

# How Addiction Impacts Parenting: Implications for Intervention

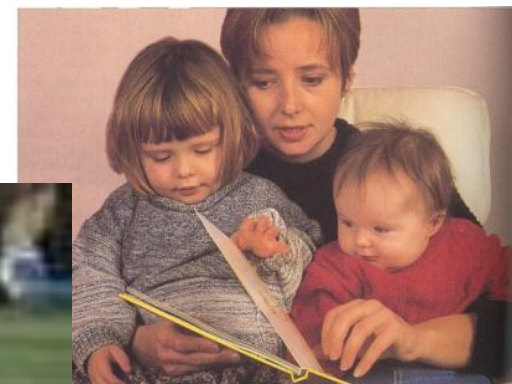
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October 24, 2012



# Subtext/Research Model:

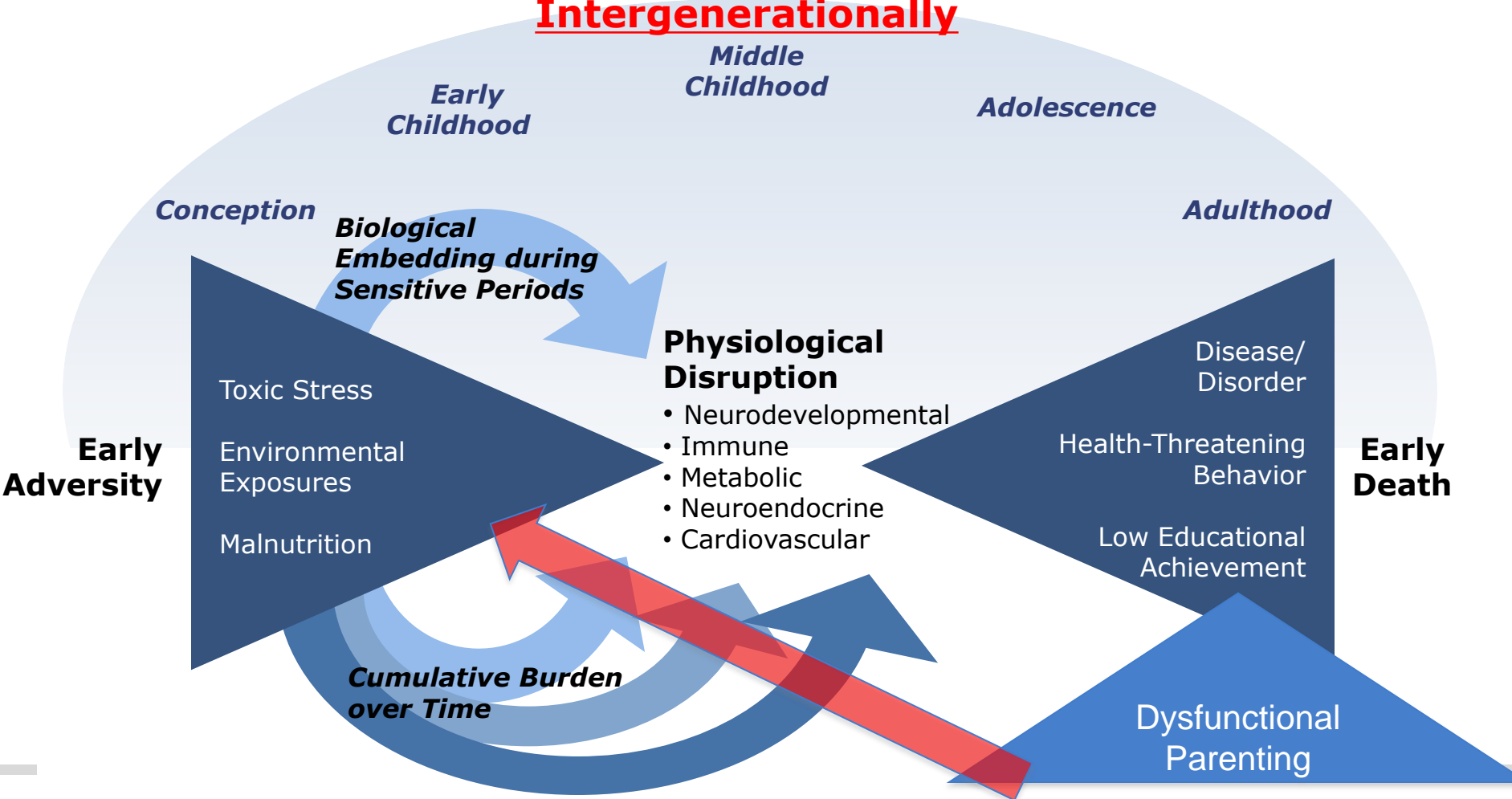
## How Addiction & Early Adversity Compromises Parenting



# Outline

- Parenting and neural circuitry of attachment
  - Imaging and electrophysiology studies of adult processing infant visual and auditory cues
  - Parental emotion regulation
  - Parental distress tolerance
- Substance Use and Parenting
- Intervention implications

# The Childhood Roots of Health & Parenting Disparities in Adulthood: How Adversity is Built Into the Body and Transmitted Intergenerationally

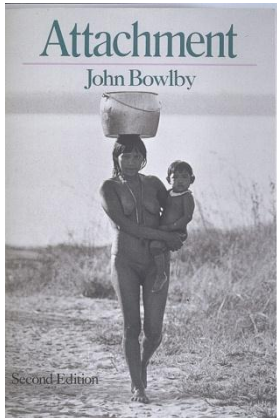


# KEY MESSAGE



- Early toxic stress has continued life long impact on emerging developmental systems including those key to parenting
- Early toxic stress compromises not only children's cognitive and emotional development but also specific capacities in these children as adults that are key to caring for the next generation
- Important implications for interventions for children and their parents and also for working with addicted adults who are parents

# Basic Science of Parental Attachment 100

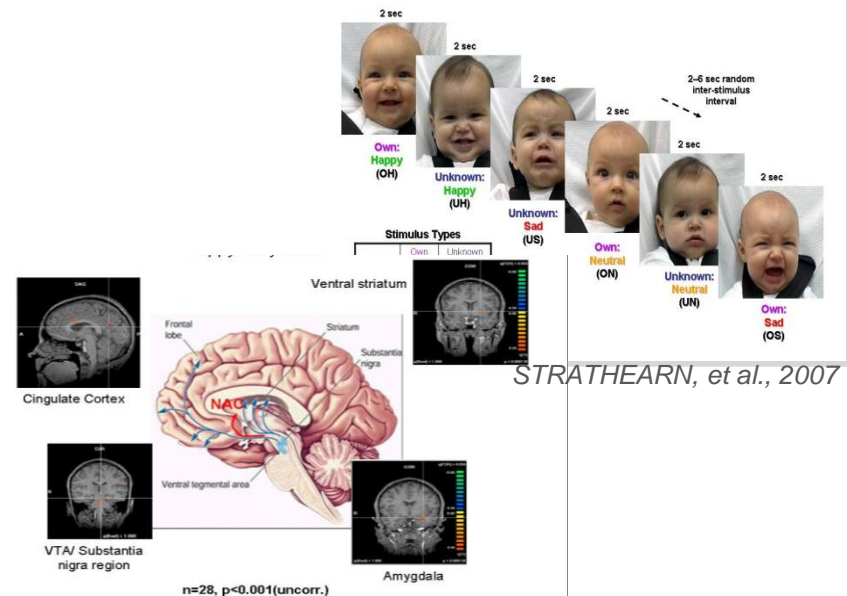
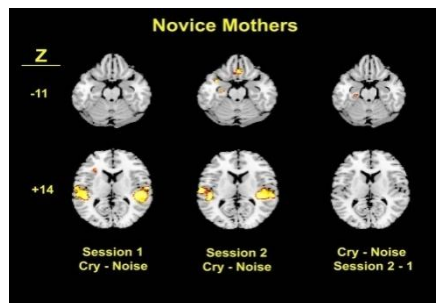


Decades of work on impact of parental care on child health and development, but.....

