



NATIONAL SERVICE OFFICE 2023 NATIONAL SYMPOSIUM

— SEATTLE, WA —

SEPT. 11-13


**Practical Brain Science: applying
the science of child development
to home-visiting practice**

Mandy A. Allison MA.Ed, MD, MSPH



LEARNING OBJECTIVES

1. Learners will summarize critical stages of brain development and factors that affect brain development.
2. Learners will review key milestones of psychosocial development.
3. Learners will evaluate cases to determine if psychosocial development concerns are present and identify next steps.
4. Learners will identify activities that home-visitors do to promote psychosocial development.

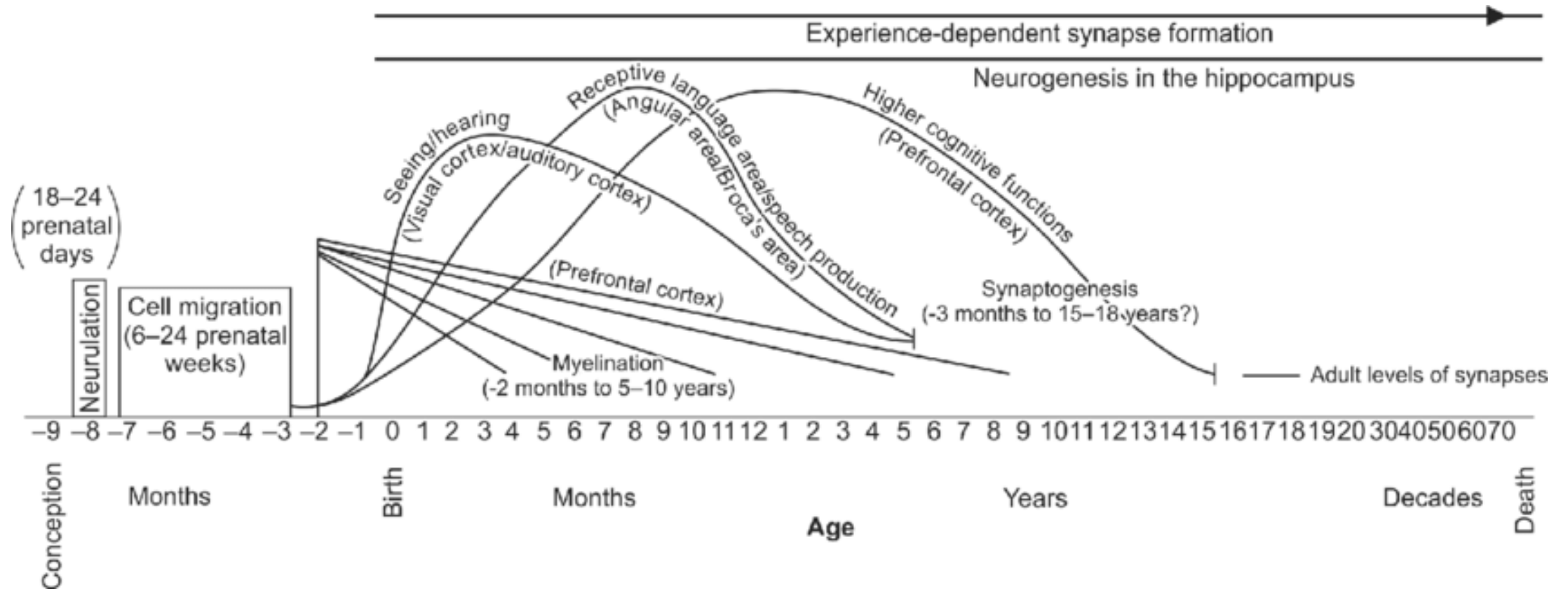
- 
- Making the brain cells
 - Getting the cells to where they need to be
 - Growing structures needed to link with other nerve cells (axons and dendrites)
 - Developing points of communication with other cells (synapses)
 - Refining connections between cells
 - Forming the tissue that surrounds cells and promotes efficient communication between them



Overlapping phases of brain development

Reference: National Research Council. 2000. From Neurons to Neighborhoods: The Science of Early Childhood Development. Washington, DC: The National Academies Press. <https://doi.org/10.17226/9824>.

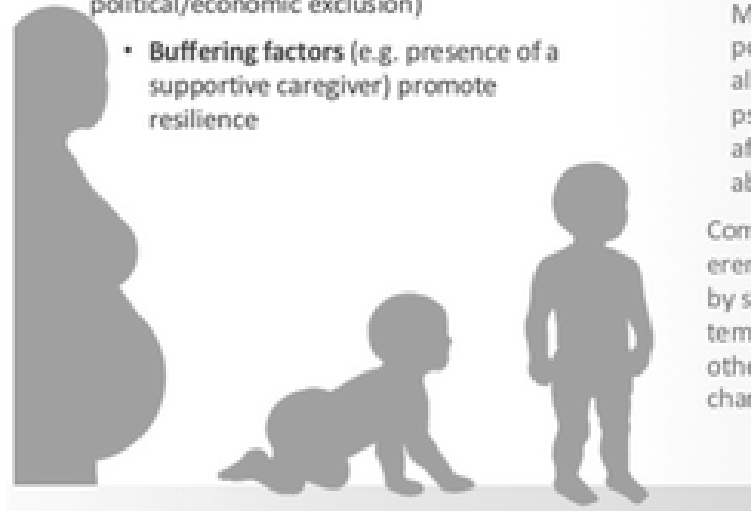
The earliest months and years are critical for brain development



Copyright © [2001] by the American Psychological Association. Reproduced with permission. The official citation that should be used in referencing this material is [Thompson RA, Nelson CA. Developmental science and the media: early brain development. *Am Psychol.* 2001;56:5-15.]. The use of APA information does not imply endorsement by APA.

