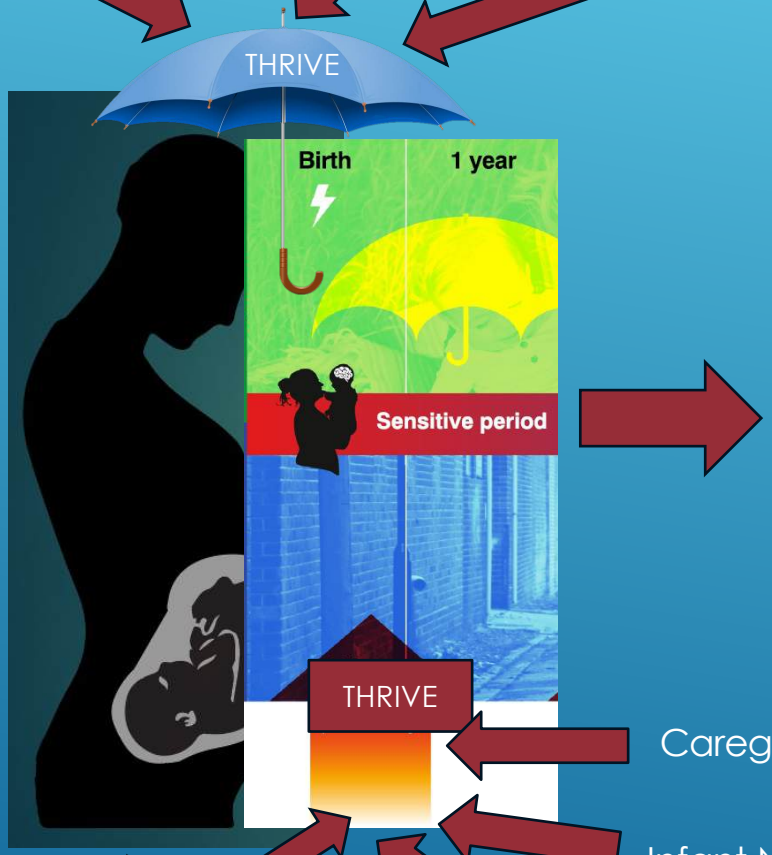
This award recognizes the Ballmer Institute's groundbreaking work to craft and implement a national model for a bachelor's-level specialty training program in children's behavioral health.

Caregiver identity/Attachment history

Sleep/Circadian Rhythms

Stress Management

Maternal Nutrition



Caregiver Nurturance

Infant Nutrition

Stimulation

Safety

Infant Sleep and Circadian Rhythms

RE-THINKING HEALTH PRIORITIES: GROWING HEALTHY CHILDREN

- Investing in the psychosocial environment and mental health of pregnant women.
- Investing in the fundamental needs of infants to facilitate thriving.
- Both highly cost effective---
- Both investments clearly enhance infant development on many levels for both individual and social benefit
- The app provides scientific developmental information to support and supplement zoom therapy sessions at mother's convenience.

CONCLUSIONS ABOUT PERINATAL PREVENTION:

- Humans are born with inherent positivity and potential to thrive.
- The psychosocial environment can and should be used to support and facilitate those developmental skills.
- Developing children need key basic resources and protections from adversity to support this natural drive/capacity to thrive.
- Essential biological processes depend/vary based upon the presence or absence of basic resources to function adaptively
- Timing of these protections/enhancements are key---based on sensitive periods.

Ana Luiza Penna, PH.D. (lead)
Bloom: intervention development and pilot study coordination

- PhD in Population Health Sciences, Harvard University

AREAS OF EXPERTISE

- Design, testing and implementation of parenting programs in low- and middle-income countries.
- Integration of programs into local platforms

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Key Collaborators

- Caroline Hoyniak, Ph.D. (sleep)
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- Deanna Barch, Ph.D. (neurodevelopment)
- Simone Anza, Ph.D. (metabolomics)