- Presence of a new infant activates specific neural circuitry involved in balance between reward and stress
- Enhancement in neural circuits with increasing time with infant



*How does becoming a parent impact adults' psychological and neuropsychological development?*



STRATHEARN, et al., 2007



# TEXTS OF PARENTING

“I do not believe it is possible to understand the functioning of the mother at the very beginning of the infant’s life without seeing that she must be able to reach this state of heightened sensitivity...and recover from it.”

D. Winnicott,  
1956



“I can’t quite describe it but something is different in me since she came into our lives. She is center of nearly every waking moment, my thoughts, my plans – and when I wake up at night, she’s the first thought in my head. Everything I thought was important before has slipped down the list... Not only have I centered around her but somehow she has made me a different person....and I only want to be with her and attend to her every need”

New mother... 2011

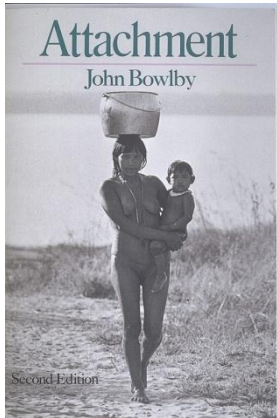
# WHAT THESE TEXTS SUGGEST

- Becoming a parent is a developmental process
- With transition to parenthood, there is a change in attentional focus, investment, what is rewarding, and what is stressful
- State of being “preoccupied” both reflects change in mental “economy” and also facilitates shift in attention and reward salience (“enhanced signal detection” or sensitivity to infant cues)





# Basic Science of Parental Attachment 100

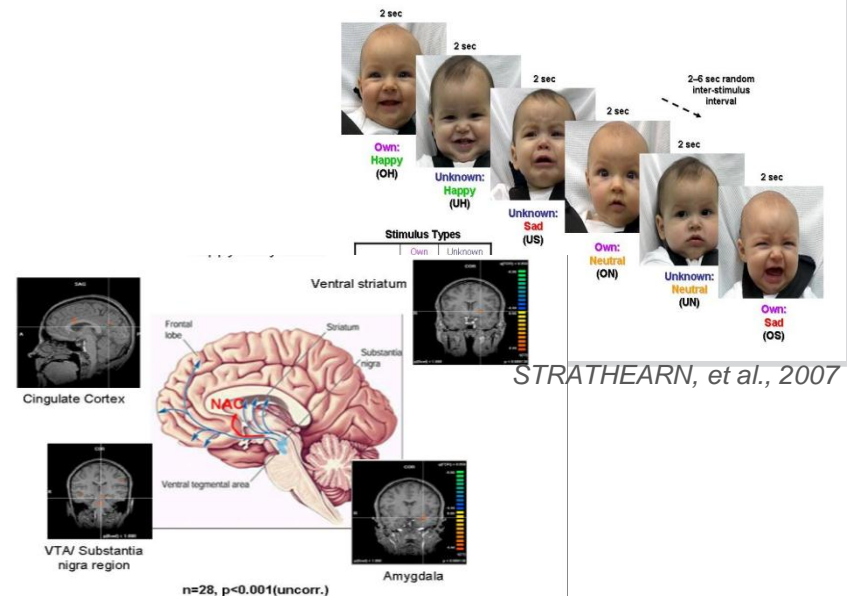
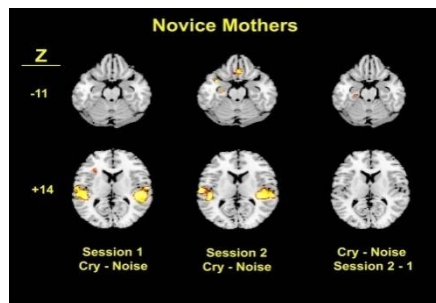


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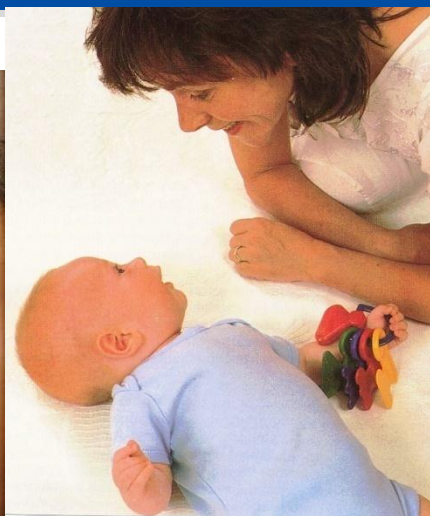
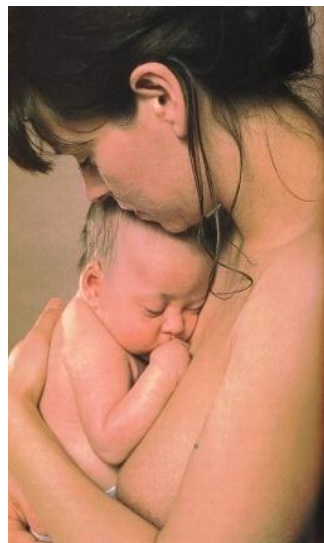
- Presence of a new infant activates specific neural circuitry involved in balance between reward and stress
- Enhancement in neural circuits with increasing time with infant



*How does becoming a parent impact adults' psychological and neuropsychological development?*



# RETHINKING “PARENTING”



*What’s “beneath” or required for parental “sensitivity” and parental care?*

Adaptive parenting involves key capacities involved in reward seeking, motivation, and stress regulation:

- Self-control versus impulsivity
- Emotional regulation or distress tolerance
- Decision making/Consequence appraisal
- Reflective or mindful capacities toward self and child

# Neurobiology of Parental Behavior

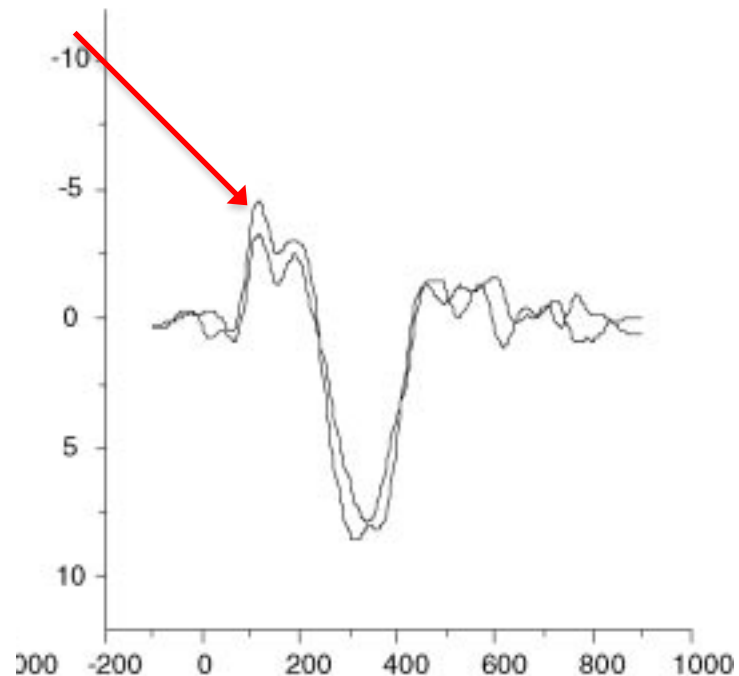


- **Extensive data from rodents regarding “affiliative” circuits (Numan 2007):**
  - Reward circuits (accumbens, striatum)
  - Associated approach/avoidance pathways (amygdala)
  - Modulation by oxytocin, estrogen, prolactin, dopamine
  - At least 10 genes identified (fosB, prolactin & estrogen receptors, oxytocin, dopamine) as involved in regulating/initiating some aspects of parental behavior
- **Human studies using brain imaging converge with animal model findings (Rutherford, Williams, Moy, Mayes & Johns 2011)**