Early psychosocial environment

- Child deprivation & caregiver/child stress linked to:
 - Caregiving environment (child abuse and neglect, caregiver psychopathology, incarceration, or death, depriving institutional care, etc.)
 - Family context (familial conflict, domestic violence, addiction, marital breakdown, etc.)
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- Buffering factors (e.g. presence of a supportive caregiver) promote resilience



Sensitive period effects

Adverse exposures impair specific functions most during rapid/foundational development

Legend—GR: glucocorticoid receptor; PFC: prefrontal cortex; COPD: chronic obstructive pulmonary disease

Biological changes

Genetic variation & other child characteristics

Genetic variants alter susceptibility

- E.g. 5-HTTLPR, BDNF, FKBP₅, and MAOA polymorphisms alter risk of psychopathology after early abuse

Complex differential effects by sex, gender, temperament, and other child characteristics

Epigenetic change → altered phenotypes

- DNA methylation (e.g. GR promoter)
- Histone modification & chromatin remodeling
- RNA-associated pathways

Additional systemic effects

- Metabolic dysregulation (e.g. insulin resistance, altered lipid metabolism)
- Immunosuppression with chronic inflammation
 - Possible contribution to gut dysbiosis

Altered neural structure & function

- Neuronal death, reduced/altered volumes (e.g. PFC, hippocampus)
- Altered functional activity & connectivity
- Neurocognitive compromise

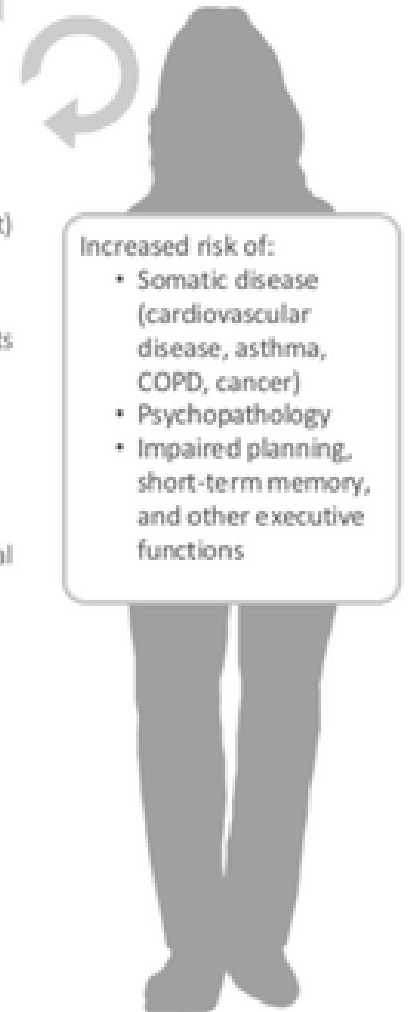
Altered HPA & sympathetic stress reactivity

- Excess early activation generates dysregulation
- Central & peripheral cortisol resistance/aberrant levels drive systemic pathology

Developmental trajectory

- Behavioral risk factors (e.g. substance use, exercise, diet, stress management) may be influenced by early development
- Behavior impacts future social exposures
- Early social & educational setbacks compound social disadvantage

Adult outcomes



- Increased risk of:
- Somatic disease (cardiovascular disease, asthma, COPD, cancer)
 - Psychopathology
 - Impaired planning, short-term memory, and other executive functions



<https://developingchild.harvard.edu/resources/inbrief-science-of-eed/>



REFLECTION

What thoughts or questions have come to your mind about brain development?



< Activities

Moderate

Visual settings

Edit



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Send
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What thoughts or questions have come to your mind about brain development?

Nobody has responded yet.

Hang tight! Responses are coming in.

Research about how the early environment affects brain development is ongoing

Associations Between Socioeconomic Status, Obesity, Cognition, and White Matter Microstructure in Children

Zhaolong Adrian Li, BA; Yuqi Cai, BA; Rita L. Taylor, MA; Sarah A. Eisenstein, PhD; Deanna M. Barch, PhD; Scott Marek, PhD; Tamara Hershey, PhD

Abstract

IMPORTANCE Lower neighborhood and household socioeconomic status (SES) are associated with negative health outcomes and altered brain structure in children. It is unclear whether such findings extend to white matter and via what mechanisms.

OBJECTIVE To assess whether and how neighborhood and household SES are independently associated with children's white matter microstructure and examine whether obesity and cognitive performance (reflecting environmental cognitive and sensory stimulation) are plausible mediators.

DESIGN, SETTING, AND PARTICIPANTS This cross-sectional study used baseline data from participants in the Adolescent Brain Cognitive Development (ABCD) study. Data were collected at 21 US sites, and school-based recruitment was used to represent the US population. Children aged 9 to 11 years and their parents or caregivers completed assessments between October 1, 2016, and October 31, 2018. After exclusions, 8842 of 11 875 children in the ABCD study were included in the analyses. Data analysis was conducted from July 11 to December 19, 2022.

EXPOSURES Neighborhood disadvantage was derived from area deprivation indices at participants' primary residence. Household SES factors were total income and highest parental educational attainment.

