

Intervening Early to Enhance Children's
Brain and Behavioral Development:
Attachment and Biobehavioral Catch-up

Biological Embedding of Caregiving Adversity
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Power of parental sensitivity

- Altricial species
- Human infant dependent on parent as:
 - Protector/nurturer
 - Responsive partner
- When young children lack responsive caregiver, effects on brain and behavioral development (e.g., Feldman, 2007; Nelson et al., 2007; Raby et al., 2015)

Early adversity places children at risk for:

- Disorganized attachment
- Problems regulating behaviors and emotions
- Gets embedded “under the skin” as seen in problems regulating physiology and non-optimal brain development

Attachment and Biobehavioral Catch-up (ABC)



3 targets

- Nurturance
 - Following the lead
 - Avoiding frightening behavior
-
- 10 sessions
 - Implemented in home

Nurturance

- Nurturance key to development of organized attachment (Ainsworth et al., 1978; Sroufe, 1979)

Secure

Avoidant

Resistant

Organized attachment strategies
(organized to maximize proximity to parent)

Disorganized attachment (Main & Solomon, 1990)

- Lacks a coherent strategy for maximizing proximity to parent
- Manifests in one of several (7) ways (e.g., freezing, stilling, falling to floor, moving to wall, etc.)
- Frightening or frightened parent
- Leaves child with "fright without a solution" (Main & Hesse, 1991)
- Disproportionate among children who have experienced adversity
 - (Bernard et al., 2012; Carlson et al., 1989; Van Ijzendoorn et al., 1999)

Nurturance

- Nurturance key to development of organized attachment
- Two things can get in the way
 - **Children may push away**
 - Nurturance does not come naturally to some parents

What happens when children push parents away?

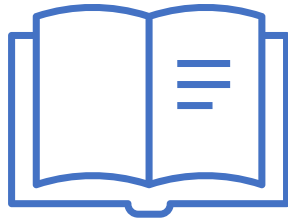
- Contingency analyses reveal that parents respond “in kind”

Stovall-McClough & Dozier, 2004,
Development and Psychopathology

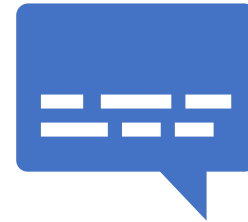
First target for ABC intervention: Providing nurturance

- Even when child doesn't elicit it
- Even when it doesn't come naturally to parent

How ABC is implemented



Manualized content



In-the-moment comments

Comments can have 1-3 components

1. Description of parent behavior

“He’s crying and you’re holding him”

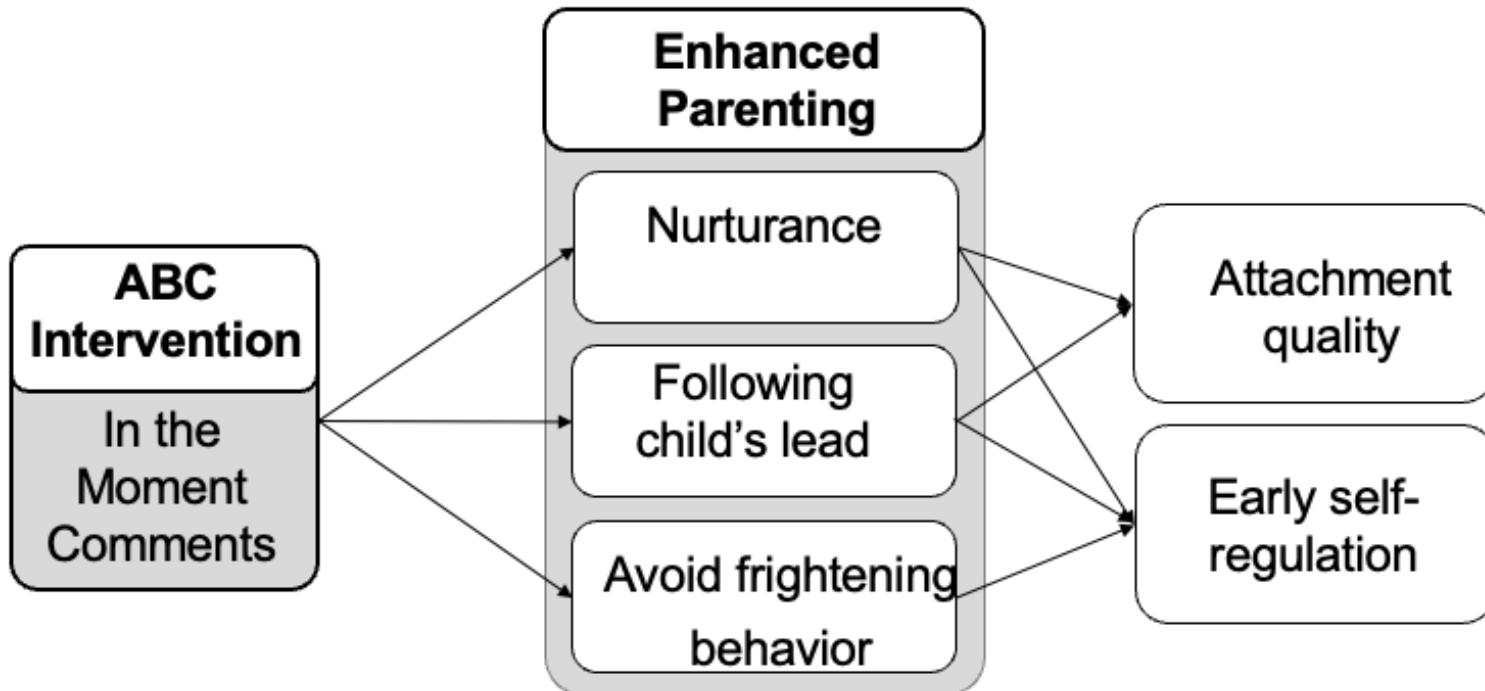
2. Link parent behavior to intervention target

“Good job nurturing him”

3. Link parent behavior to child outcome

“That lets him know you’re there for him”

Model of intervention effects



Biological dysregulation

Early adversity leads to biological dysregulation

Human, non-human primate and rodent studies have shown effects of early experience on HPA axis (e.g., Gunnar & Donzella, 2002; Levine, 1994)

HPA axis

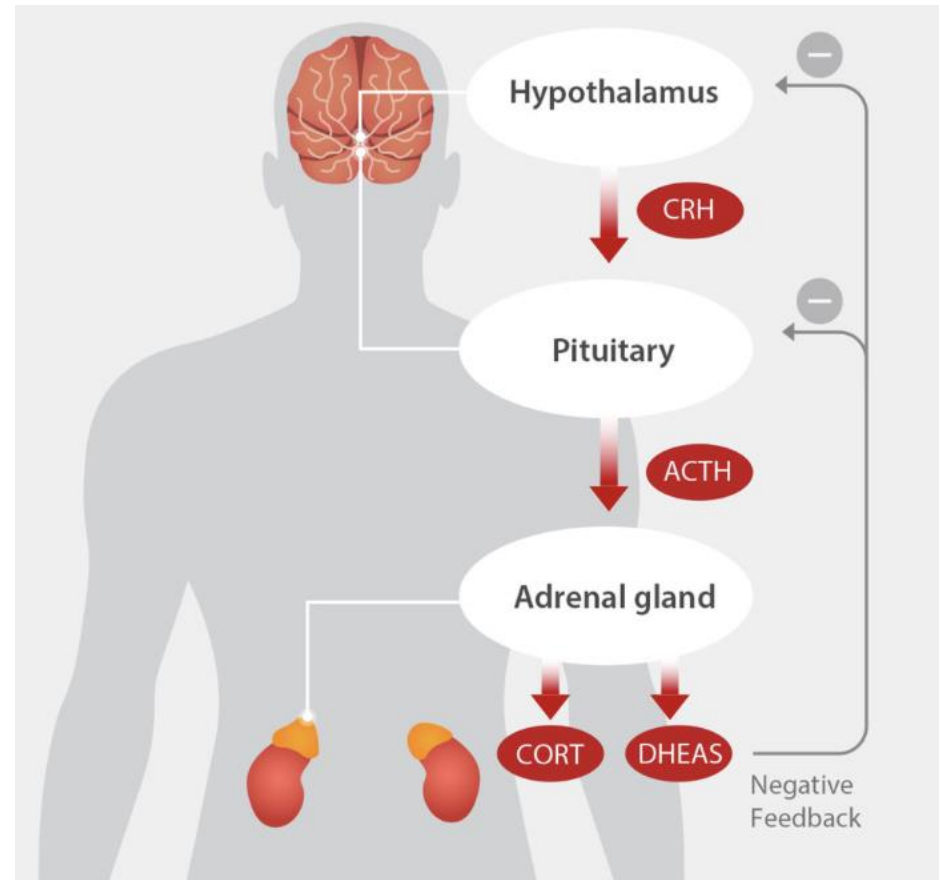
H - Hypothalamus

P - Pituitary

A – Adrenal

Cortisol an end product

Sensitive to effects of early
experience (Gunnar & Donzella,
2002)