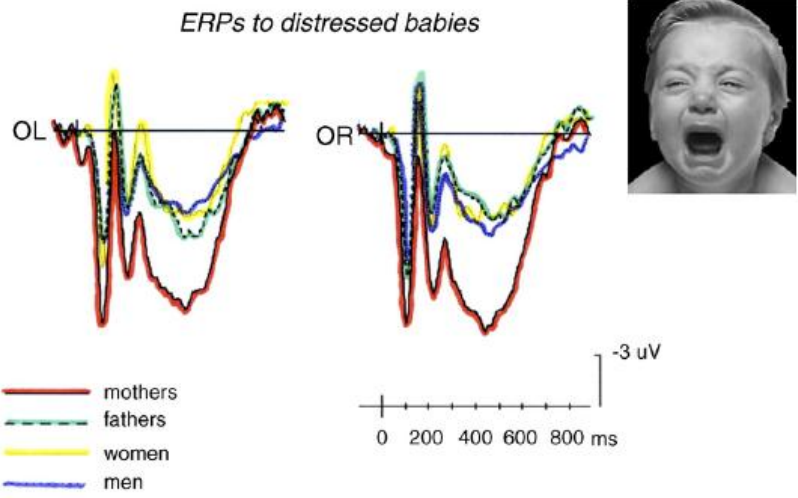
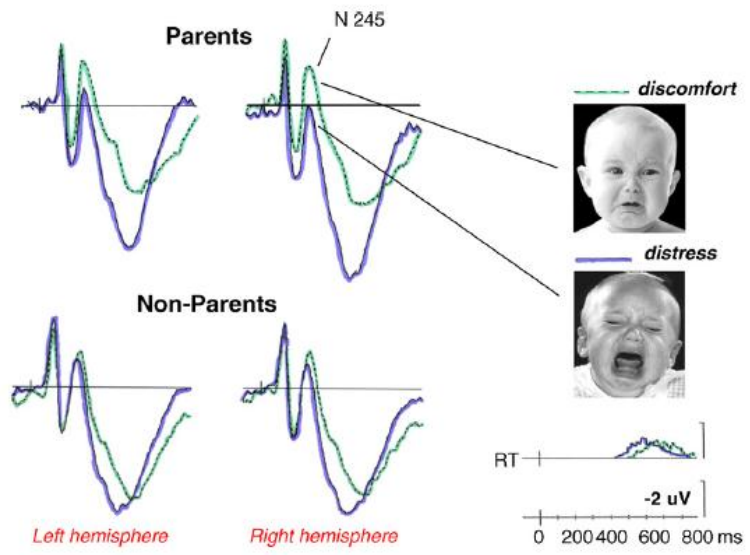
# Infant vocalizations of affect

- Auditory N100 ERP component heightened in mothers for both infant cries and control sounds compared to non-mothers (Purhonen et al., 2001; 2008)



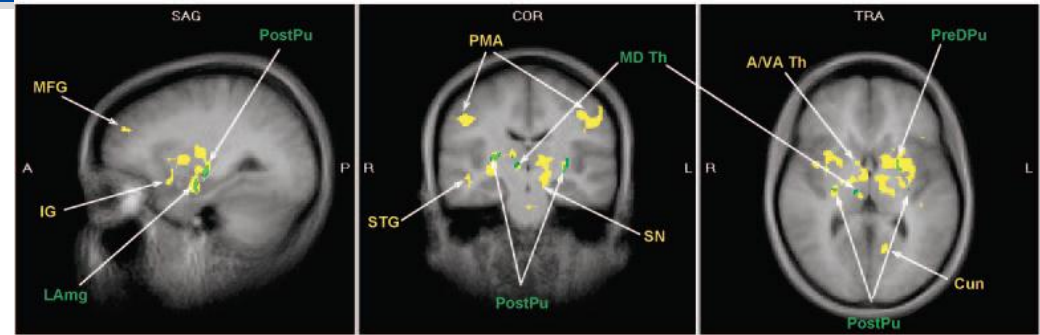
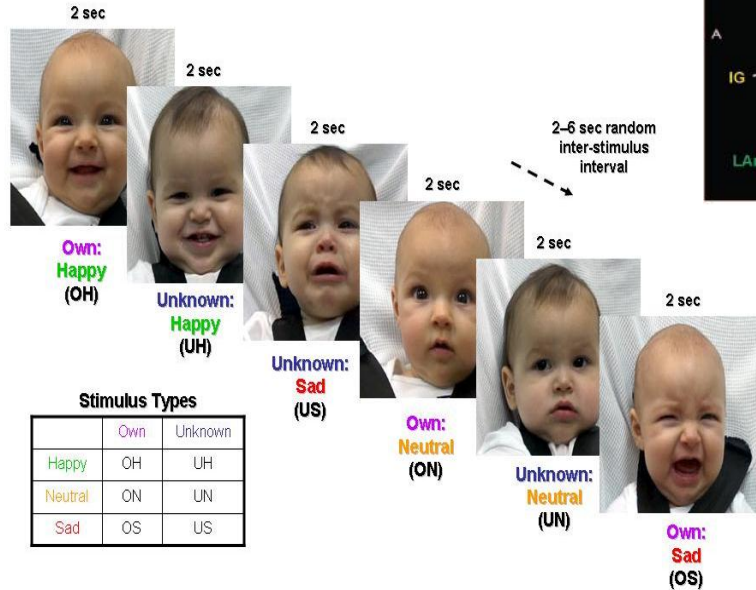
# ERP studies – Infant Faces

- Early and later visual ERPs are sensitive to parental status when viewing infant faces and to differences in facial affect (Proverbio et al., 2006; Grasso, et al., 2008)





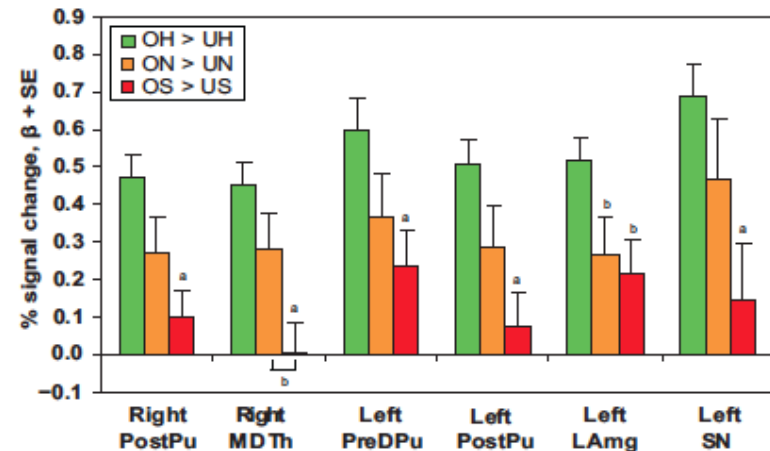
# OWN BABY VISUAL CUES ACTIVATE NEURAL REWARD CIRCUITS



Own > Unknown Contrast (affect groups combined)  
Own-Happy > Unknown-Happy Contrast

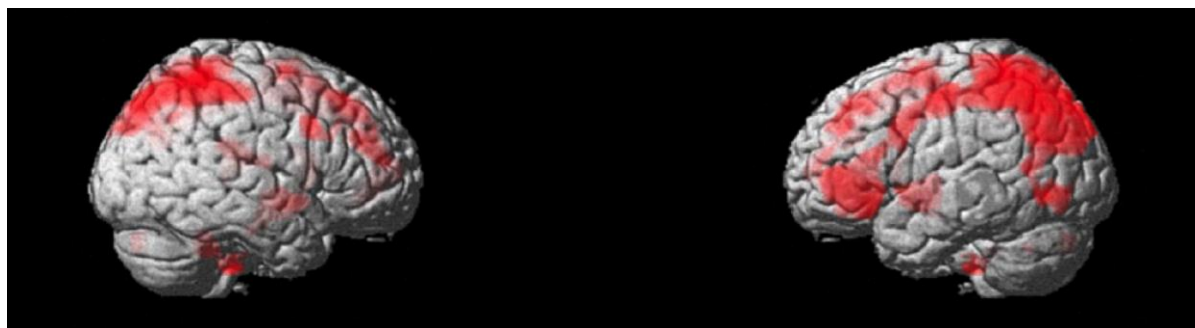
Own vs Other: VTA/SN, striatum, mPFC, ACC, insula

Happy, but not neutral or sad own-infant faces, activated nigrostriatal brain regions.