MAIN OUTCOMES AND MEASURES A restriction spectrum imaging (RSI) model was used to quantify restricted normalized directional (RND; reflecting oriented myelin organization) and restricted normalized isotropic (RNI; reflecting glial and neuronal cell bodies) diffusion in 31 major white matter tracts. The RSI measurements were scanner harmonized. Obesity was assessed through body mass index (BMI; calculated as weight in kilograms divided by height in meters squared), age- and sex-adjusted BMI z scores, and waist circumference, and cognition was assessed through the National Institutes of Health Toolbox Cognition Battery. Analyses were adjusted for age, sex, pubertal development stage, intracranial volume, mean head motion, and twin or siblingship.

RESULTS Among 8842 children, 4543 (51.4%) were boys, and the mean (SD) age was 9.9 (0.7) years. Linear mixed-effects models revealed that greater neighborhood disadvantage was associated with lower RSI-RND in the left superior longitudinal fasciculus ($\beta = -0.055$; 95% CI, -0.081 to -0.028) and forceps major ($\beta = -0.040$; 95% CI, -0.067 to -0.013). Lower parental educational attainment was associated with lower RSI-RND in the bilateral superior longitudinal fasciculus (eg, right hemisphere: $\beta = 0.053$; 95% CI, 0.025 - 0.080) and bilateral corticospinal or pyramidal tract (eg, right hemisphere: $\beta = 0.042$; 95% CI, 0.015 - 0.069). Structural equation models revealed that lower cognitive performance (eg, lower total cognition score and higher neighborhood disadvantage: $\beta = -0.012$; 95% CI, -0.016 to -0.009) and greater obesity (eg, higher BMI and higher neighborhood disadvantage: $\beta = -0.004$; 95% CI, -0.006 to -0.001) partially accounted for the associations between SES and RSI-RND. Lower household income was associated with higher RSI-RNI in most

(continued)

Key Points

Question Are neighborhood and household socioeconomic status associated with children's brain white matter microstructure and, if so, do obesity and cognitive performance (reflecting environmental stimulation) plausibly mediate the associations?

Findings In this cross-sectional study of 8842 children who participated in the Adolescent Brain Cognitive Development study, higher neighborhood disadvantage, lower household income, and lower parental educational attainment had independent associations with lower restricted directional diffusion and greater restricted isotropic diffusion in white matter. Greater body mass index and poorer cognitive performance partially explained these associations.

Meaning These findings suggest that future research on children's brain health may benefit from considering obesity incidence and environmental cognitive enrichment from multiple socioeconomic perspectives.