HPA axis: 2 orthogonal functions

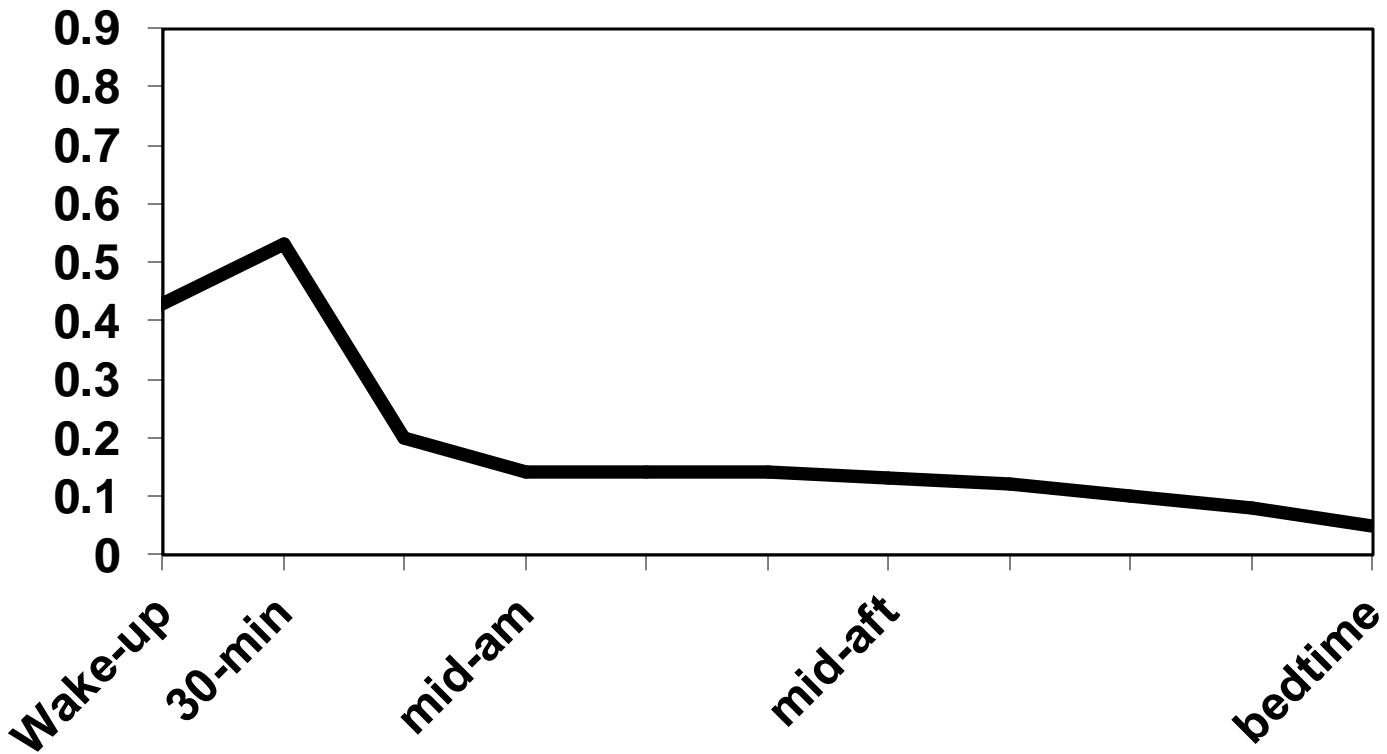
Stress reactive function

- Body's mounting a stress response

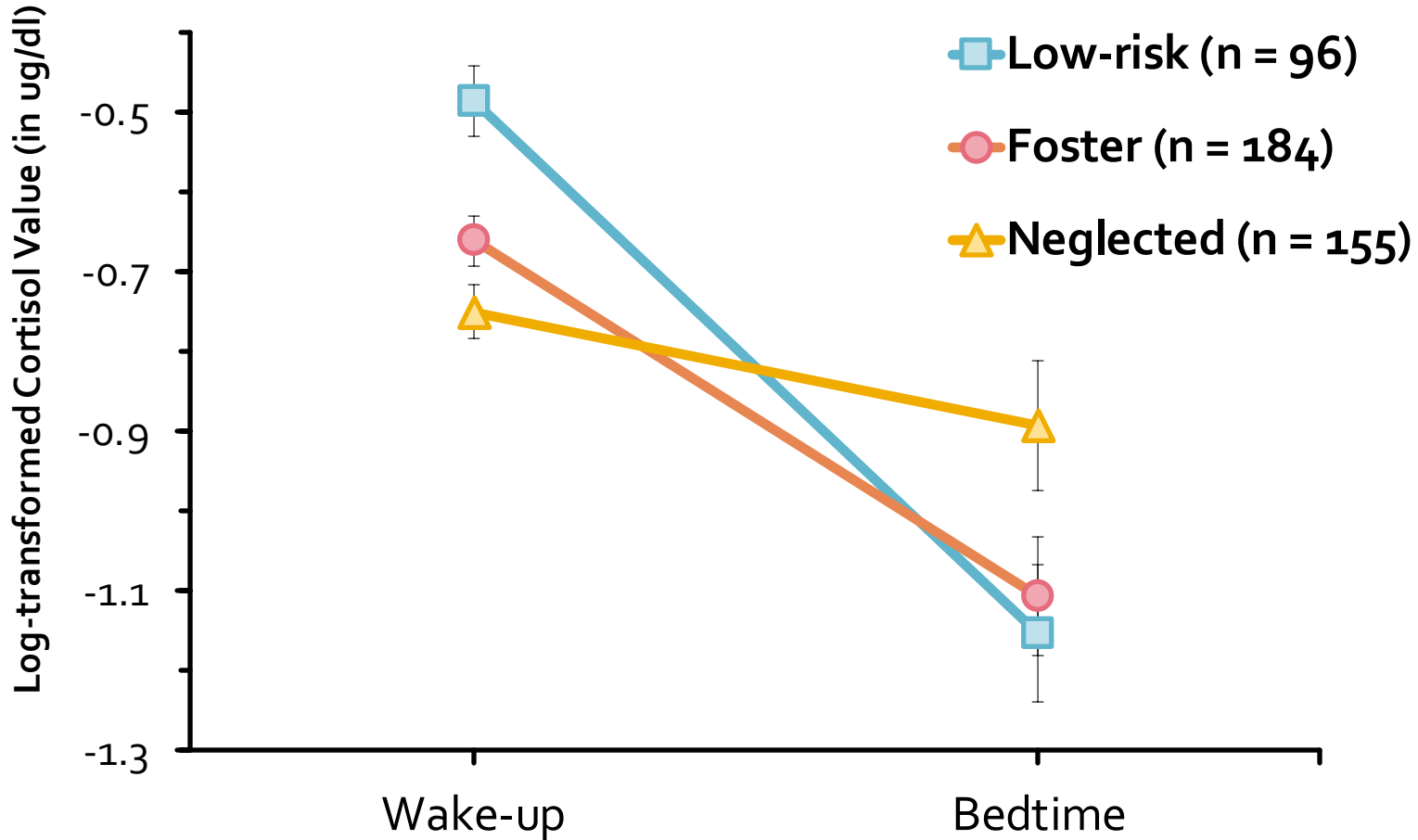
Diurnal function

- Organism functioning as diurnal (or nocturnal) creature

Typical diurnal pattern of cortisol



Early adversity and diurnal cortisol



Bernard et al., 2010, *Archives Ped Adol Med*

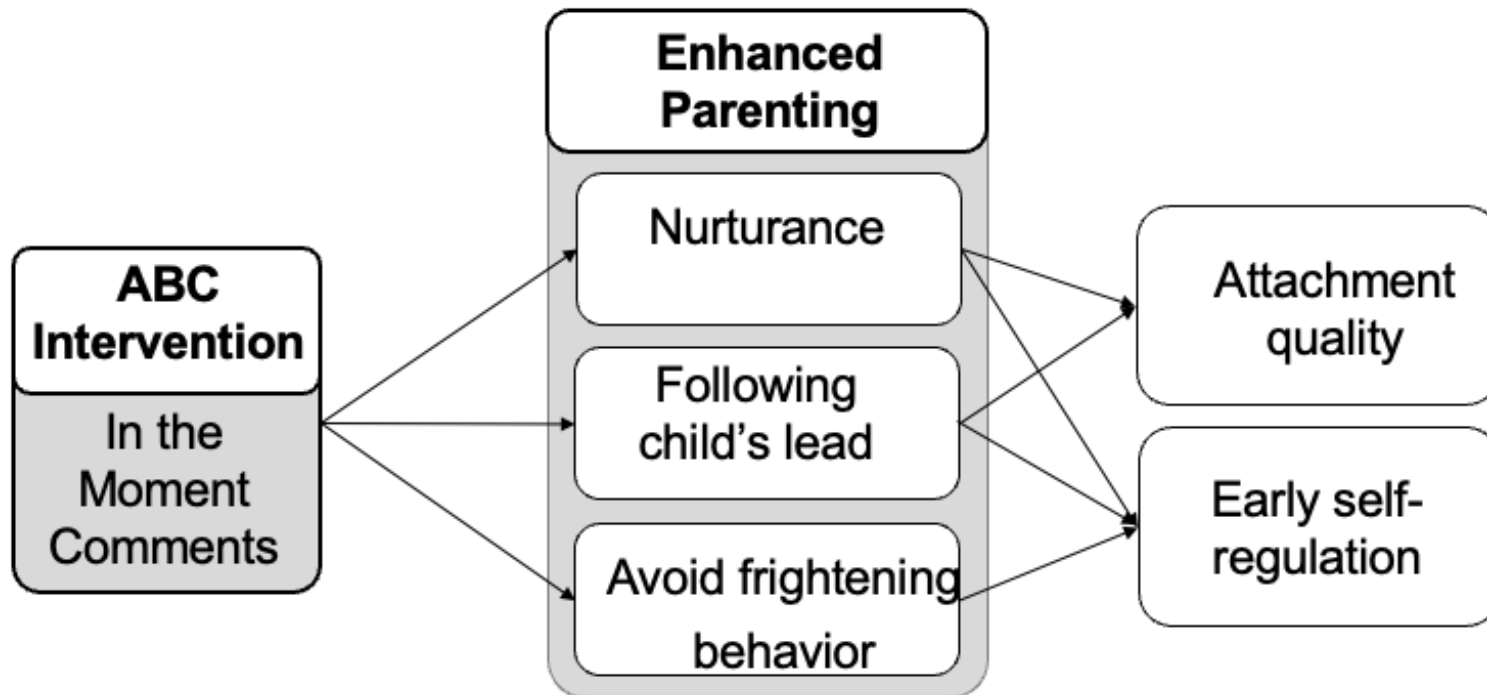
Adversity and dysregulation

- Biological dysregulation: cortisol
 - e.g., Bernard et al. (2010); Koss et al. (2016)
- Challenges regulating behavior
 - e.g., Lunkenheimer, Ram, Skowron, & Yin (2024)
- Challenges regulating emotions
 - e.g., Kim-Spoon et al. (2013)

Second target for intervention: Helping children develop better regulatory capacities

- Parental responsiveness associated with child self-regulation (Raver, 1996)
- Serve and return interactions (Shonkoff)
- Following child's lead (Dozier & Bernard, 2019)
- Akin to synchrony (Feldman) but not synonymous

Model of intervention effects



Harsh/frightening behavior

- Harsh, frightening, and/or intrusive behavior
 - Undermines child's ability to regulate behavior and biology
 - Associated with disorganized attachment

Carlson, 1996

Assessing effectiveness

- Randomly assigned children and parents to Attachment and Biobehavioral Catch-up (ABC) or to an alternate intervention (DEF)
 - Focus here on outcomes for neglected/CPS-involved sample
 - Children 3-24 months at start of intervention
 - About 120 participants in most analyses

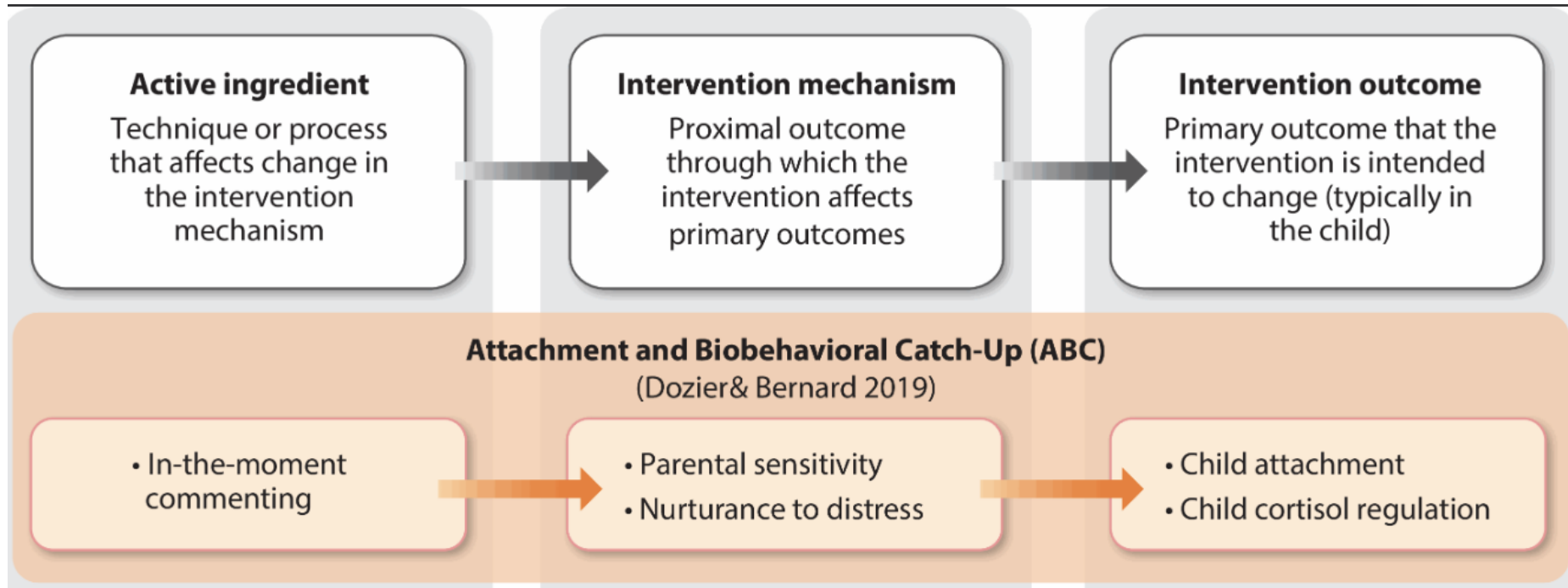
Control intervention: Developmental Education for Families (DEF)

Control intervention
focused on cognitive
and motor
development

Structure same as for
ABC

10 weekly sessions in
home

Model of change



ABC effects on parents' sensitivity

How it gets under the mom's skin

In-the-moment commenting predicts change in parenting

- In-the-moment commenting predicts parenting behavior
 - Higher frequency of on-target comments
 - More components included in comments



- Greater increases in parent following lead and greater decreases in intrusiveness

Caron et al., 2018, *JCCAP*

ABC effects on parental sensitivity

- Parents who received ABC more sensitive and less intrusive than DEF mothers at post-intervention (medium to large effects)
- These gains sustained 3 years later

Bick & Dozier, 2013; Raby et al. 2019;
Yarger et al., 2016

Parents' attachment narratives

Raby et al. (2021). *Development and Psychopathology*

Secure base script knowledge assessment 8 years after intervention (Theo Waters' measure)

Mothers instructed: Come up with the best story you can using the words below starting with Tommy.