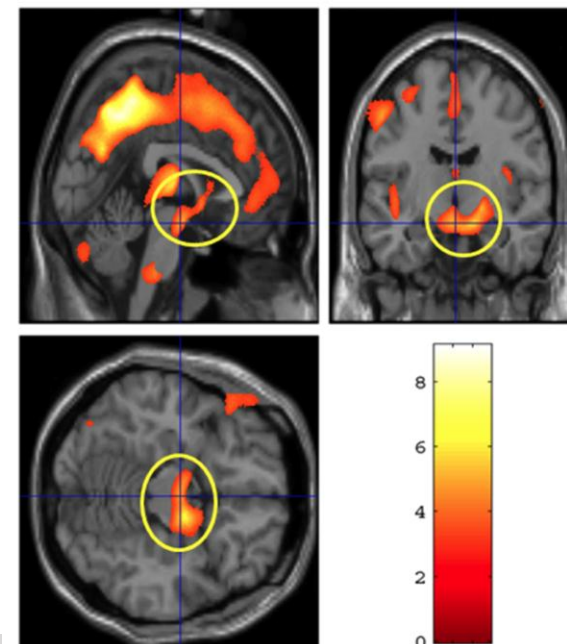




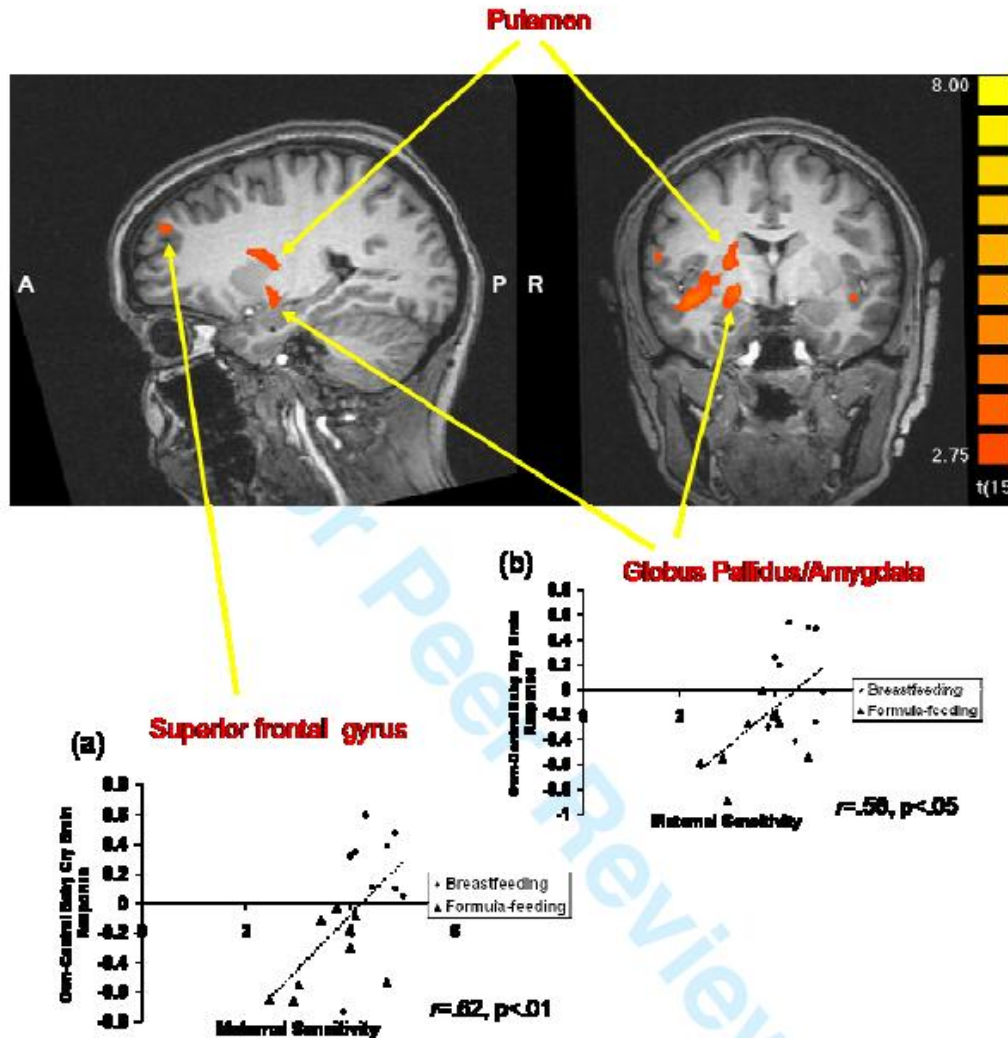
# Gray Matter Change With Experience and Parental Investment (Kim, Leckman, Mayes, Feldman, Wang, & Swain, 2011)



- Grey matter increase from 2-4 weeks to 3-4 months postpartum ( $n = 19$ ,  $p < .05$ , (FDR corrected)  $> 100$  voxels)
  - Grey matter increase from 2-4 weeks to 3-4 months postpartum predicted by mothers' positive perception of own baby at 2-4 weeks postpartum



# Predicting Maternal Sensitivity at 3-4 months with neural response to infant cries (Kim, Feldman, Leckman, Mayes, and Swain, 2011, JCPP).



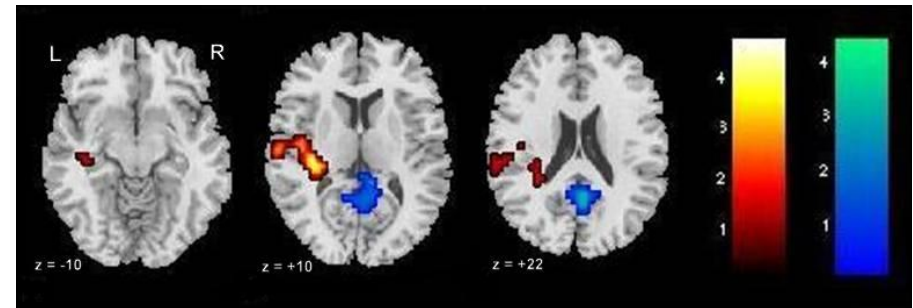
- Maternal sensitivity at 3-4 months postpartum positively correlated with activations in right superior frontal gyrus ( $r = .62, p < .01$ ), and right lateral globus pallidus/amygdala ( $r = .53, p < .05$ ) at 2-4 weeks postpartum to own versus other cries.