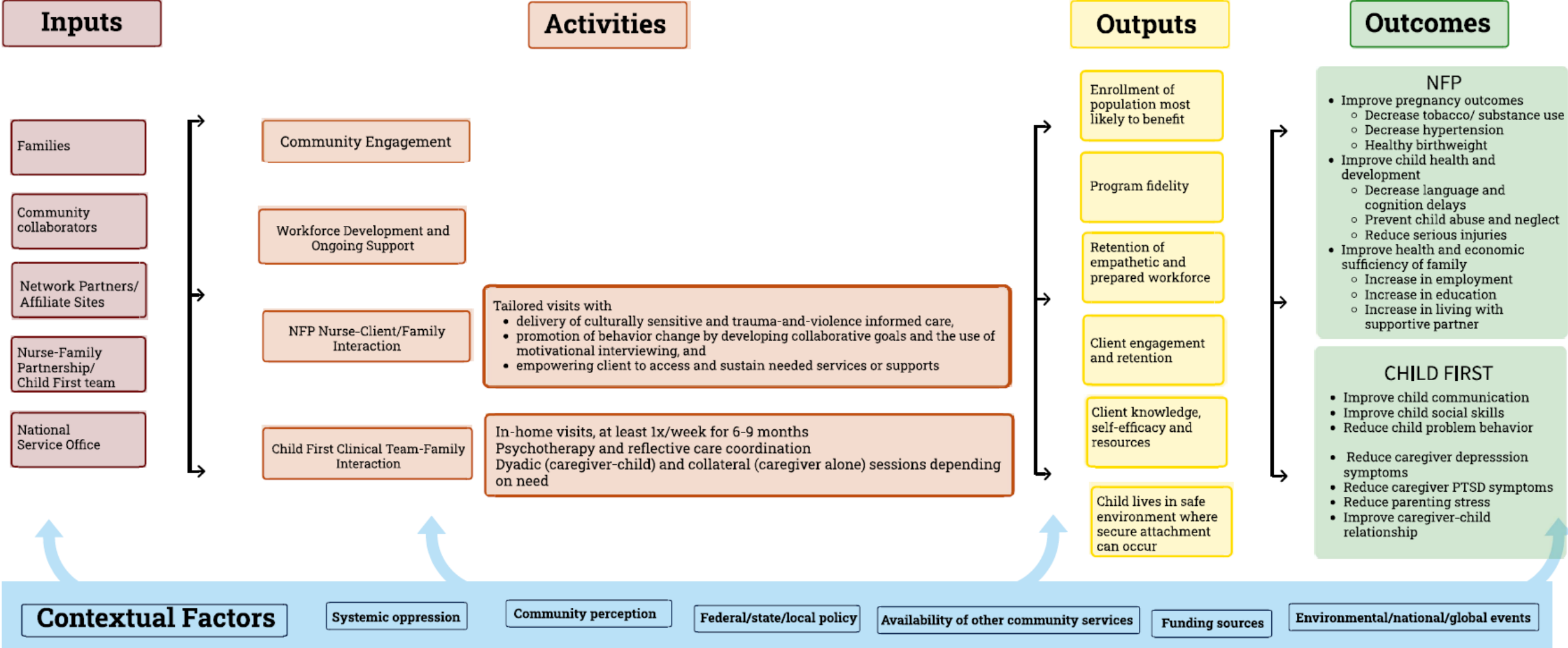
+ Supplemental content

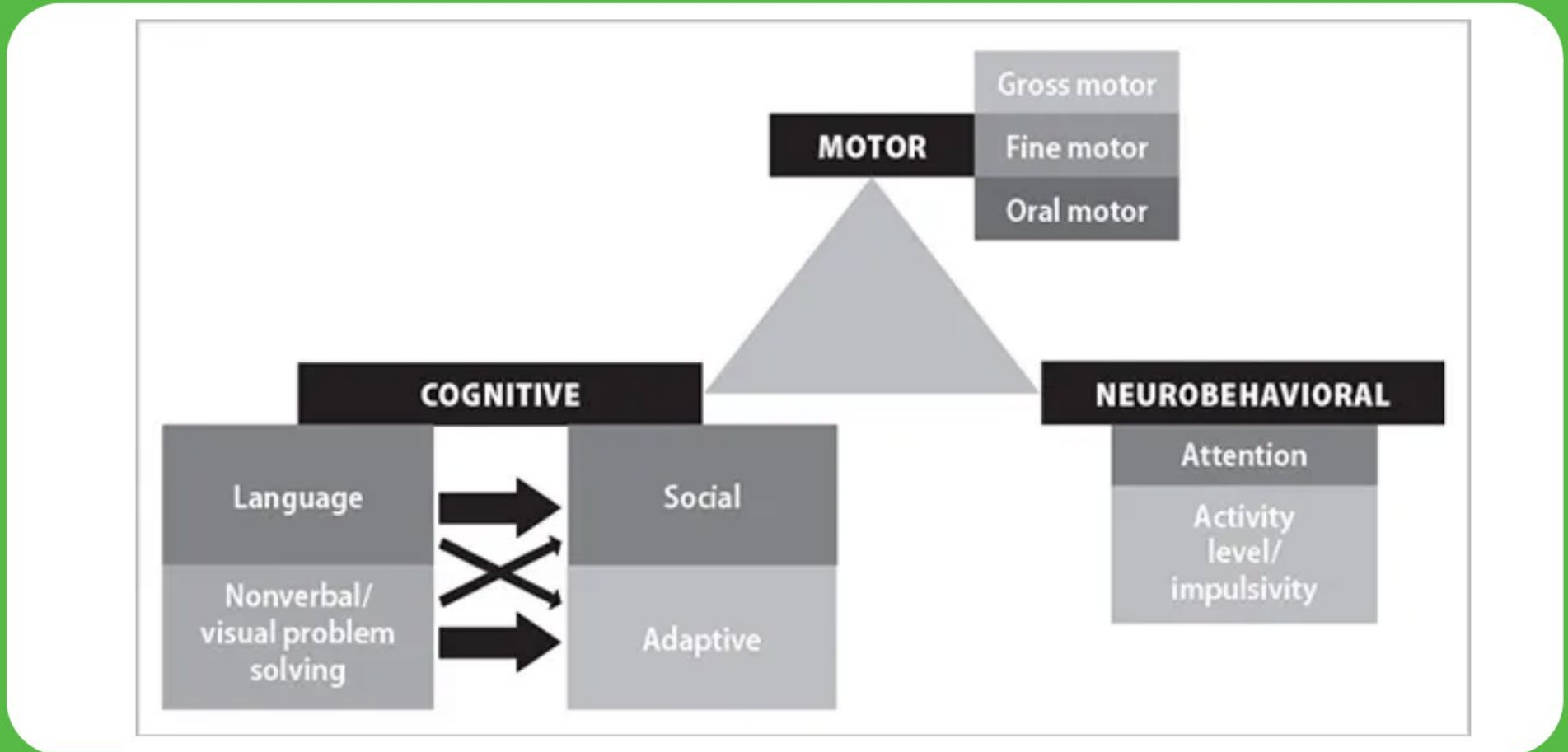
Author affiliations and article information are listed at the end of this article.

Our understanding of how interventions work to promote brain development, such as connections between neurons (synaptogenesis, maturation, and pruning) and supportive structures (white matter), is a research gap.



Nurse Family Partnership and Child First Logic Model





Capute's triangle. Adapted from Capute AJ. The expanded Strauss syndrome MBD Revisited. In: Accardo PJ, Blondis TA, Whitman BY, editors. *Attention Deficit Disorders and Hyperactivity*. 1991; New York: Marcel Dekker, Inc. p 28.



DEVELOPMENTAL SCREENERS USED BY NFP AND CHILD FIRST

NFP	CHILD FIRST
<p>Ages and Stages (ASQ: 3) 5 categories: communication, gross motor, fine motor, social, problem solving</p>	
<p>Ages and Stages Social-Emotional (ASQ: SE-2)</p>	
	<p>BITSEA (Brief Infant-Toddler Social and Emotional Assessment)</p>
	<p>PKBS2 (Preschool and Kindergarten Behavior Scale, 2nd Edition)</p>