Doctor's Office

Tommy

hurry

mother

bike

doctor

toy

hurt

cry

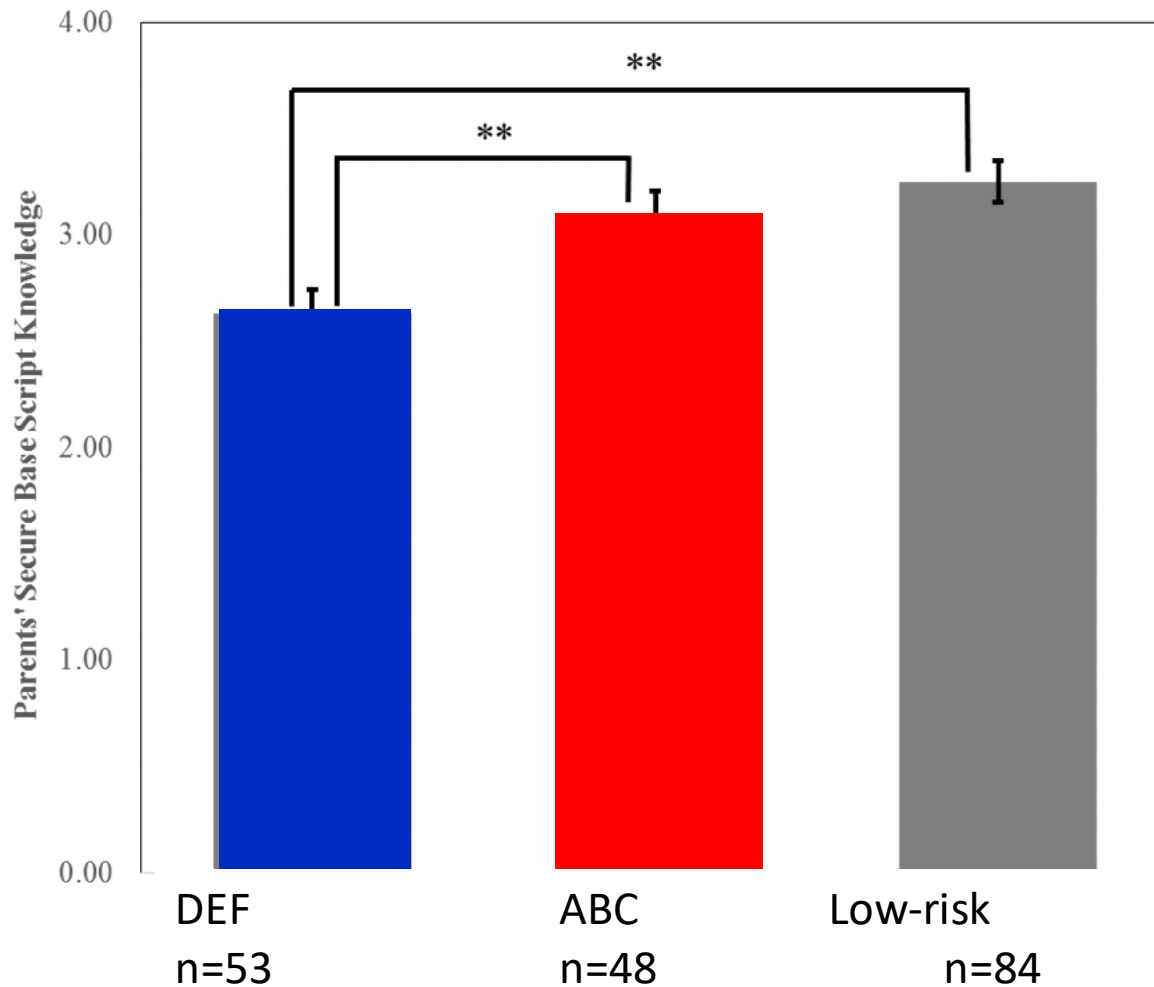
stop

mother

shot

hold

Intervention effects on parents' secure base script knowledge



Raby et al., 2021

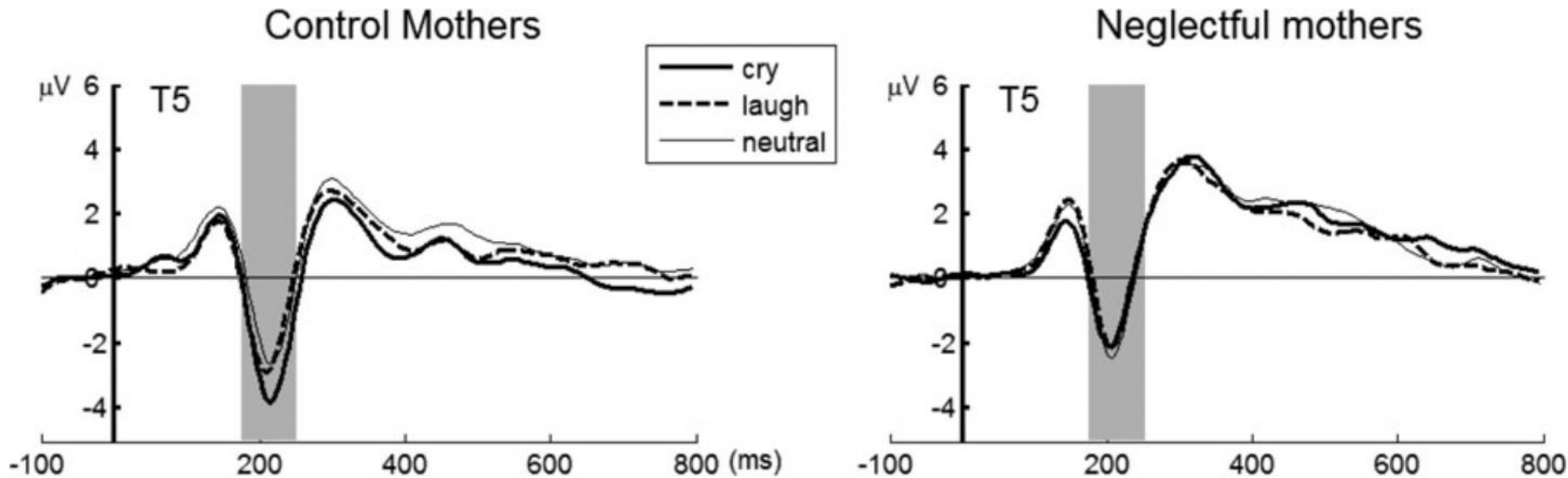
Parenting a
newborn
represents a period
of neuroplasticity

- Nehl et al., 2024
- Barba-Muller et al., 2018

Intervention effects on maternal brain activity

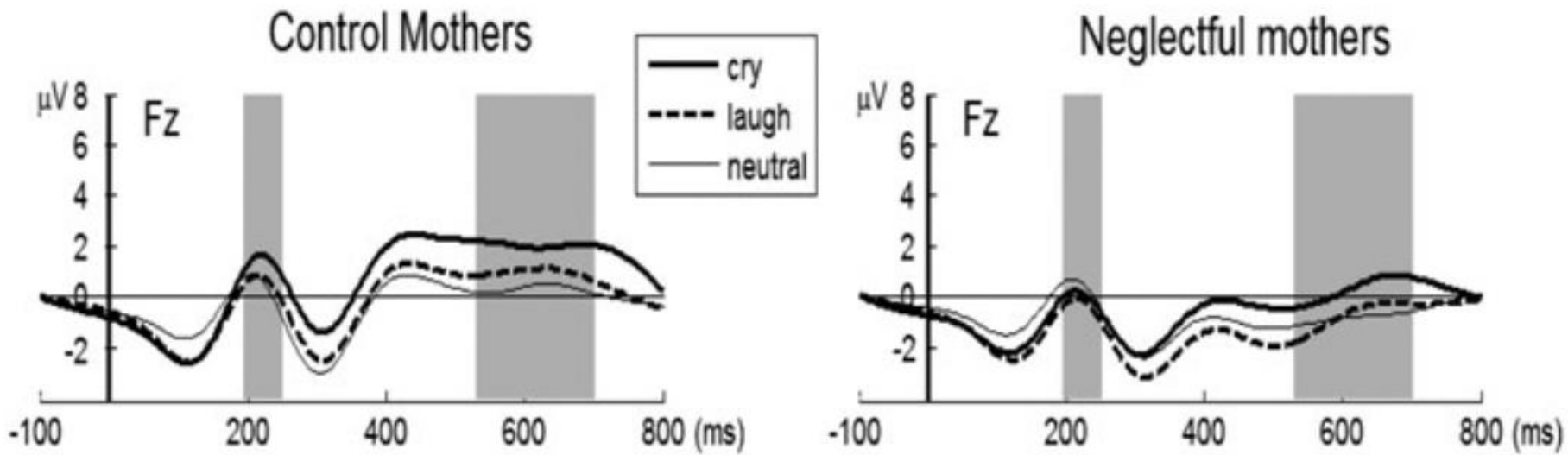
Brain activity of neglecting mothers indicated failure to discriminate faces (Rodrigo et al., 2011)

ERP components of interest: N170



Rodrigo et al., 2011

ERP components of interest: Late-positive potential (LPP)

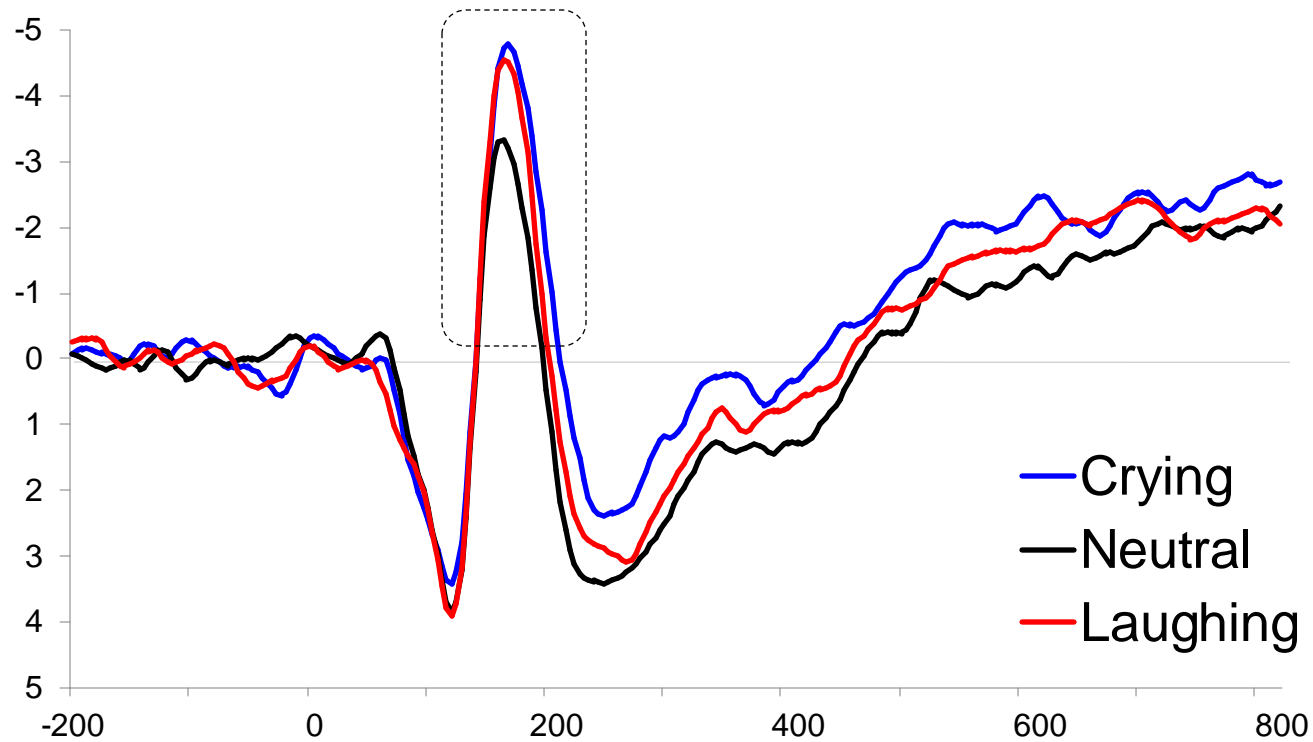


Rodrigo et al., 2011

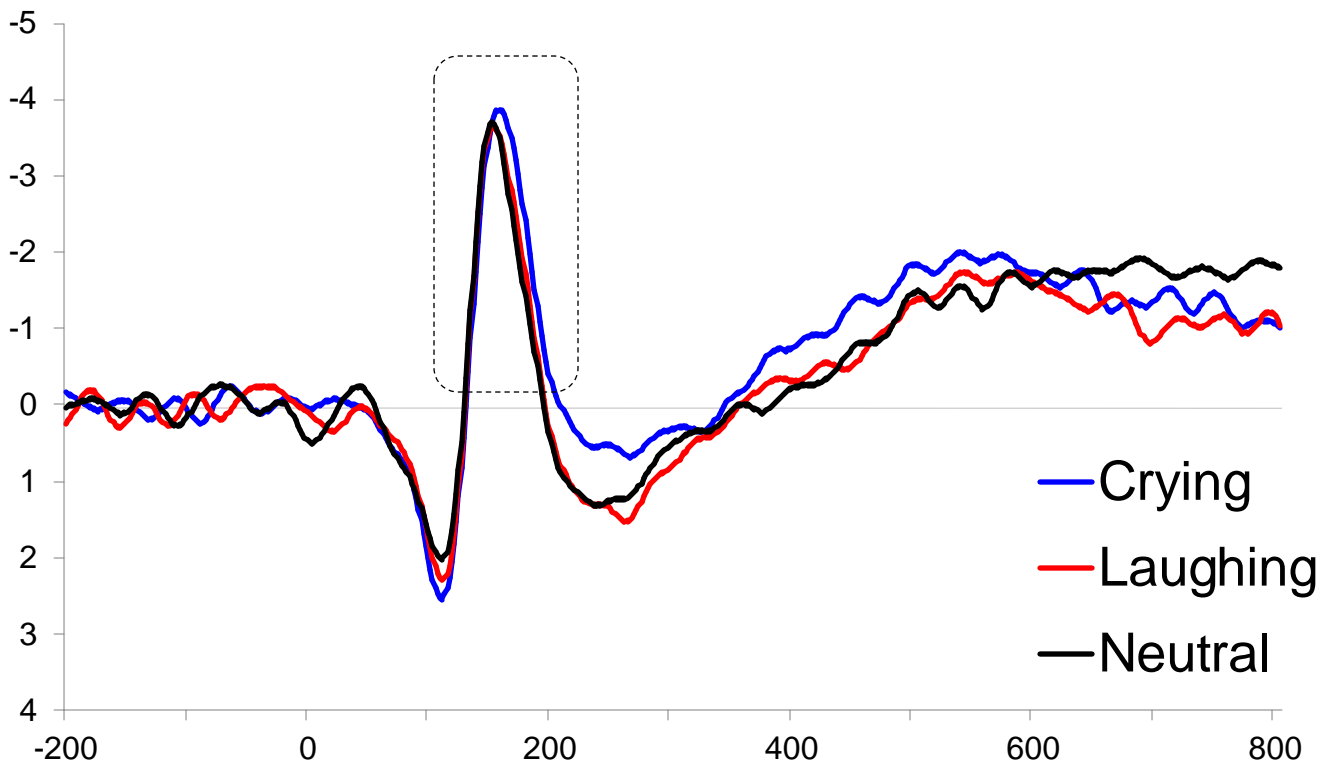
Maternal
neural
processing of
infant
emotions
assessed
through event
related
potentials
(ERPs)

- **3 groups:**
 - **Low-risk comparison**
 - **DEF (high-risk control)**
 - **ABC (high-risk experimental)**

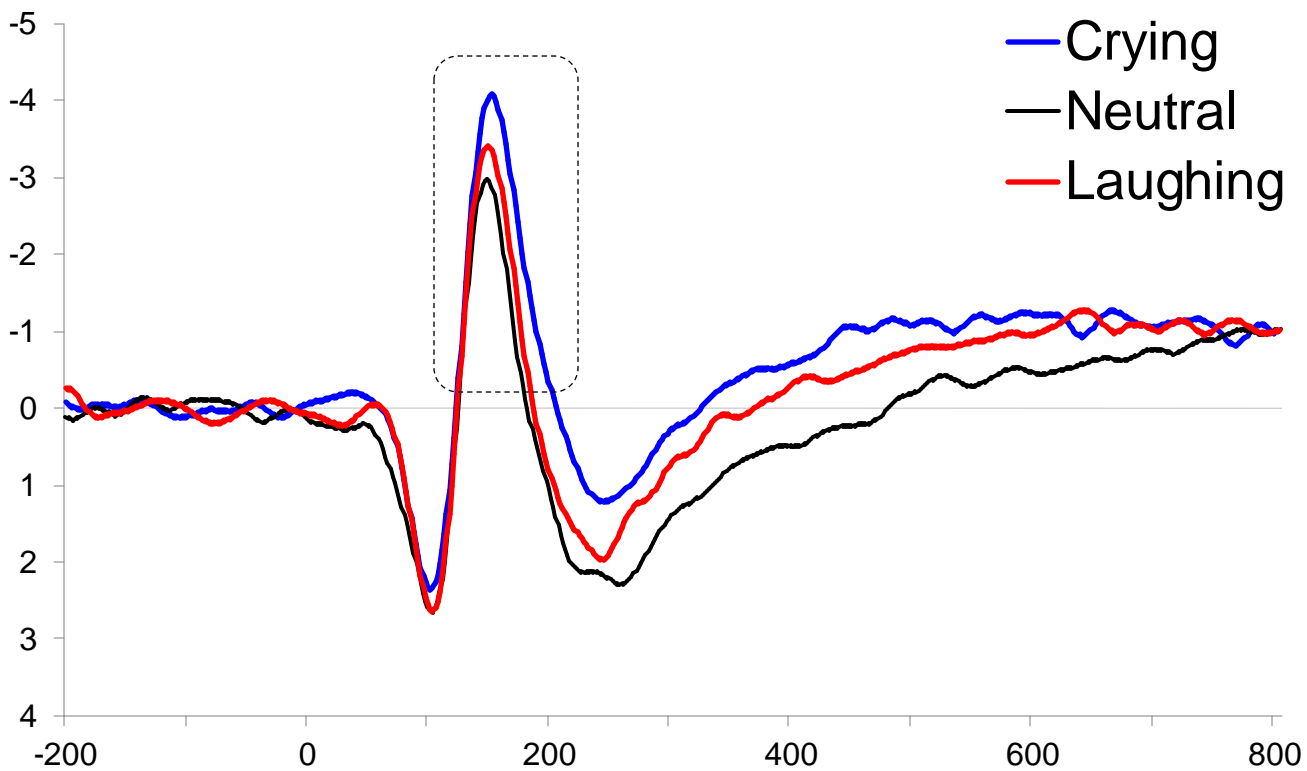
N170 for low-risk comparison group



N170 for control group (DEF)