# Parents and Non-Parents fMRI Response to Low and High-Distress Cries (Montoya, et al, in press)

- In Hi vs Lo Distress Cry Contrast, mothers show greater activation of post-central gyrus, implicated in motoric responses, and less PCC activation implicated in stress responsiveness

- Compared to women who are not parents, mothers may be primed to initiate motoric responses and show less of a stress response to high-distress cries

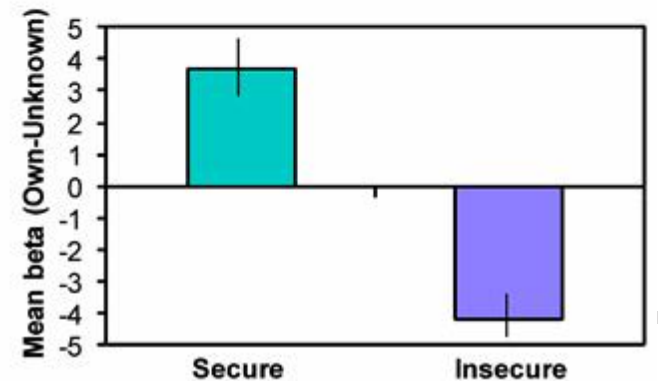
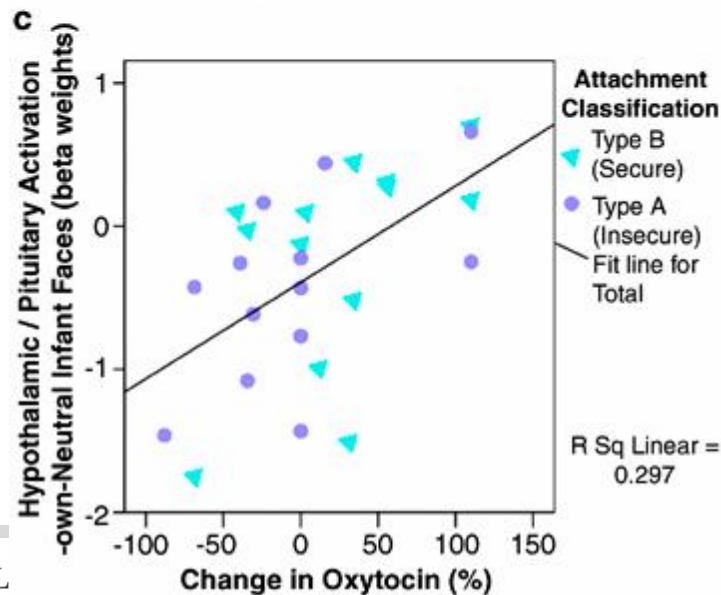
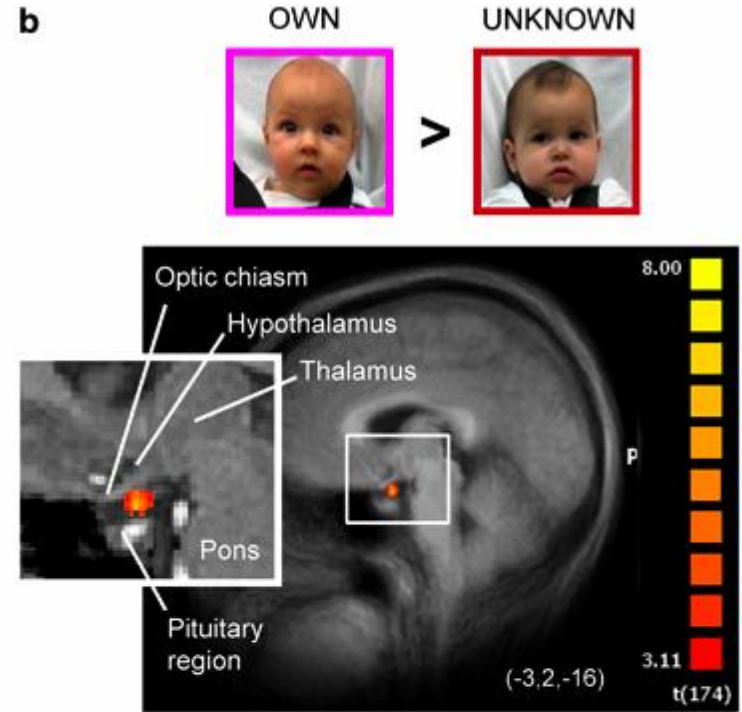
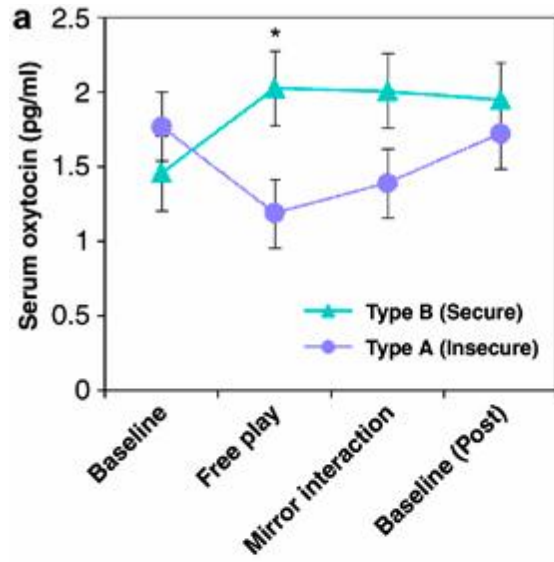
Hi vs Lo Moms Vs Non-Moms



$$p_{\text{voxel}} < 0.01 \quad p_{\text{cluster}} < 0.05$$

# Sources of Individual Differences in Transition to Parenting

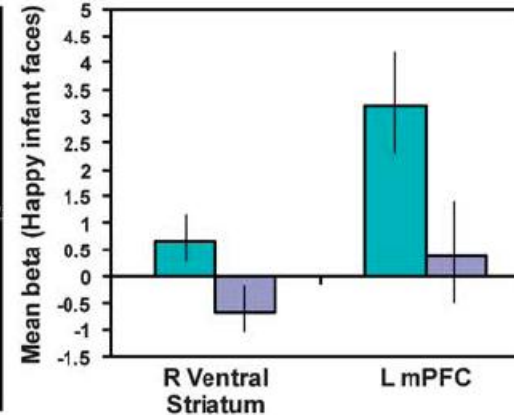
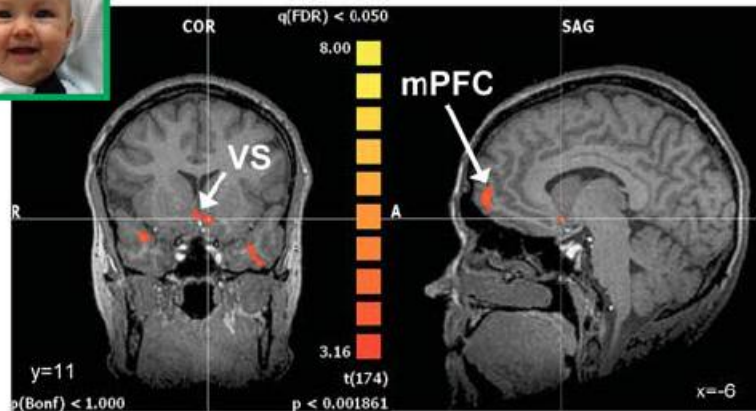
# Oxytocin and Attachment Security Predicts Striatal Response (Strathearn, et al, 2010, Pediatrics)



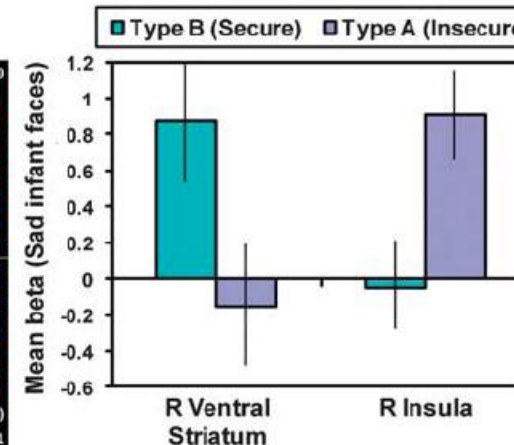
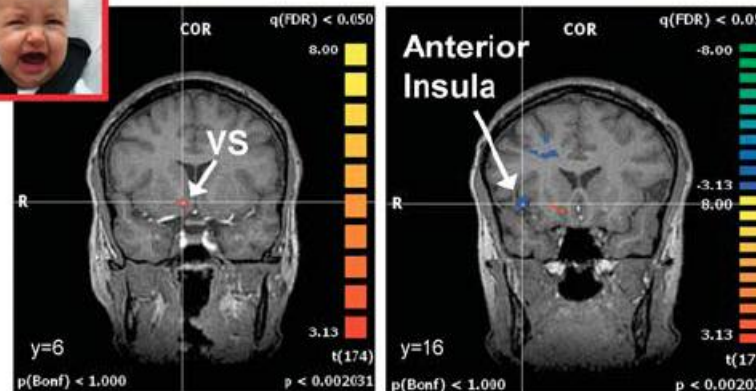