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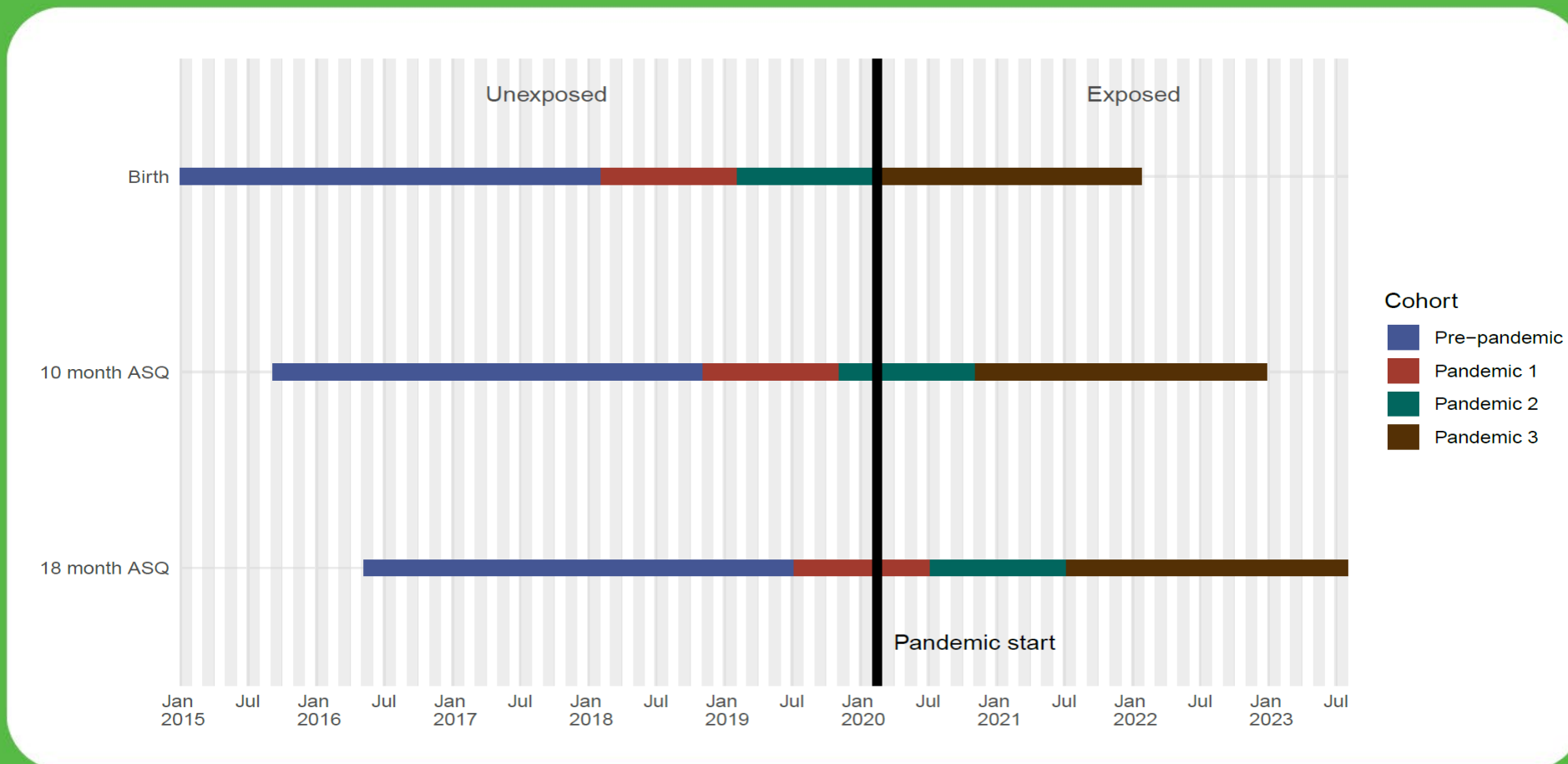
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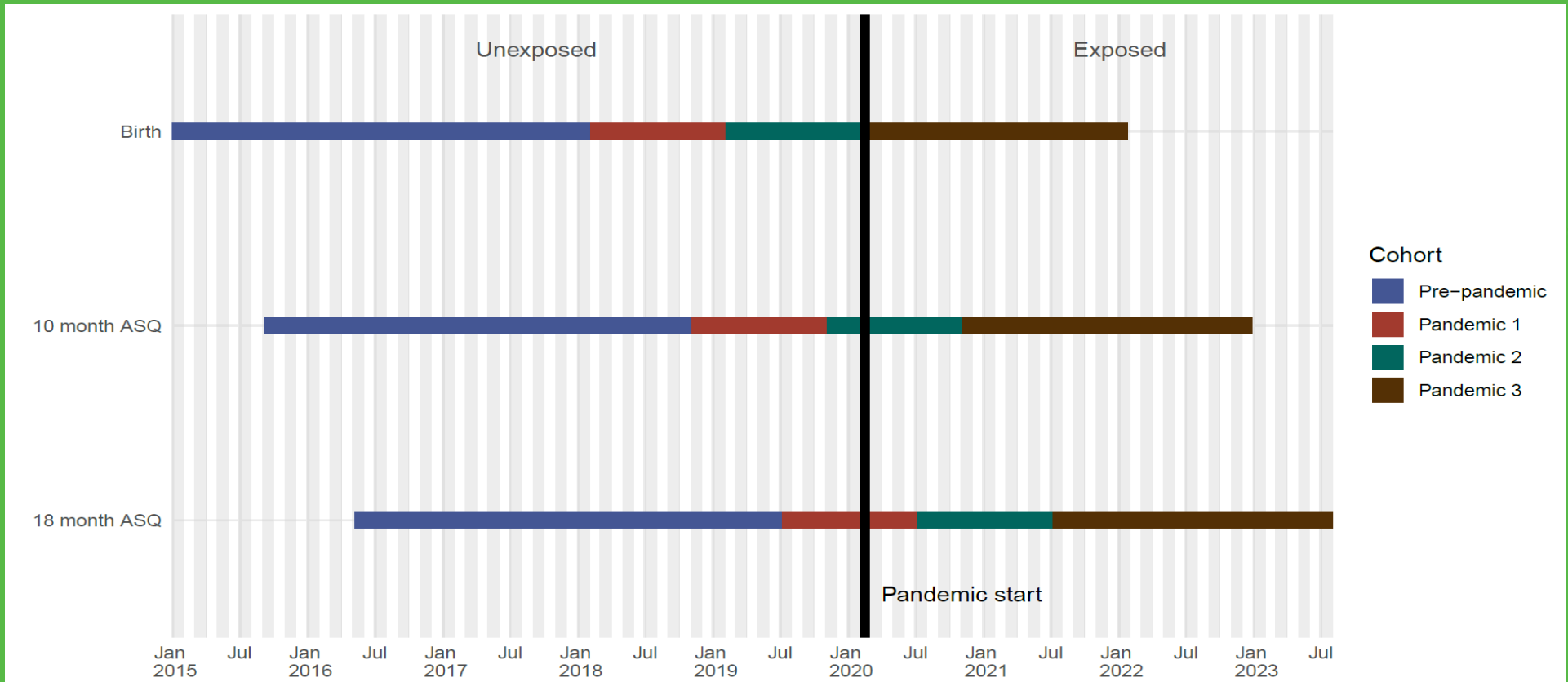
Why focus on social and emotional development?