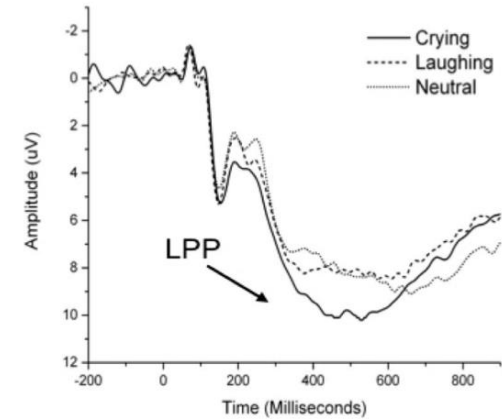


N170 for ABC group

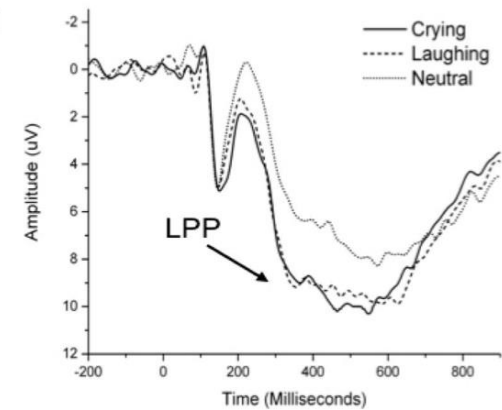


Late-positive potential (LPP)

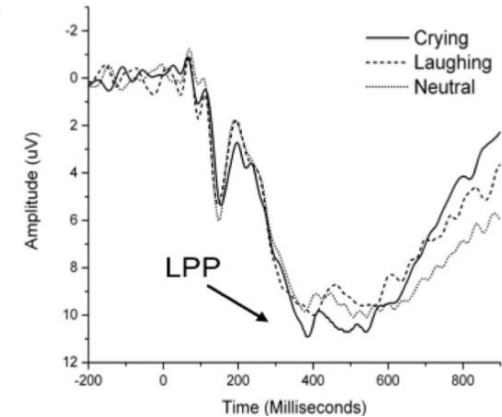
(a) Low-risk



(b) CPS-referred ABC



(c) CPS-referred DEF



Other measures of interest for effects on parents' biological embedding

- Cortisol
- Autonomic nervous system regulation (RSA) (with Rina Eiden)
- DNA methylation (OXTR, BDNF, etc.)
- ERPs (in response to substances, in response to own baby)

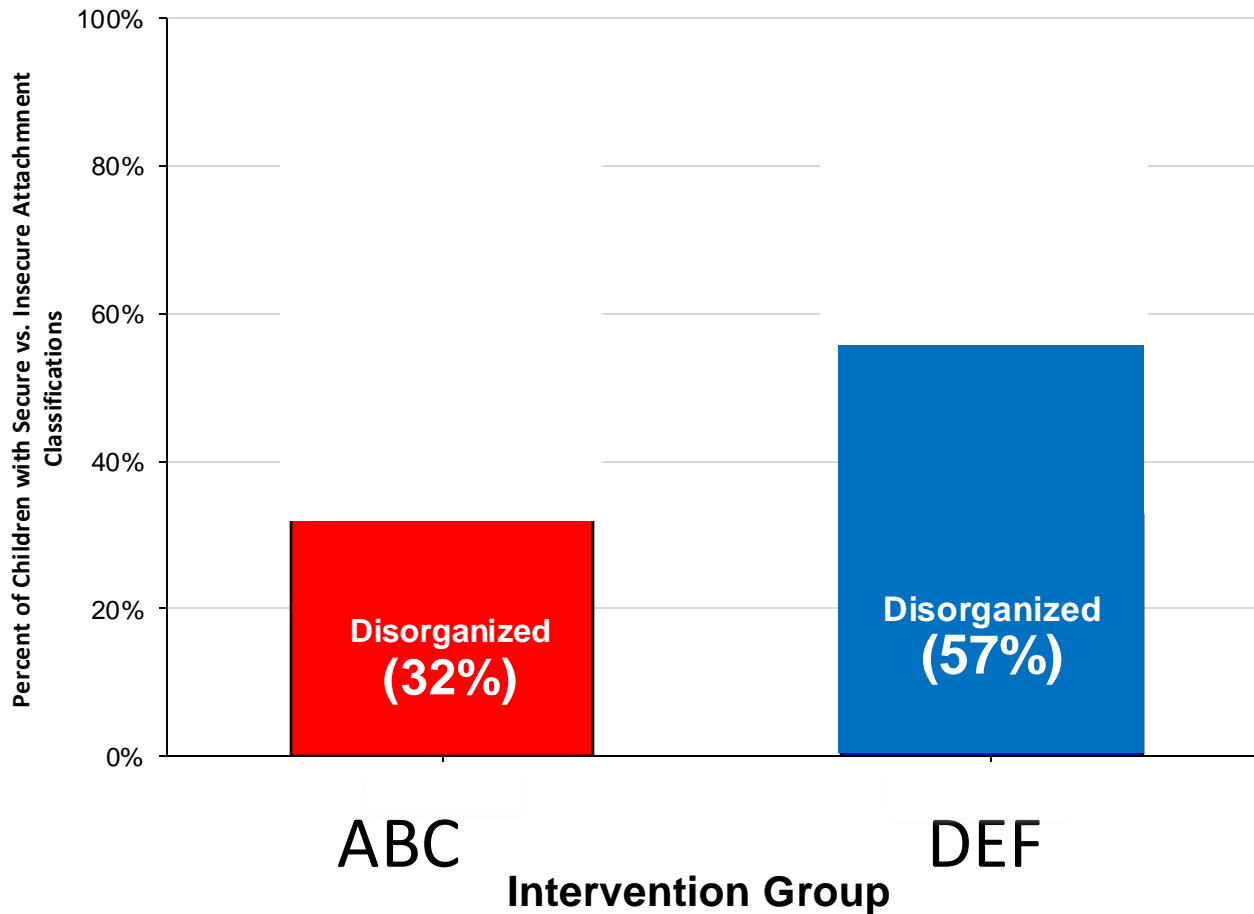
Intervention effects on attachment

- Adversity places children at risk for disorganized attachment and related brain development
- Can intervention alter this trajectory?

Intervention
effects on child
attachment
organization

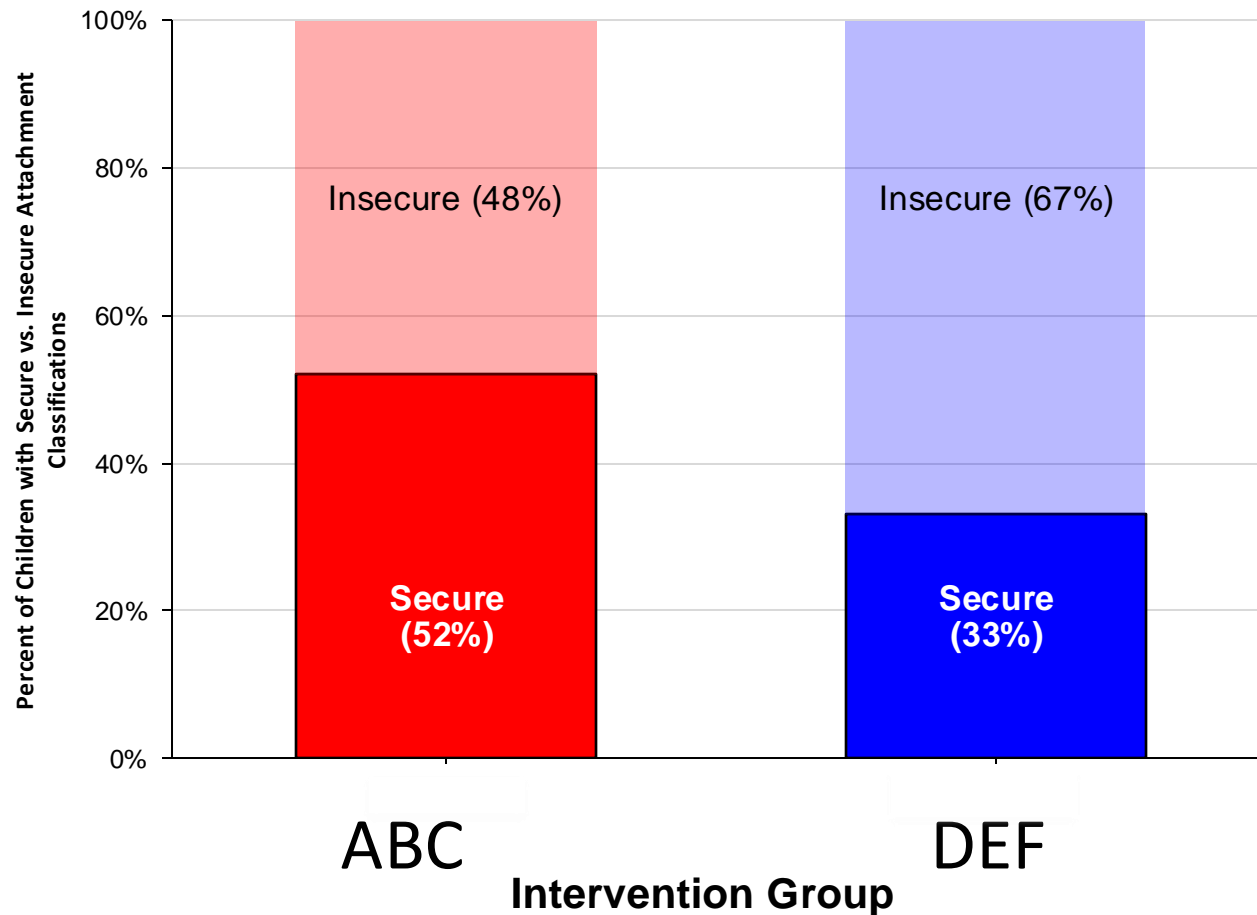
- Assessed in Strange Situation
- Parents involved in child welfare system
- N=120

Intervention effects on attachment organization



Bernard et al., 2012, *Child Development*.

Intervention effects on attachment security



Bernard et al., 2012, *Child Development*.

Kerns Attachment Measure (Age 9)

Example of question

Some kids find it easy to trust their mom.

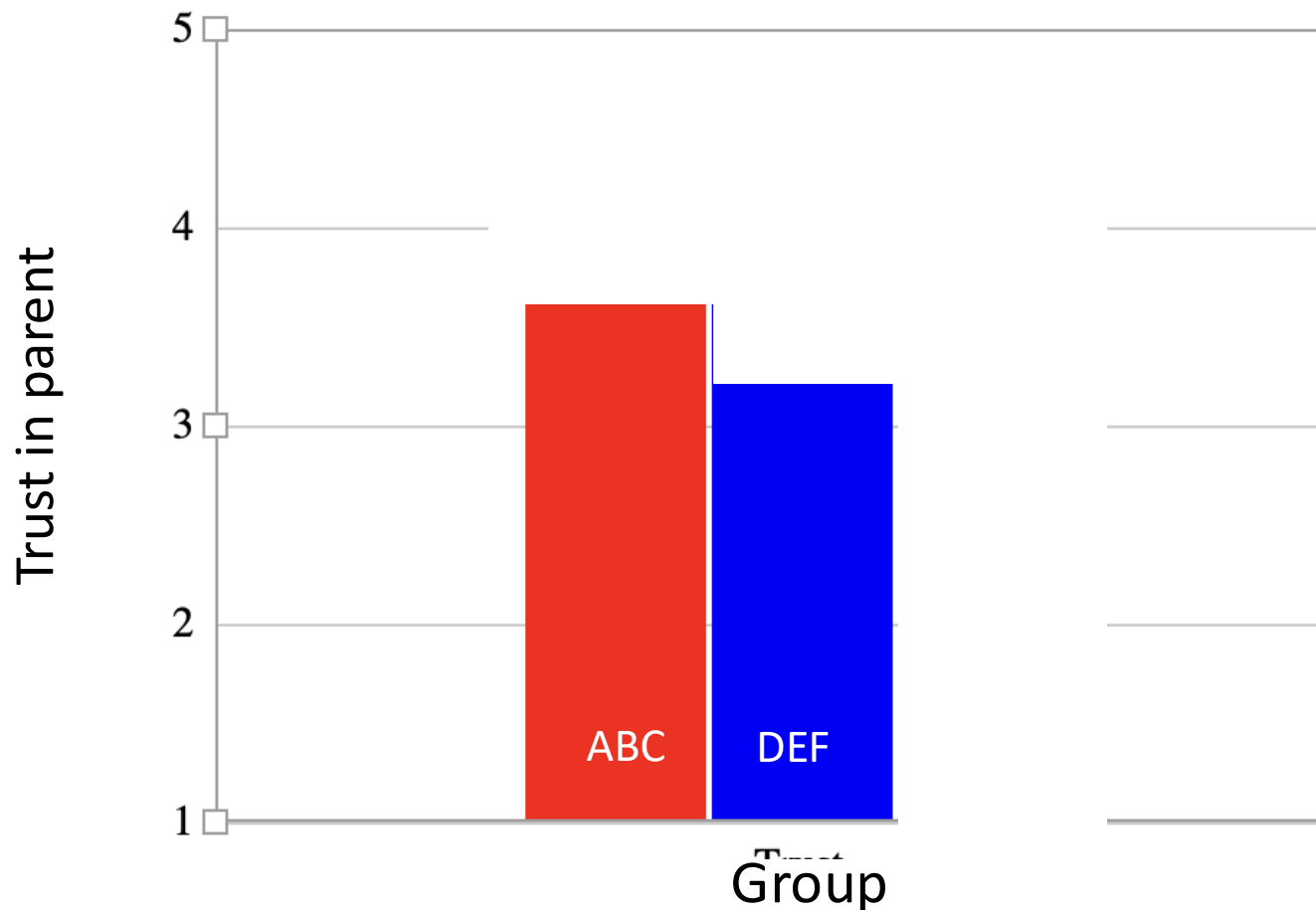
BUT

Other kids are not sure if they can trust their mom.