# Differential Response to Infant Affect by Attachment Profile (Strathearn, et al, 2010)

a



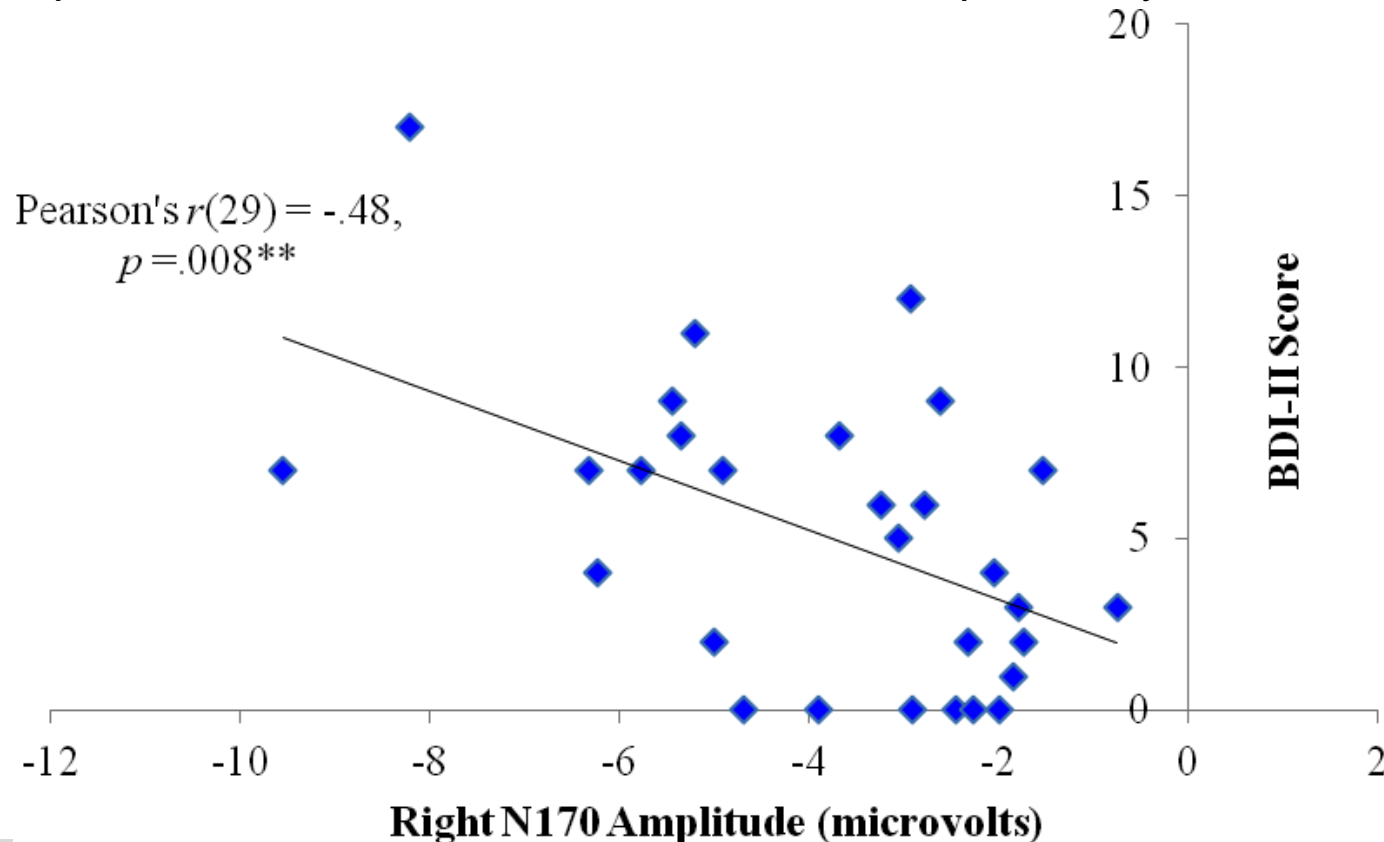
b





# Maternal Mood and Infant Face Response (Noll, Mayes, & Rutherford, in press, 2012)

Moms (17) and Non-moms (12); Viewed happy, sad, and neutral infant faces – no group effect and no modulation of the N170 amplitude by emotion.



# Key Points

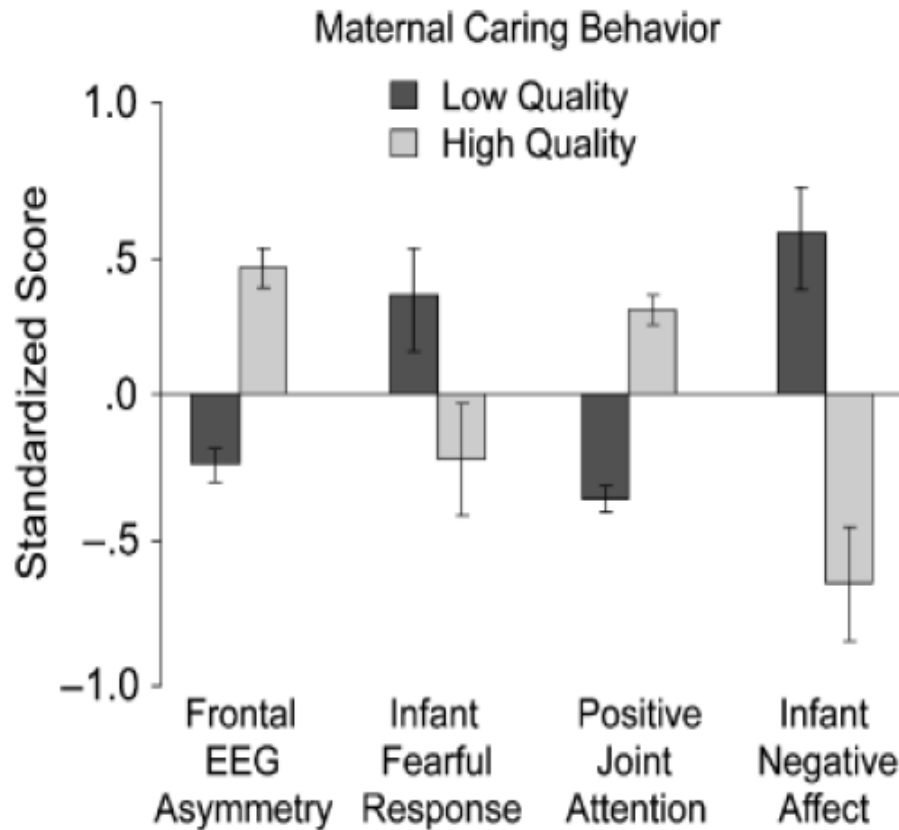
- Consistent differences with parents vs non – parents in patterns of neural activation
- Activate components of reward circuitry (and parallel change in attentional focus, e.g., preoccupation)
- Own infant especially salient & motivating
- Negative cues such as cries activate both reward as well as stress systems
- May be consolidation/changes in connectivity in circuitry over time with exposure to infant
- Individual differences and challenges to neural shift, e.g., substance abuse, depression