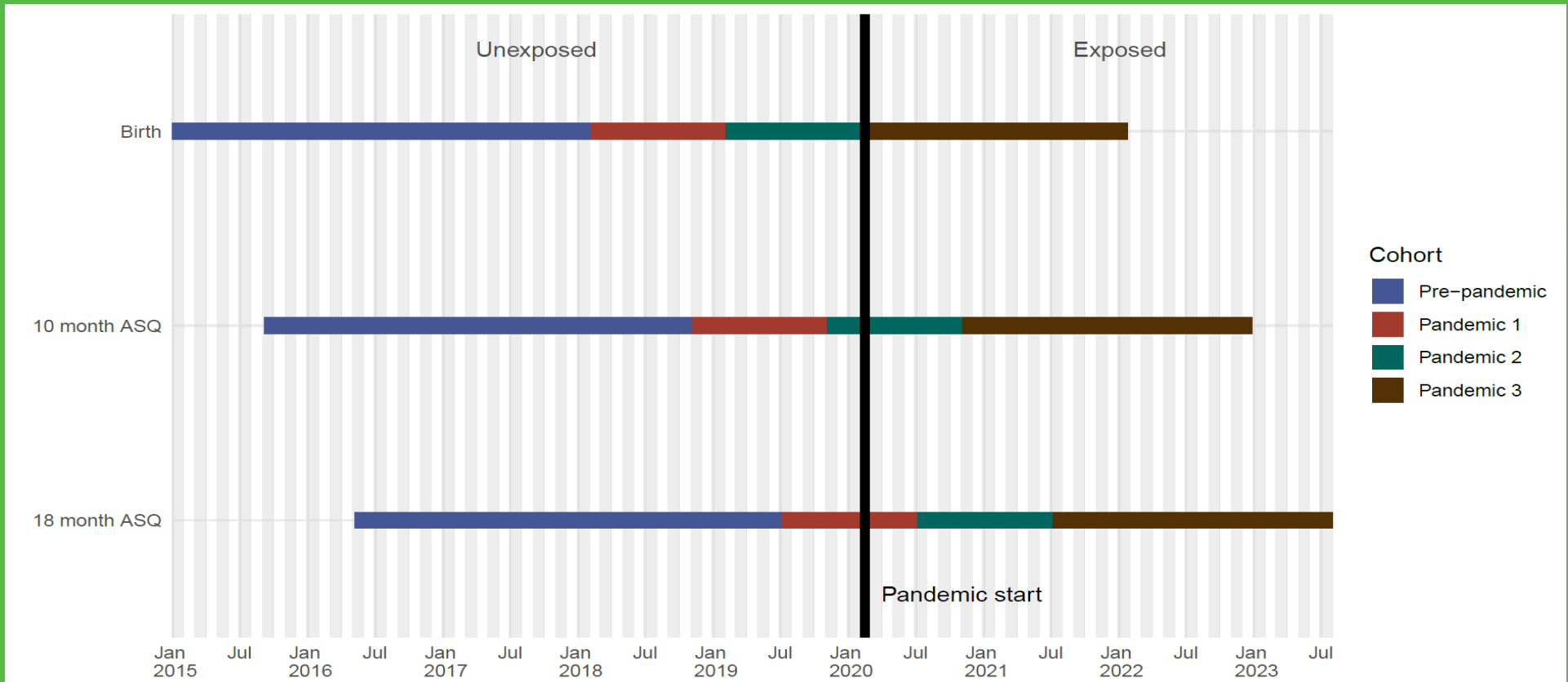
The COVID-19 Pandemic's Effects on Young Children's Socio-Emotional Development

Larisa Kuehn, RN IBCLC¹, Ashley Jones, PhD, RN², Laura Helmkamp MS¹, Michael Knudtson, MS¹, Gretchen Domek, MD, MPhil¹, Mandy A. Allison MEd, MD, MSPH¹