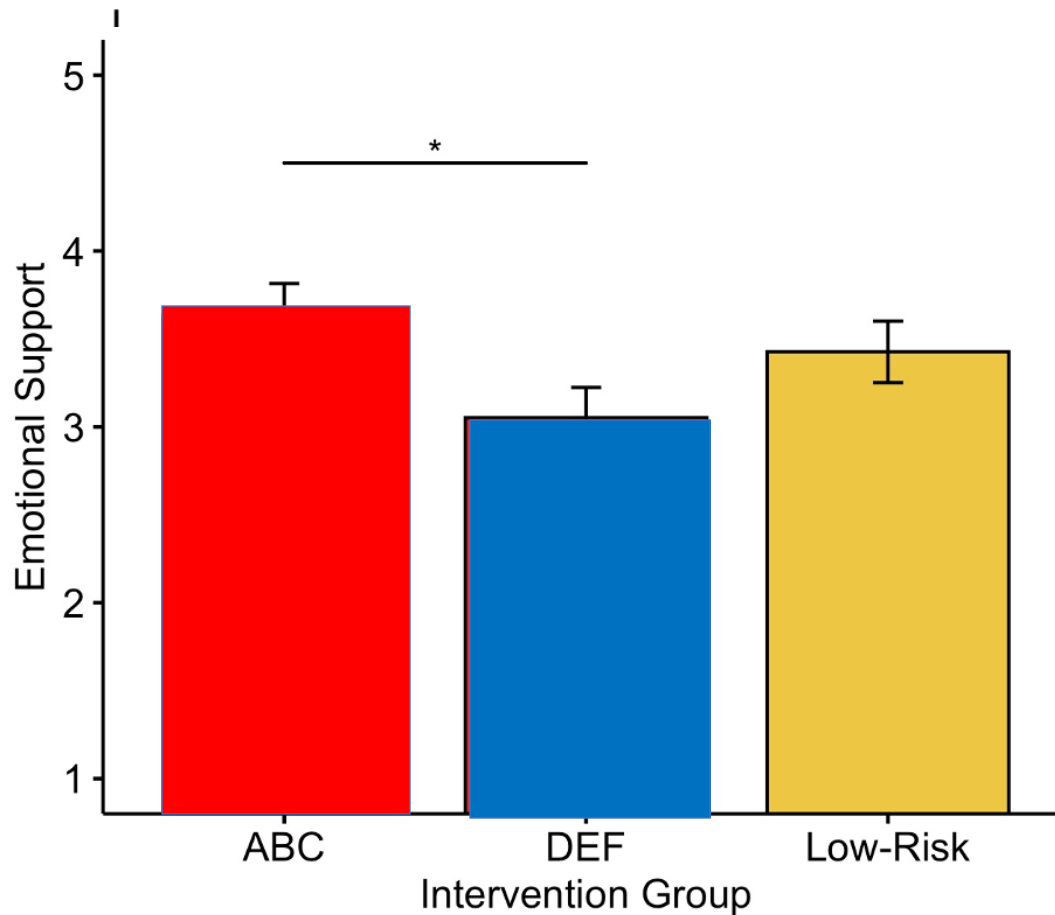
Which is true of you?

How true? A little or a lot?

Intervention effects on child feelings of trust in parent at age 9 (Kerns)

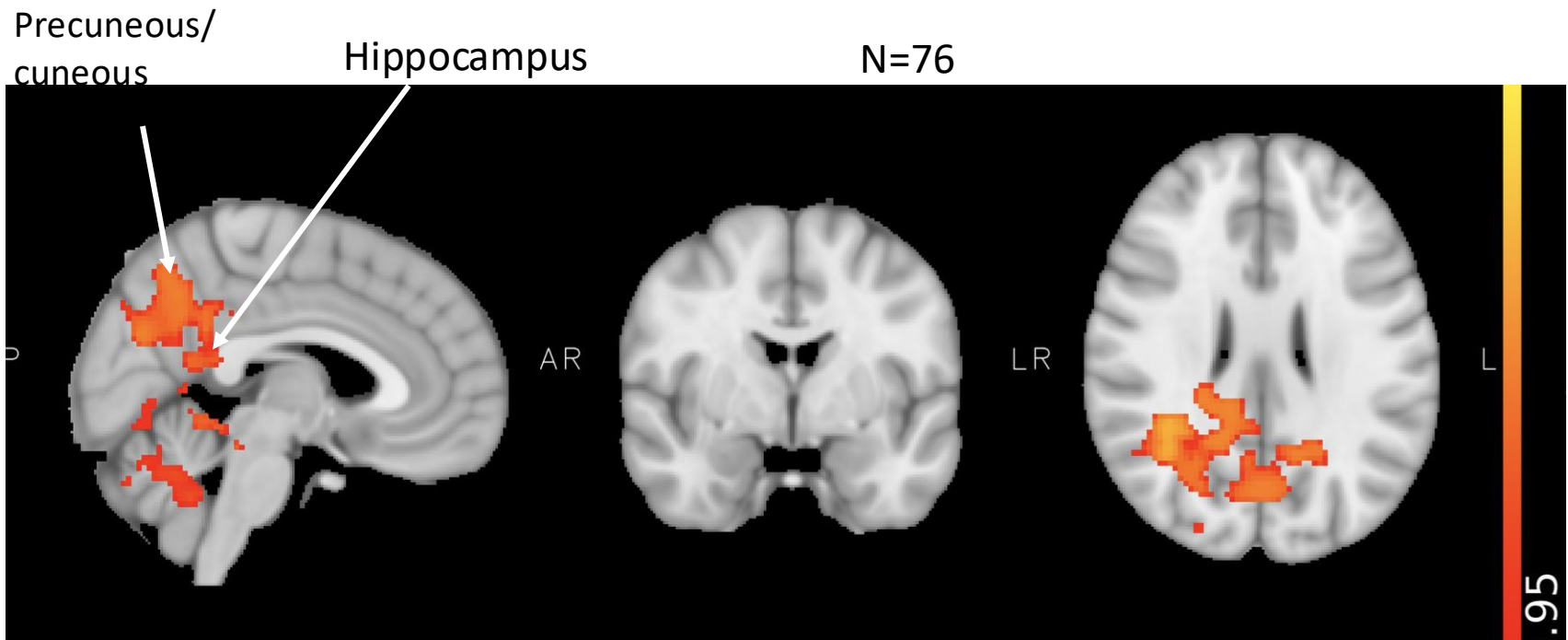


Intervention effects on emotional support from mother at age 14 (Network of Relationships Inventory)



Mother vs. stranger: Intervention effects

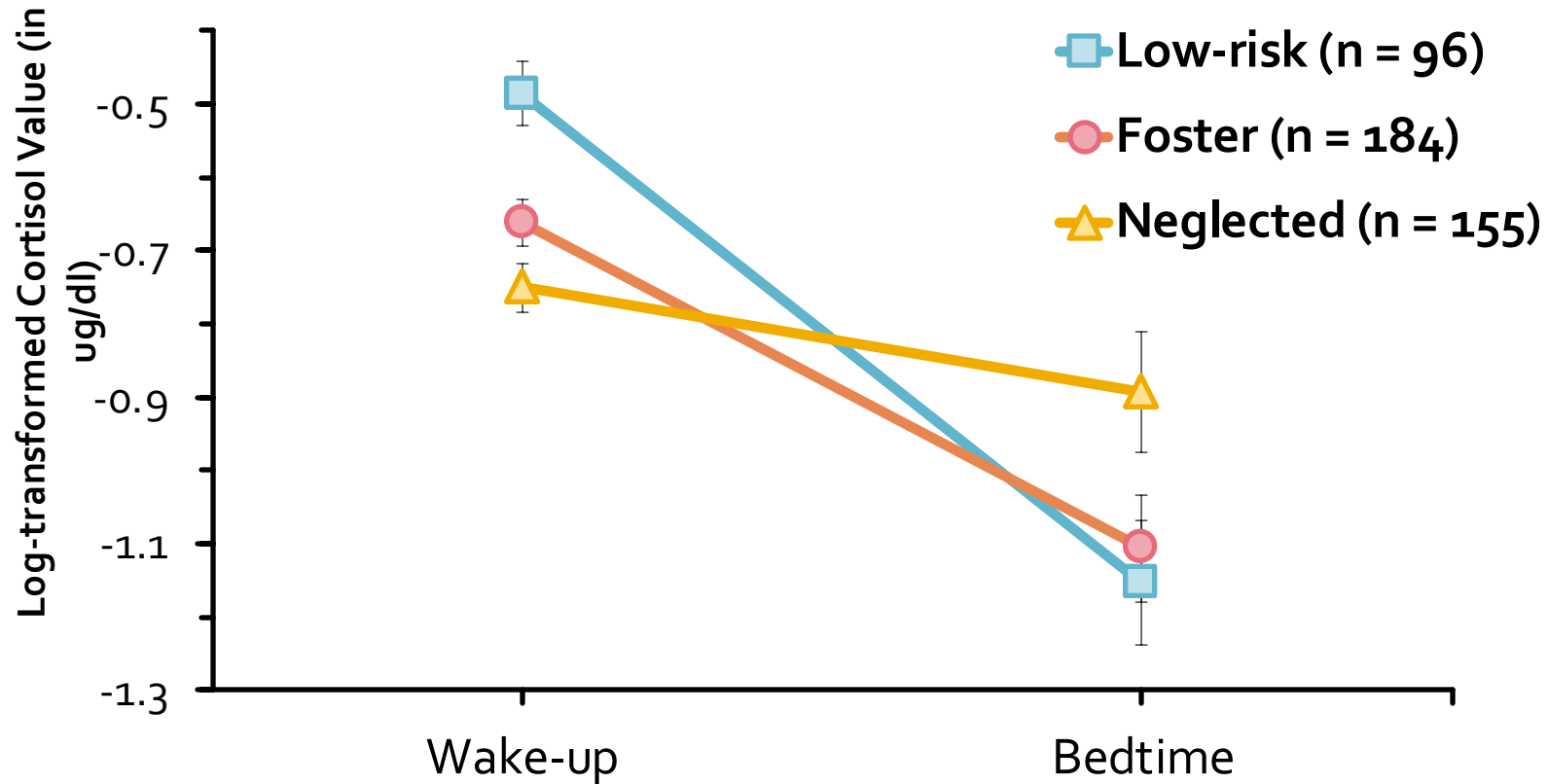
- ABC group had greater activation than DEF group in areas involved in social cognition (development of theory of mind, etc.):
 - Precuneus
 - Cuneal cortex
 - Occipital cortex
 - Left hippocampus



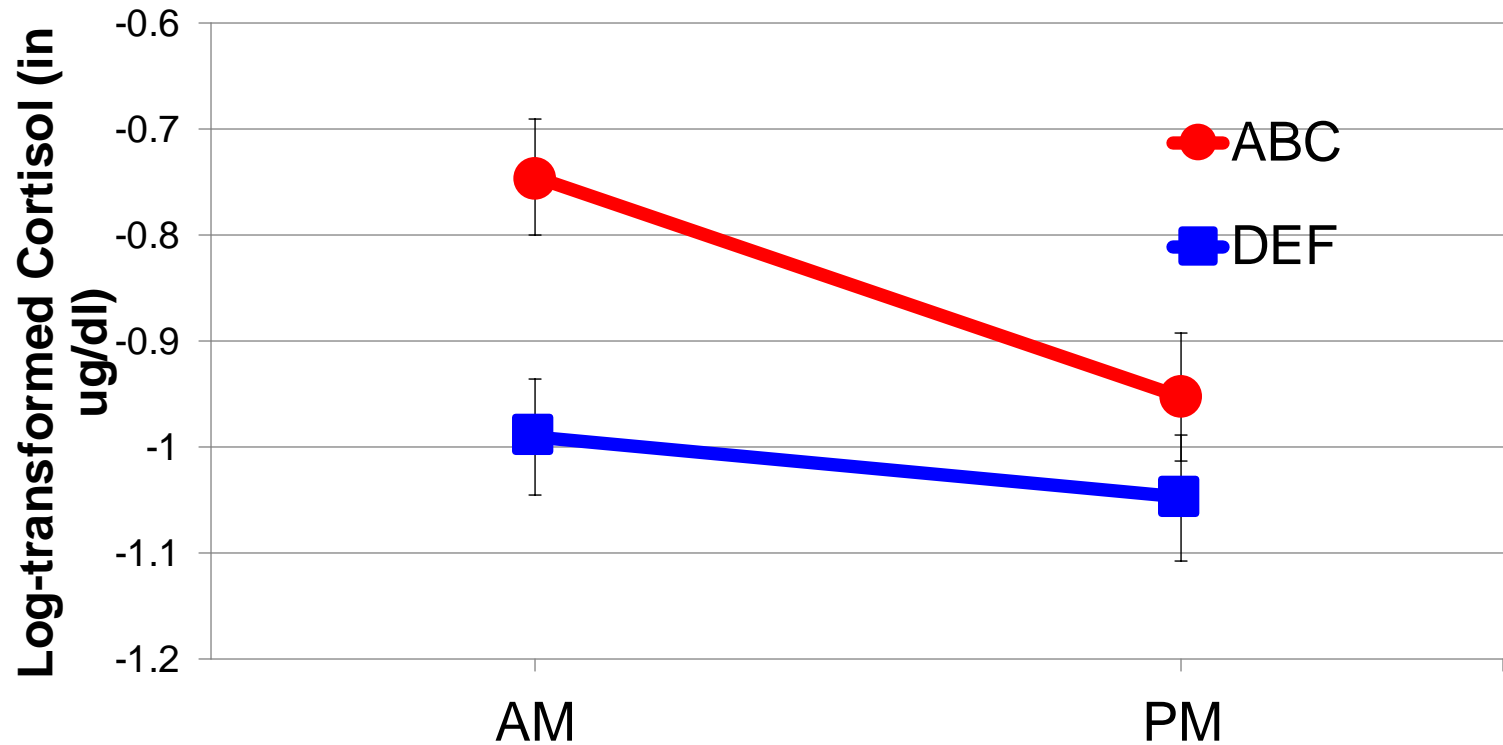
ABC effects on physiological regulation

- Adversity places children at risk for dysregulated physiology
- Can intervention alter this trajectory?