# PARENTING AMONG SUBSTANCE ABUSING ADULTS

# Key Points

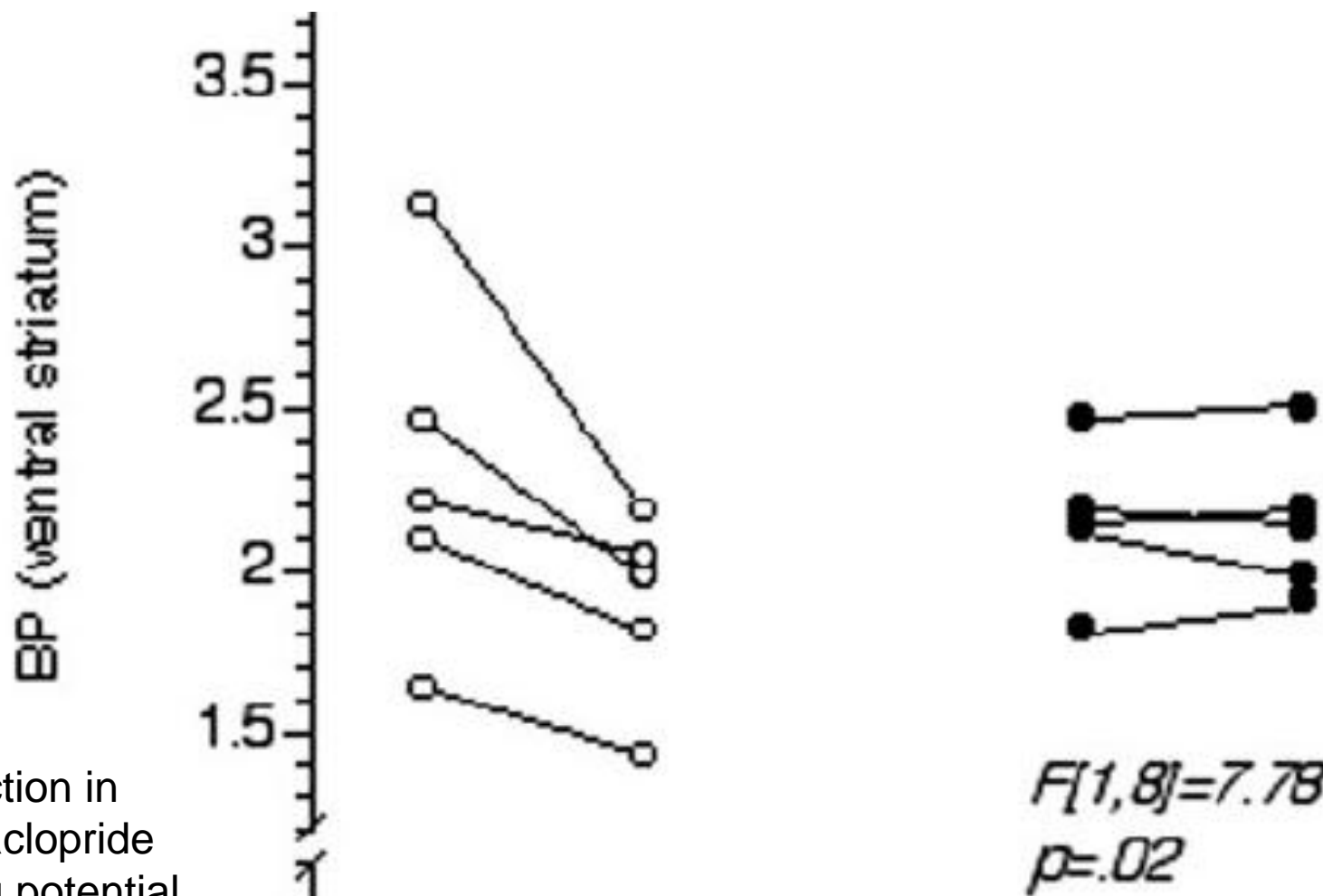
- Individual differences in parenting behavior convey individual differences in stress-reward systems in offspring enduring into adulthood
- Early adversity increases risk for addiction in adulthood
- Addiction and addictive disorders may be thought of as stress-regulatory disorders

# Individual Differences in Maternal Care Convey Differences in Emotion Regulation



Hane and Fox, 2006

# Low Maternal Care in Humans Associated with Greater Striatal Dopamine Response\* to Stressor

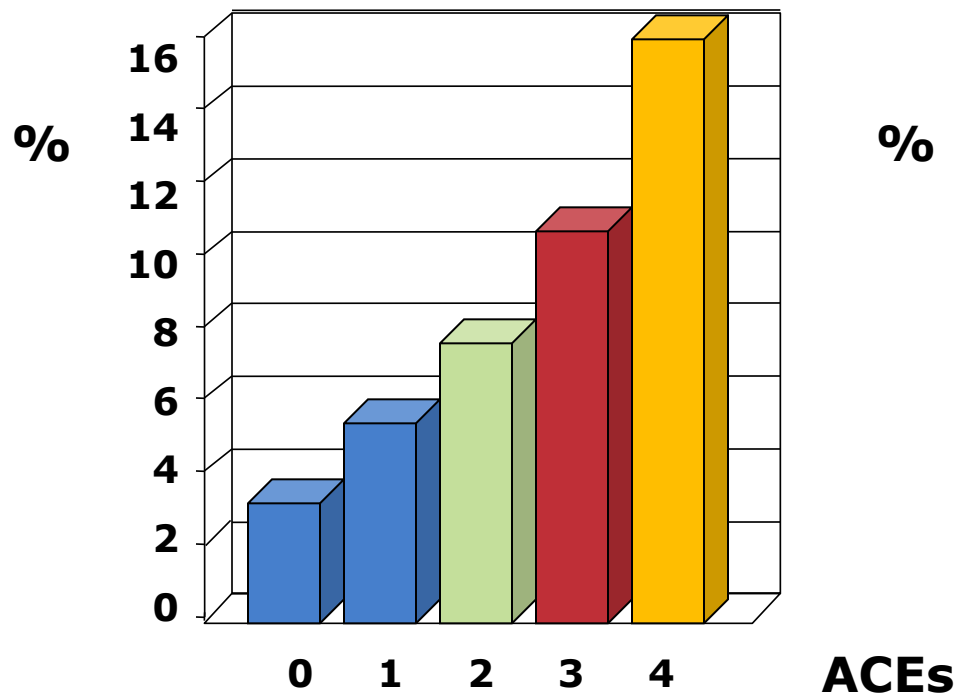


\*\* reduction in [11C]raclopride binding potential



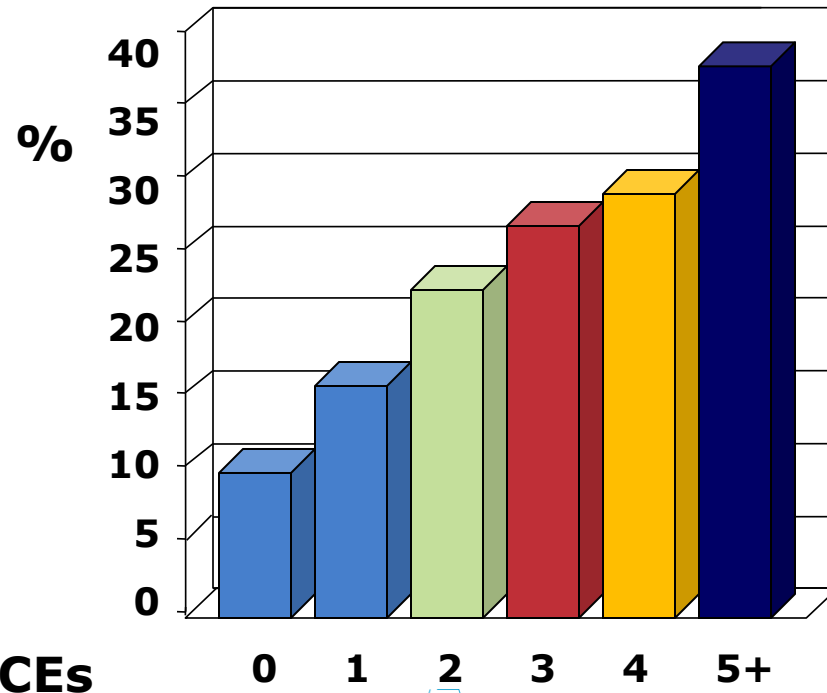
# Risk Factors for Adult Substance Abuse are Embedded in Adverse Childhood Experiences