	Pre-pandemic %(N) n=27,821	Pandemic 1 %(N) n=9,657	Pandemic 2 %(N) n=9,917	Pandemic 3 %(N) n=12,776
ASQ: SE2 (12 months)				
Odds ratio, adjusted for demographics	-reference-	1.37(1.10, 1.69)	1.65(1.34, 2.02)	2.00(1.66, 2.42)
Adjusted for demographics and family risks	-reference-	1.45(1.15, 1.82)	1.72(1.36, 2.16)	2.11(1.71, 2.61)
ASQ: SE3 (18 months)				
Odds ratio, adjusted for demographics	-reference-	1.06(0.82, 1.37)	1.65(1.32, 2.06)	1.97(1.58, 2.46)
Adjusted for demographics and family risks	-reference-	1.03(0.78, 1.35)	1.51(1.18, 1.94)	1.81(1.41, 2.31)



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**Did you notice an increase in positive developmental
screens during the pandemic?**

SEE MORE



0-3 Months

- Begins to smile in response to their caregivers, also called a social smile
- Develops more facial and body expressions
- Can briefly calm themselves, e.g. sucking on thumb
- Recognizes they are having fun and may cry when playing stops
- Makes eye contact and looks at people while interacting

4-6 Months

- Is usually happy when surrounded by cheerful caregivers
- Responds to and copies some movements and facial expressions
- Develops an awareness of their surroundings and expresses a desire to engage, e.g. banging objects or toys



7-9 Months

- May show anxiety around strangers
- Plays social games, e.g. peek-a-boo
- Learns the meaning of words when they're used consistently
- Enjoys looking at self in a mirror
- Becomes more "clingy" when leaving caregiver, e.g. reaches for caregiver when being held by someone else



10-12 Months

- Attempts to display independence, e.g. crawling for exploration or refusing food
- May show fear around unfamiliar people and objects
- Tries to get attention by repeating sounds and gestures
- Enjoys imitating people in play

1-2 Years

- Shows defiant behavior to establish independence, e.g. having tantrums
- Does not understand what others think or feel and believes everyone thinks as they do, e.g. gets upset when no longer the center of attention
- Enjoys being around other children, but not yet able to share easily
- Can play independently for brief periods of time

2-3 Years

- Copies others in more complex tasks, e.g. cleaning, cooking, self-care
- Shows affection towards friends
- Shows an increasing variety of emotions
- Upset when there are major changes in routine
- Seems concerned about personal needs and may even act “selfishly”



CASE STUDIES

- *Work in groups of 5 to 7 at your tables*
- *For each case,*
 - *Take a few minutes to write down your responses to each of the 3 questions*
 - *Share your responses at your table*
 - *Identify someone to share your group's/table's key points with the room*
 - *Each group/table will be asked to volunteer to share their key points*



Case 1: 6-month-old infant

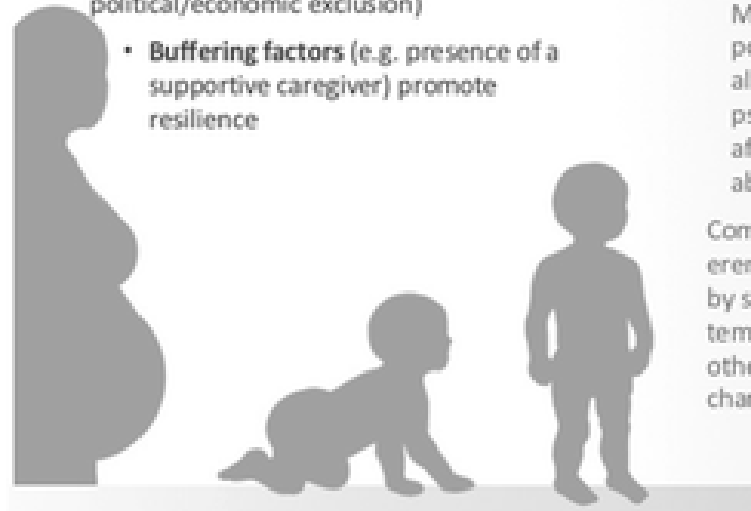
- When you arrive, the mother is texting on her phone and the infant is strapped into her car seat carrier
- The mother tearfully tells you about some relationship issues she is having while the baby continues to sit in the car seat with a neutral expression
- When you pick up the infant from the car seat with mother's permission, it takes her several minutes to smile
- The infant's ASQ: SE2 screen is positive (in black area/above cut-off)
 - 1) *What are your observations about this case?*
 - 2) *What knowledge do you need to move forward?*
 - 3) *What are your next steps?*

Case 2: 18-month-old toddler

- You have been working with the family on managing this toddler's tantrums
 - The mother is frustrated because he does not share toys with his cousins when they come over
 - The toddler can say about 6 words including 'mama', 'papa', and 'dog'
 - The ASQ: 3 screen is borderline (gray area) for communication and positive (black area) for social
- 1) *What are your observations about this case?*
 - 2) *What knowledge do you need to move forward?*
 - 3) *What are your next steps?*

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- DNA methylation (e.g. GR promoter)
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- RNA-associated pathways

Additional systemic effects

- Metabolic dysregulation (e.g. insulin resistance, altered lipid metabolism)
- Immunosuppression with chronic inflammation
 - Possible contribution to gut dysbiosis