Early adversity and diurnal cortisol

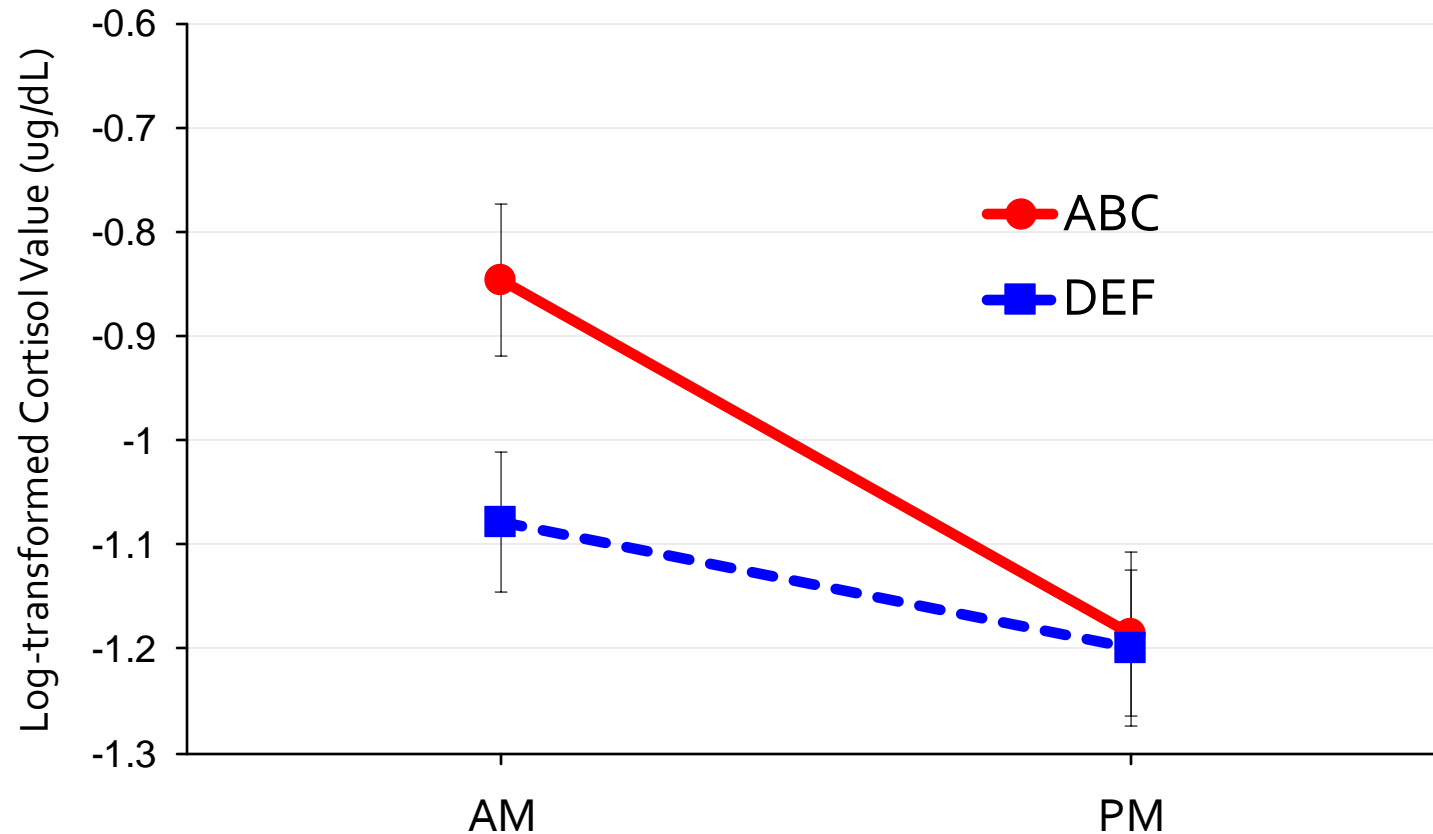


Intervention effects on diurnal cortisol 1 month post-intervention



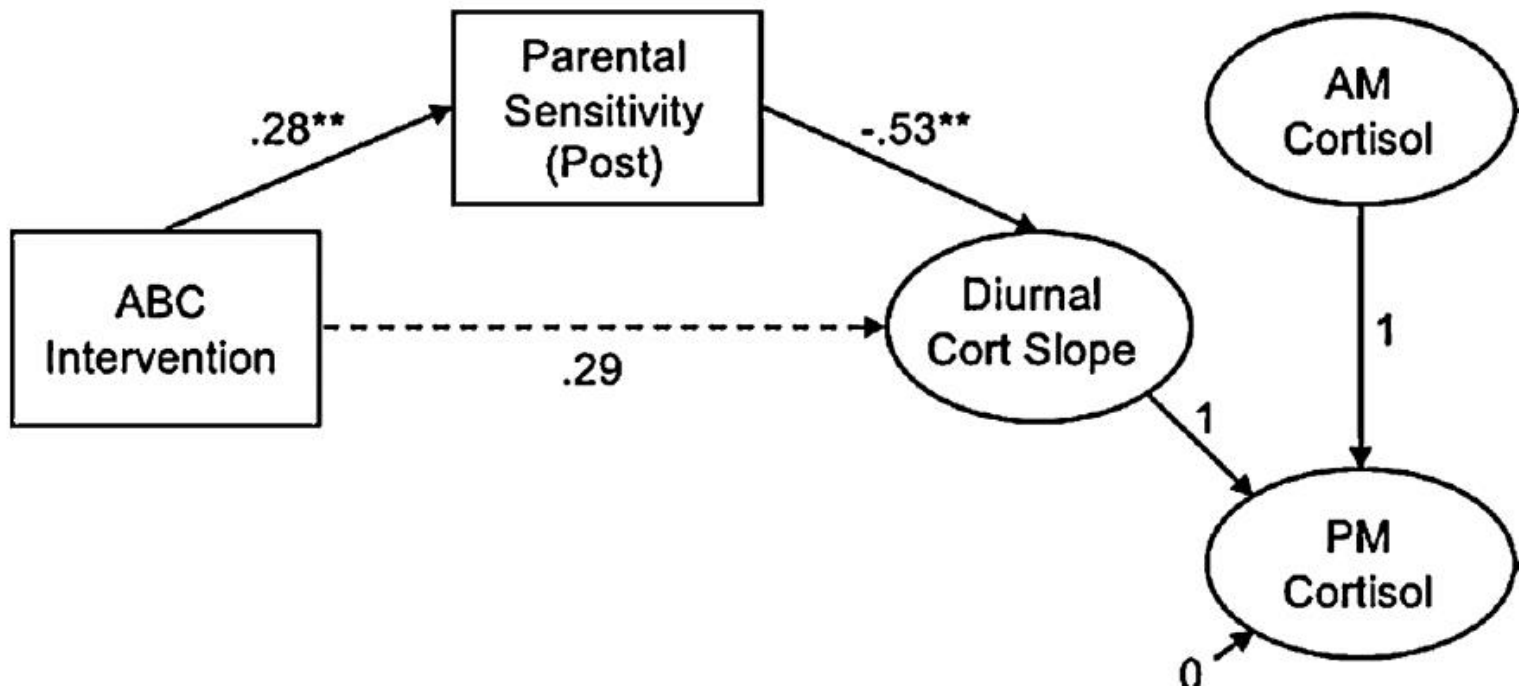
Bernard, Dozier, et al., 2015, *Development and Psychopathology*

Intervention effects on diurnal cortisol 3 years post-intervention

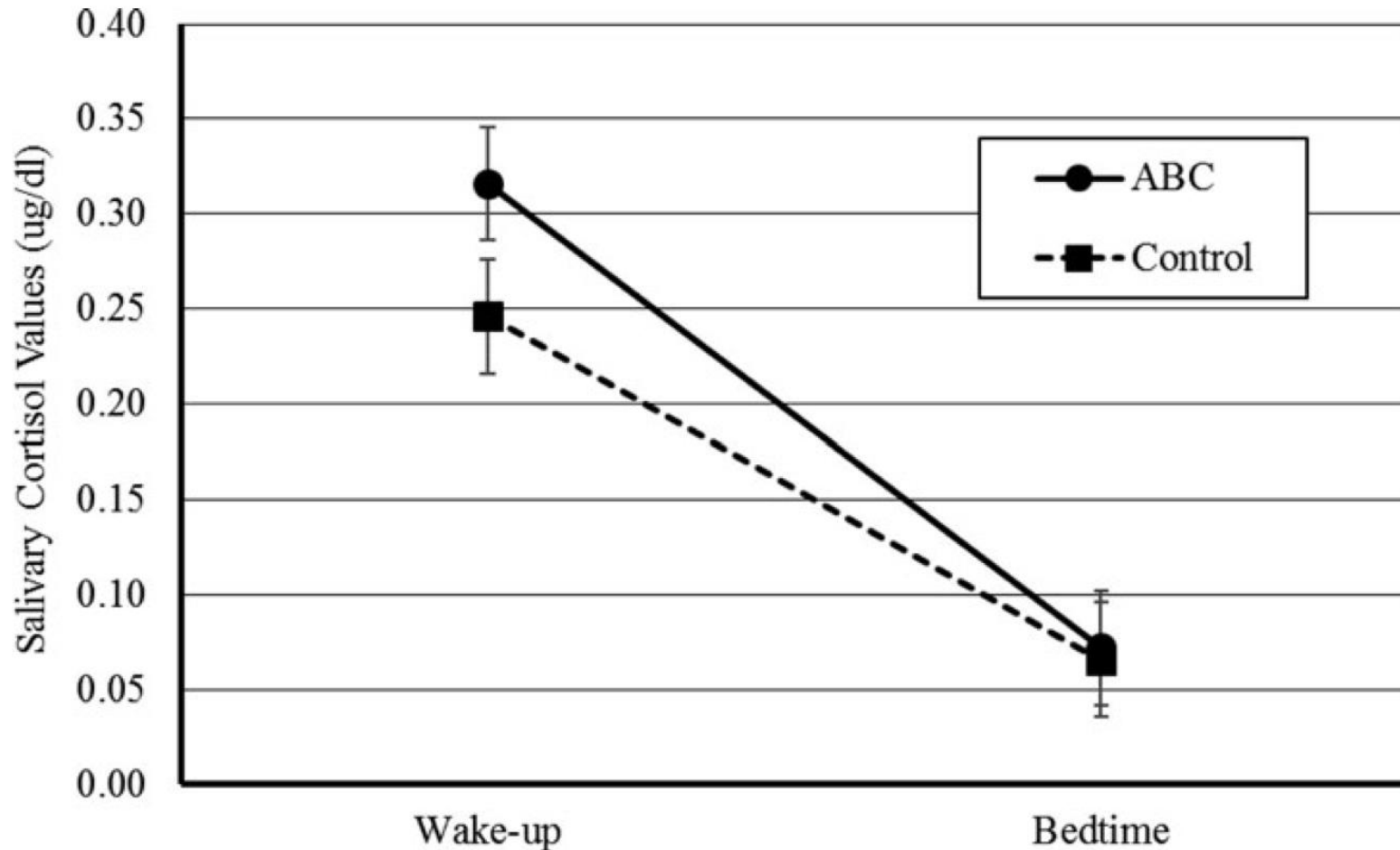


Bernard, Hostinar, & Dozier, 2015, *JAMA - Peds*

Intervention effects on diurnal cortisol 8 years post-intervention mediated by parental sensitivity



ABC effects among children adopted internationally



Raby et al., 2020, *Development and Psychopathology*

Other evidence of ABC effects on physiological regulation

- Autonomic nervous system regulation
 - Infancy – greater RSA reactivity for ABC than DEF infants (Tabachnick, Eiden et al., 2022, *Developmental Psychobiology*)
 - Middle childhood – higher resting RSA for ABC than DEF (Tabachnick et al., 2019, *Biological Psychiatry*)

Intervention effects on executive functioning, regulation of behavior and emotions, and related brain development

Adversity: Deficits in executive functioning, regulation of behavior and emotions

Intervention: Enhancements in executive functioning and related brain development?

Inhibitory control

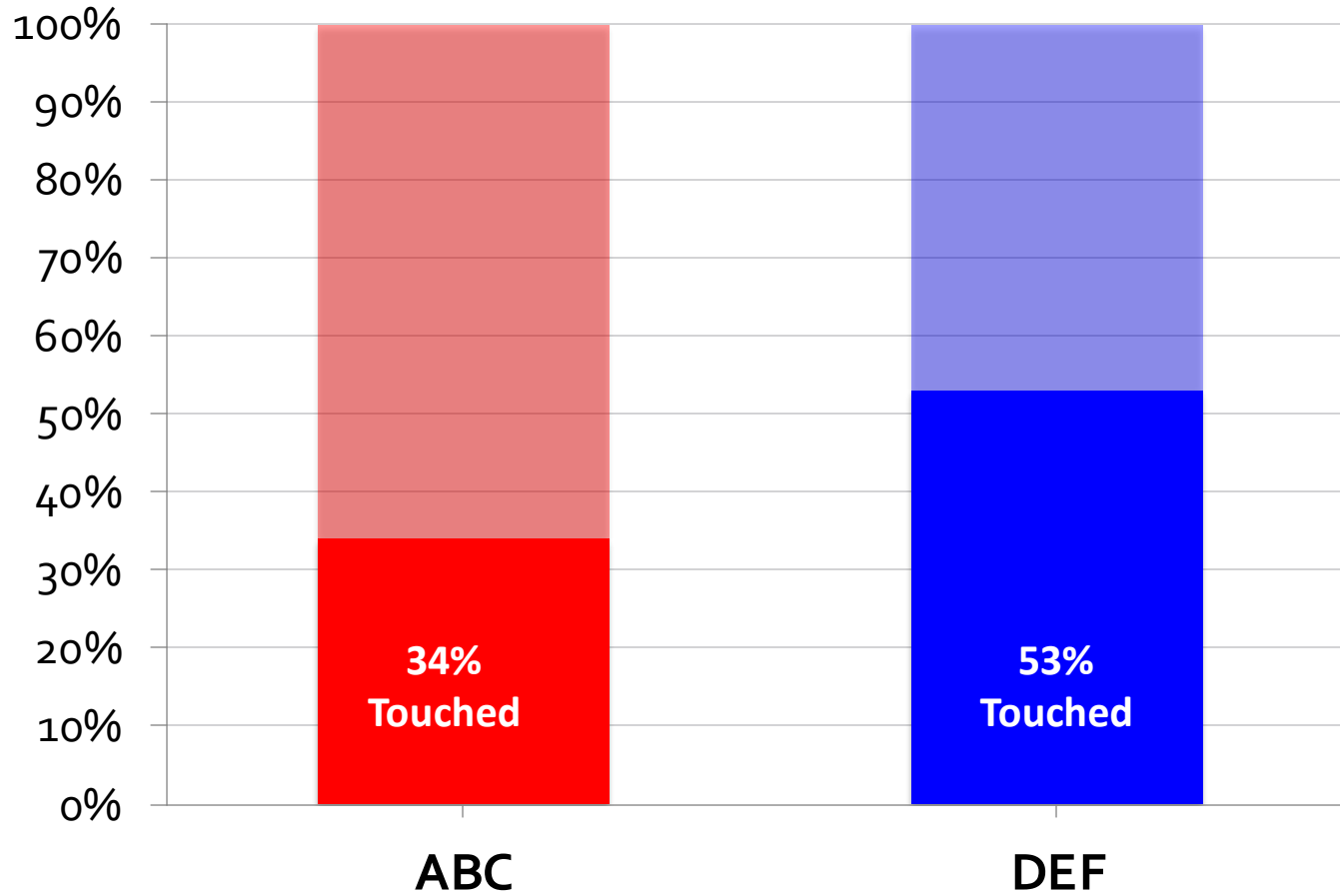
- Being able to sit quietly in school key to success
 - Doing what one is supposed to do
 - Inhibiting urge to do what one wants to do



Assessment of inhibitory control

- Put attractive toys in front of child
- Tell him or her not to play with them, instead play with crayons (boring in this context)

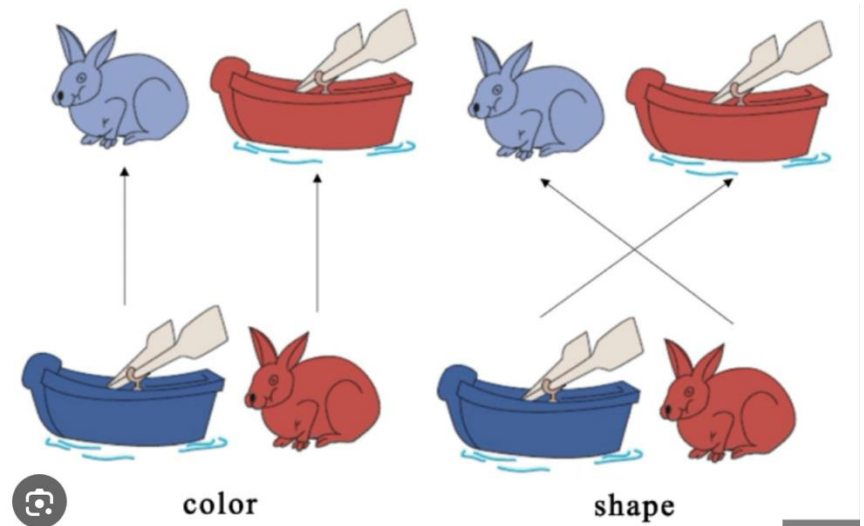
Intervention effects on inhibitory control



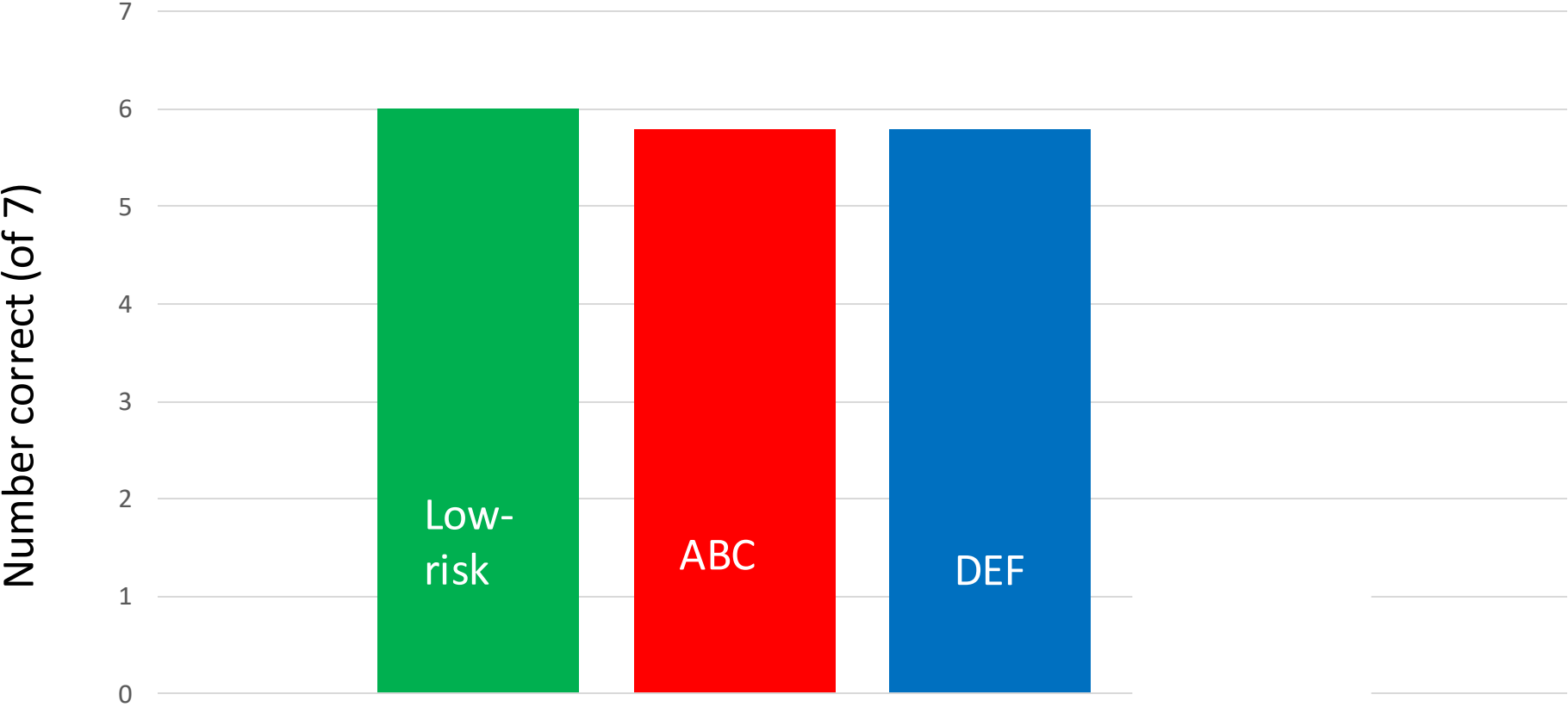
Lind, et al., 2017, *Child Development*

Intervention effects on executive functioning: Set shifting

- Assess executive functions in Dimensional Change Card Sort (DCSS)
 - Foster children
 - Sort according to one dimension, then switch dimensions
 - Assess number correct pre- and post-dimensional change