Altered neural structure & function

- Neuronal death, reduced/altered volumes (e.g. PFC, hippocampus)
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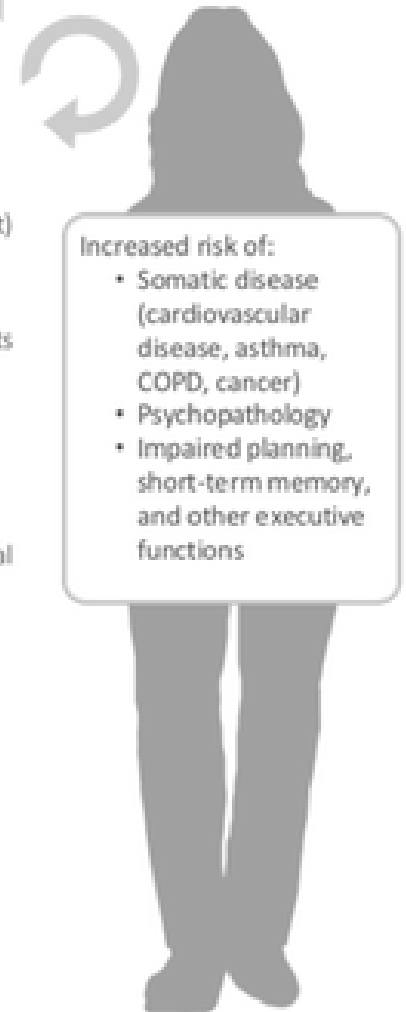
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Developmental trajectory

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Adult outcomes

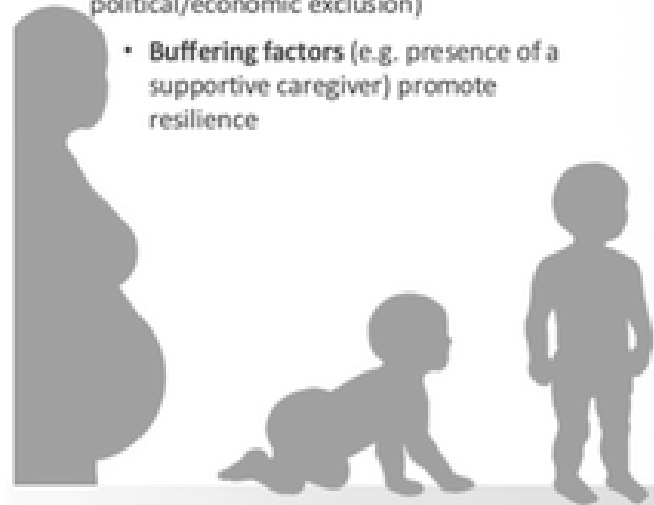


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Legend: GR, glucocorticoid receptor; PFC, prefrontal cortex; COPD, chronic obstructive pulmonary disease

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Home visitors use a strengths-based approach to address the early psychosocial environment

Developmental trajectory

Behavioral risk factors (e.g. substance use, exercise, stress management) can be influenced by early development

Behavior impacts future social exposures

- Early social & educational setbacks compound social disadvantage

Adult outcomes

Increased risk of:

- Somatic disease (cardiovascular disease, asthma, COPD, cancer)
- Psychopathology
- Impaired planning, short-term memory, and other executive functions

Legend: 5-HTTLPR, serotonin transporter gene; BDNF, brain-derived neurotrophic factor; COPD, chronic obstructive pulmonary disease



REFLECTION

What are things you do in your clinical practice or work to promote early brain development?



< Activities



Moderate



Visual settings



Edit



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What are things you do in your clinical practice or work to promote early brain development?

Nobody has responded yet.

Hang tight! Responses are coming in.

- Early childhood is a critical period for brain development
- The early environment affects genetic expression, brain structure, neurochemistry
- Social and emotional development is critical because it affects all other areas of development
- Home visitors support brain development and resulting social and emotional development
 - Screening and referral for caregivers and children
 - Substance use
 - IPV
 - Mental health
 - Development
 - Increasing caregivers' knowledge, skills, and self-efficacy
 - Modeling sensitive and development-promoting interactions
 - Identifying resources and supporting caregivers to have a safe community
 - Housing
 - Childcare



SUMMARY

RESOURCES (all free to use)

Quick reference for social-emotional milestones:

<https://pathways.org/topics-of-development/social-emotional/>
<https://www.cdc.gov/ncbddd/actearly/milestones/index.html>

Developmental milestones checklists:

<https://pathways.org/all-ages/checklists/>
<https://www.cdc.gov/ncbddd/actearly/milestones/index.html>

Activities to promote social-emotional development:

<https://pathways.org/baby-milestones-calendar/>
<https://www.zerotothree.org/resource/activities-for-bonding-and-learning-from-birth-to-12-months/>

Brain science:

<https://www.zerotothree.org/resource/whats-going-on-in-your-babys-mind-in-the-first-year-5-ways-to-put-brain-science-into-action/>
<https://nap.nationalacademies.org/catalog/9824/from-neurons-to-neighborhoods-the-science-of-early-childhood-development>

30 Month Questionnaire

OVERALL Use the space below for additional comments.

34. Do you have concerns about your child's eating and sleeping behaviors or about her toilet training?
If yes, please explain:

 YES NO

35. Does anything about your child worry you? If yes, please explain:

 YES NO

No. She's happy. I just want her eczema to get better.

36. What do you enjoy about your child?

I enjoy ever insytingy, bit of her. I enjoy how active and playful she is. How engaged she is in life and figuring things out. She such a good and kind spirit. I enjoy what she teaches Me.





QUESTIONS?