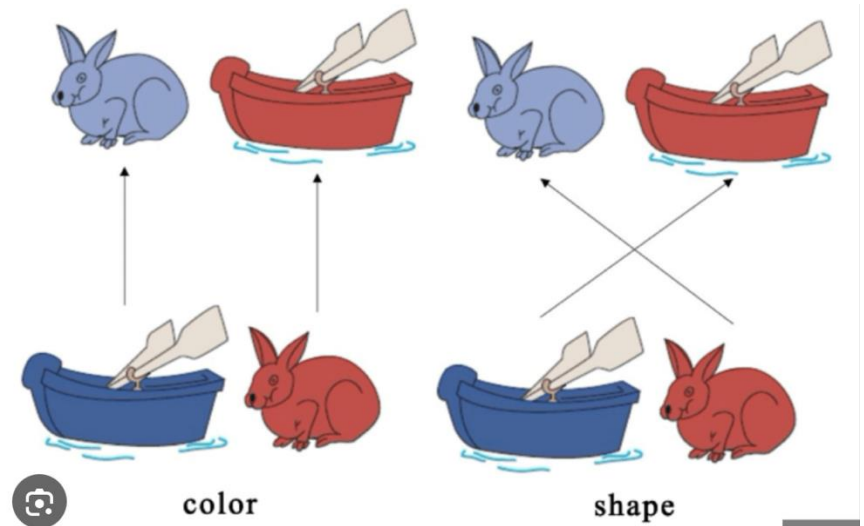
Pre-switch



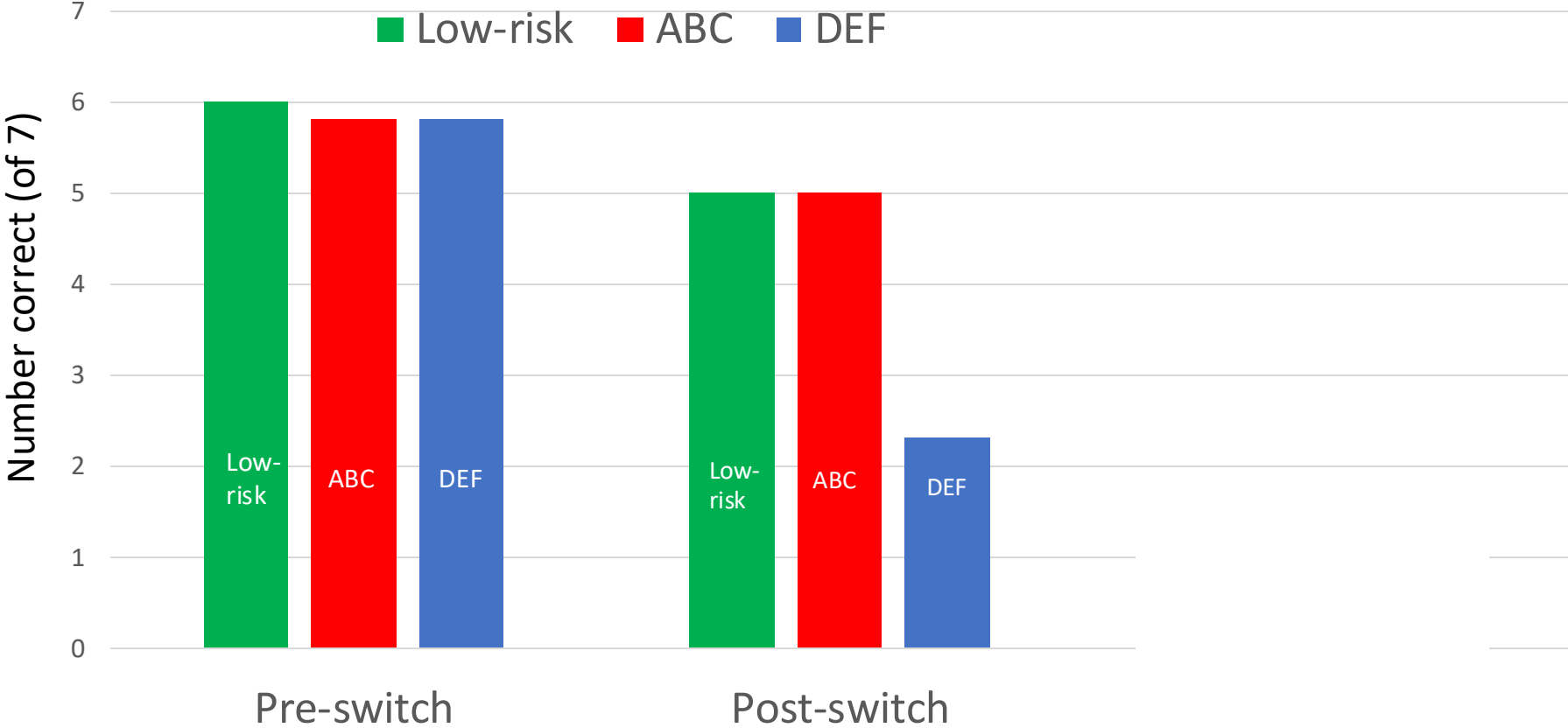
5.8

Intervention effects on executive functioning: Set shifting

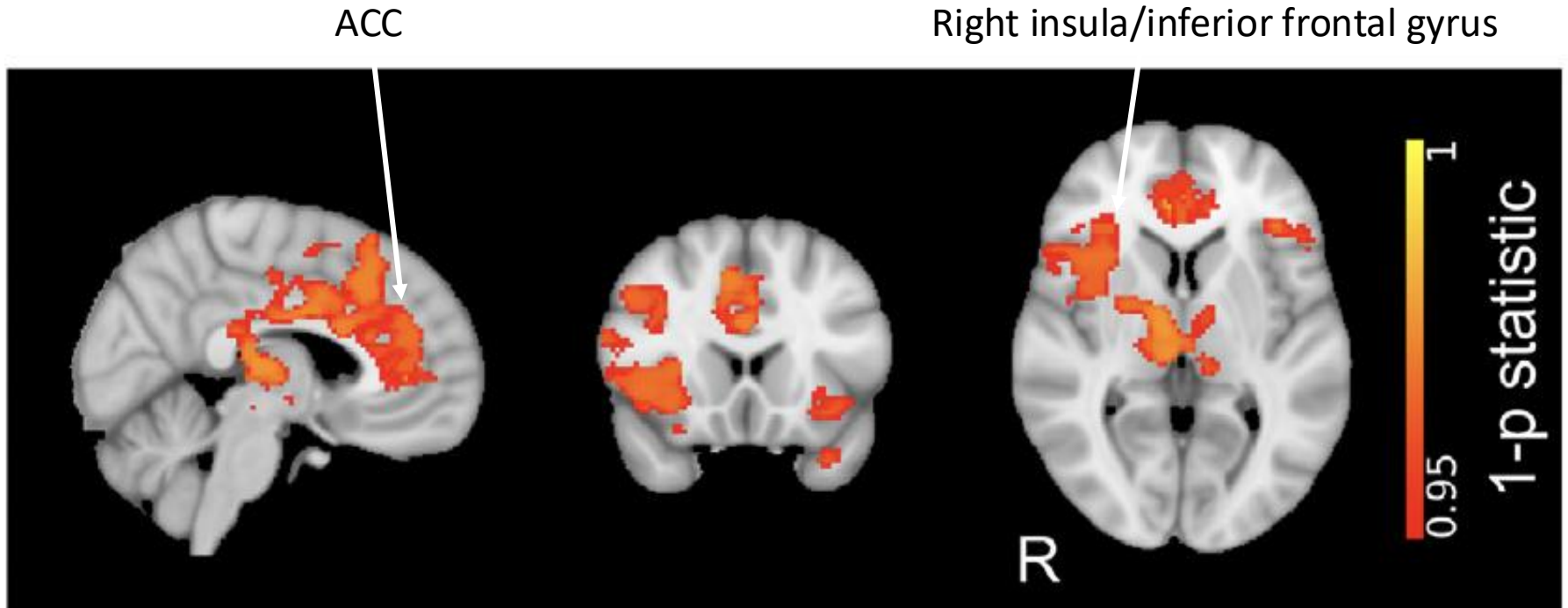
- Assess executive functions in Dimensional Change Card Sort (DCSS)
 - Foster children
 - Sort according to one dimension, then switch dimensions
 - Assess number correct pre- and post-dimensional change



Intervention effects on pre-switch to post-switch



Faces vs. blank screen: Intervention effects

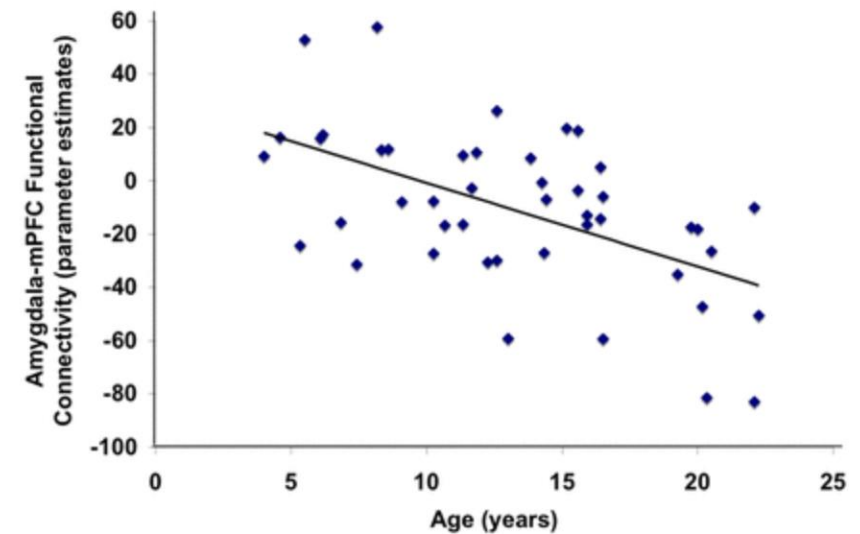


ABC children show greater activation than control children in ACC, inferior frontal gyrus, right insula, and right OFC

Valadez et al., 2024, *Journal of American Academy of Child and Adolescent Psychiatry*

Is greater activation a function of differential amygdala-PFC connectivity?

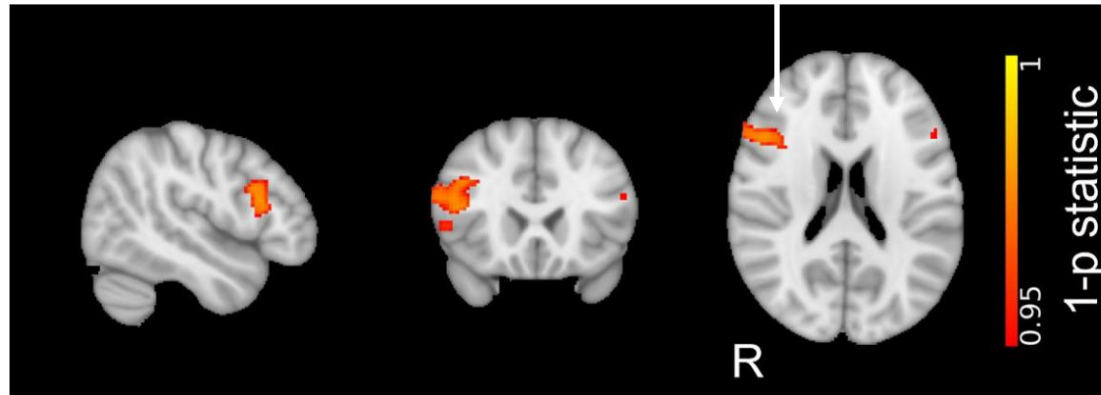
- Negative coupling (inverse correlation) reflects greater PFC control over amygdala
- Represents adult-like pattern
- We “seeded” amygdala – examined PFC activation



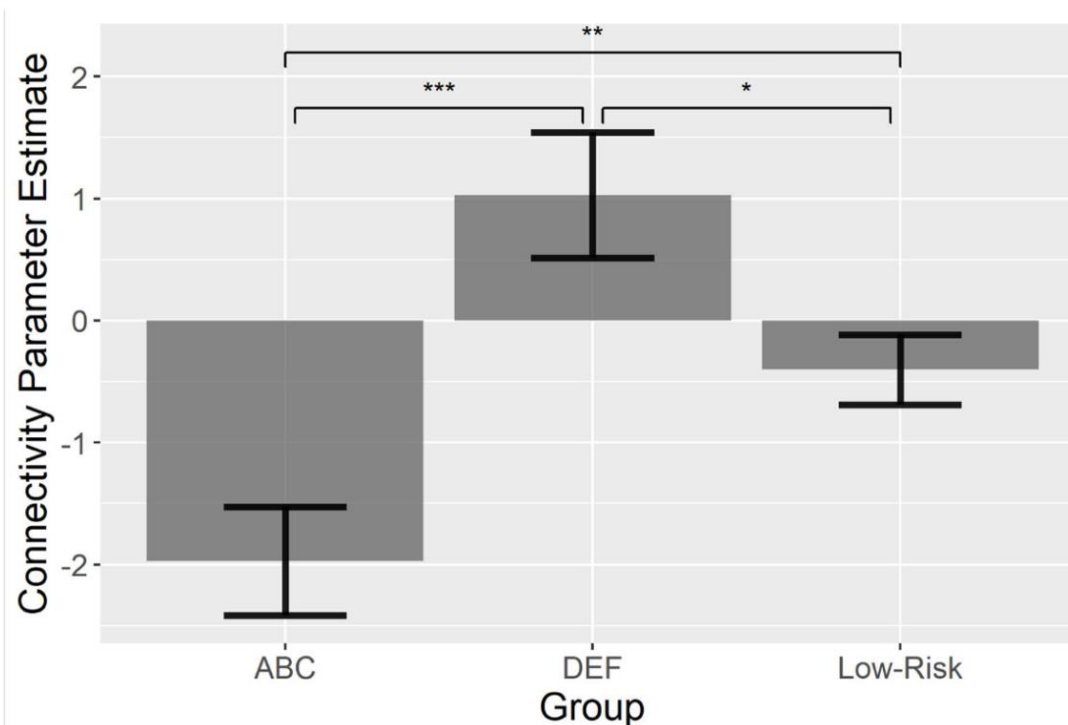
From Gee et al., 2013

Amygdala-seeded prefrontal cortex activation

PFC: Insula, inferior frontal gyrus



ABC shows mature pattern (negative connectivity) of amygdala-PFC connectivity; Control group (DEF) shows immature pattern (positive connectivity).



- Amygdala-PFC connectivity fully mediates intervention effect on PFC activation
- Responsive, nurturing parenting helps build brain that supports strong emotion regulation

Effects of ABC (nurturing, responsive parenting)

Infancy

- Attachment (Bernard et al., *Child Development*, 2012)
- Cortisol production (Bernard et al., *Development and Psychopathology*, 2015)
- DNA methylation (Hoye, *Development and Psychopathology*, 2020)

Early childhood

- Inhibitory control (Lind et al., *Child Development*, 2020)
- Set-shifting (Lewis-Morrarty et al., *Journal of Adolescent Health*, 2012)
- Emotion expression (Lind et al., *Child Abuse and Neglect*, 2014)
- Cortisol production (Bernard et al., *Development and Psychopathology*, 2015)
- Language development (Raby et al., *Developmental Science*, 2020; Bernard et al., *Child Maltreatment*, 2017)

Middle childhood

- Cortisol production (Garnett et al., 2020)
- Brain activation (Valadez et al., *American Journal of Psychiatry*, 2020)
- Neural activity (Bick et al., *Biological Psychiatry*, 2019)
- ANS regulation (Tabachnick et al., *Biological Psychology*, 2020)
- Security (9-years-old) (Zajac et al., *Journal of Child Psychology and Psychiatry*, 2020)

Adolescence

- Brain structure (Korom et al., 2024)
- Brain function (Korom et al., in prep)
- Trust in parent (Miller et al., 2024)
- Depression and self-esteem (Chen et al., in prep)

Grant support

NIH R01 MH074374

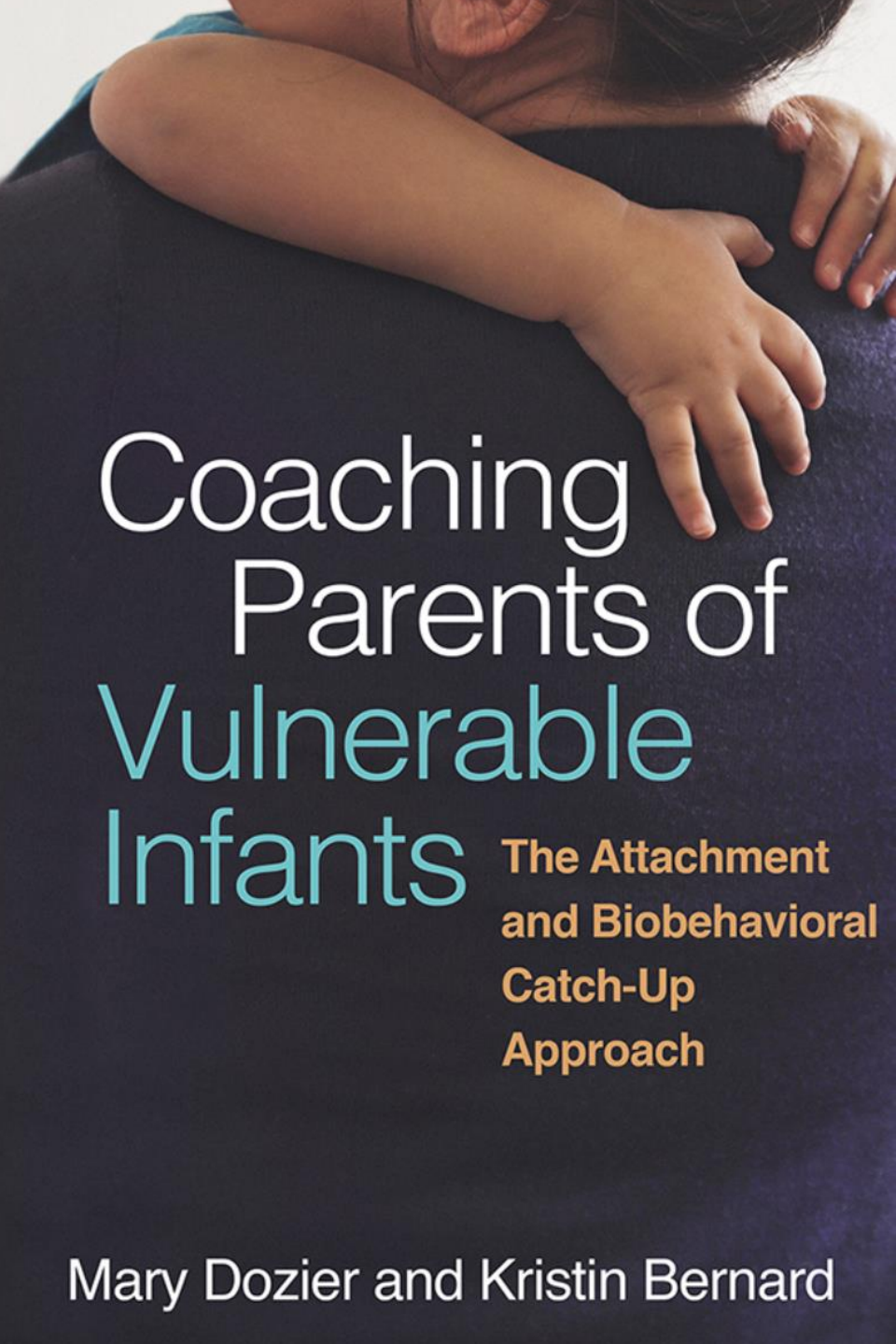
NIH R01 MH052135

NIH R01 MH084135

NIH R01 HD098525

NIH R01 MH119310

Edna Bennett Pierce (2006-2022)



Coaching Parents of Vulnerable Infants

**The Attachment
and Biobehavioral
Catch-Up
Approach**

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Guilford Press