## Self-Report: Alcoholism



Source: Dube et al, 2002

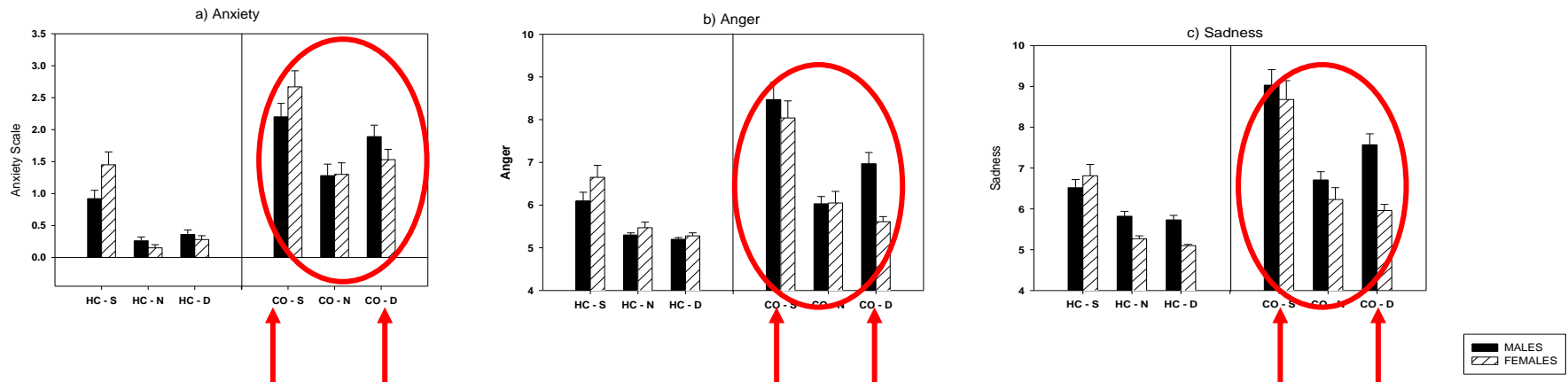
## Self-Report: Illicit Drugs



Source: Dube et al, 2005

# RESPONSE TO STRESS AMONG ADDICTED ADULTS

- Drug/alcohol cue and stress scripts result in increased craving, anxiety, heart rate, and indices of HPA axis function among cocaine dependent and alcohol dependent subjects (Sinha, 2003; Breese et al., 2005)



- Stress-induced craving predicts treatment outcome (Greater craving= increased risk for relapse) (Sinha, 2006)
- Addicted adults who experienced child maltreatment perceive greater stress and use more avoidant coping strategies including drug use (Hyman, et al, 2007)

# Maternal Substance Use



- 90% of women abusing substances are of child bearing age (Strathearn & Mayes, 2010)
- 5.2% of pregnant women report current or recent use of illicit drugs, 11.6% report alcohol use and 16.4% report tobacco use (SAMHSA 2008)
- Substance use during pregnancy
  - Increase rates of preterm delivery, low birth weight, & multiple congenital abnormalities (Jansson & Velez, 2011)

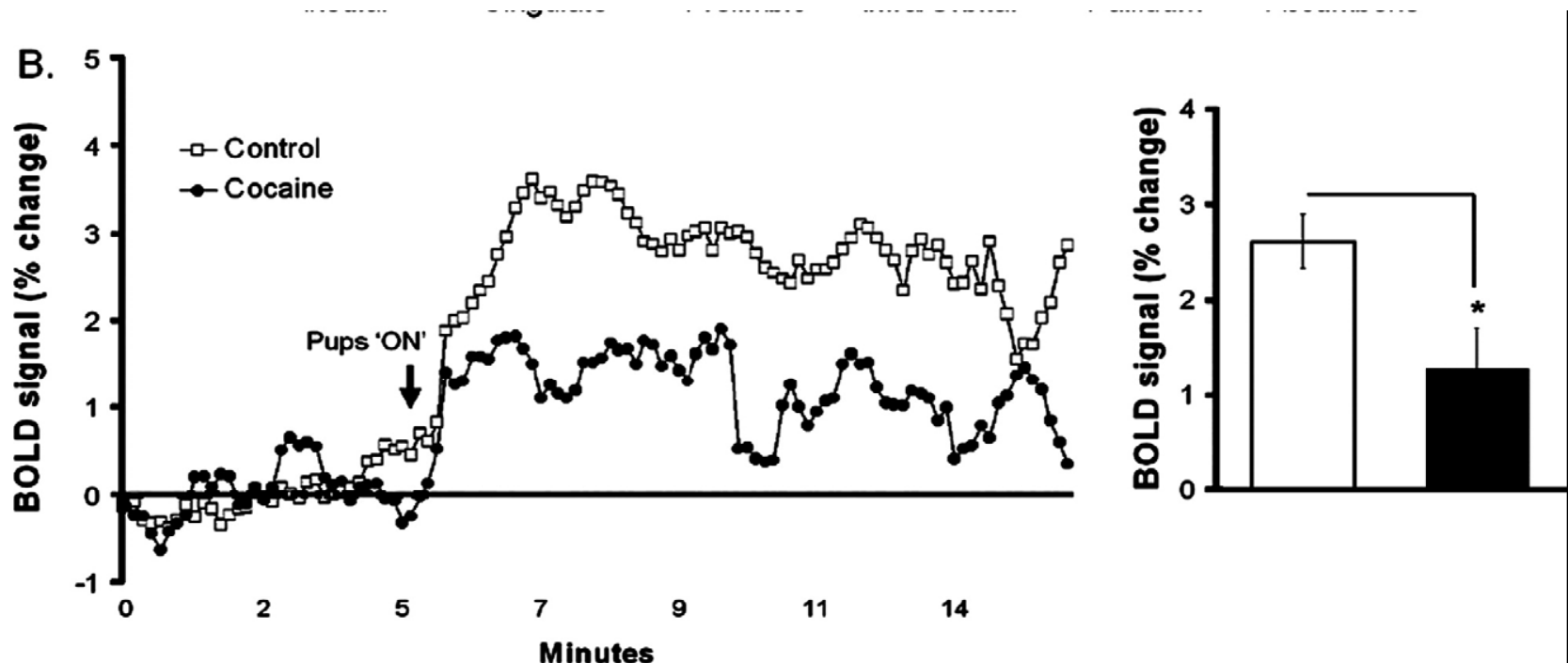
# Maternal Substance Use

- Influences on the postpartum environment
  - Increased rates of:
    - Child maltreatment (including neglect and abuse)
    - Removal of a child from a family
    - Two-thirds of child maltreatment fatalities

(Cash & Wilke, 2003; Reid, Macchetto, & Foster, 1999; US Department of Health and Human Services, 1999)

# Animal Models of Parenting & Drug Addiction

- Suckling increases activation in dopaminergic reward system but cocaine diminishes this activation (Ferris, et al., 2005; Febo and Ferris, 2007)



# Animal models of Parenting and Drug Addiction

- In prenatal, chronic exposure model (*Johns and colleagues*):
  - Diminished attention to pups and to pup environment (e.g., nest building, gathering pups)
  - Heightened aggression to intruders but not to protect pups
  - Decreased attention to pup vocalizations



# Parenting Behavior Among Substance Abusing Adults

- In human mothers:
  - Withdraw in face of infant distress
  - Less attentive to infant bids for attention
  - Less contingent responding or increased non-contingent behaviors
  - Higher rates of negative affect in interactions and heightened physical provocation and intrusiveness
- ? Each as markers of heightened stress in response to infant

Truman and Mayes, 2005

# Addiction and the addictive process

- Addiction represents the dysregulation between reward and stress neural circuitries
- Transition from positive reinforcement to negative reinforcement:
  - Initial reward of substance use
  - Continued drug use to relieve the negative affective state of abstinence, leads to habitual use
- Reward system is “co-opted” to maintain habitual behavior associated with relief of negative affect and stress

(Koob & LeMoal, 2001; Koob & Volkow, 2009)

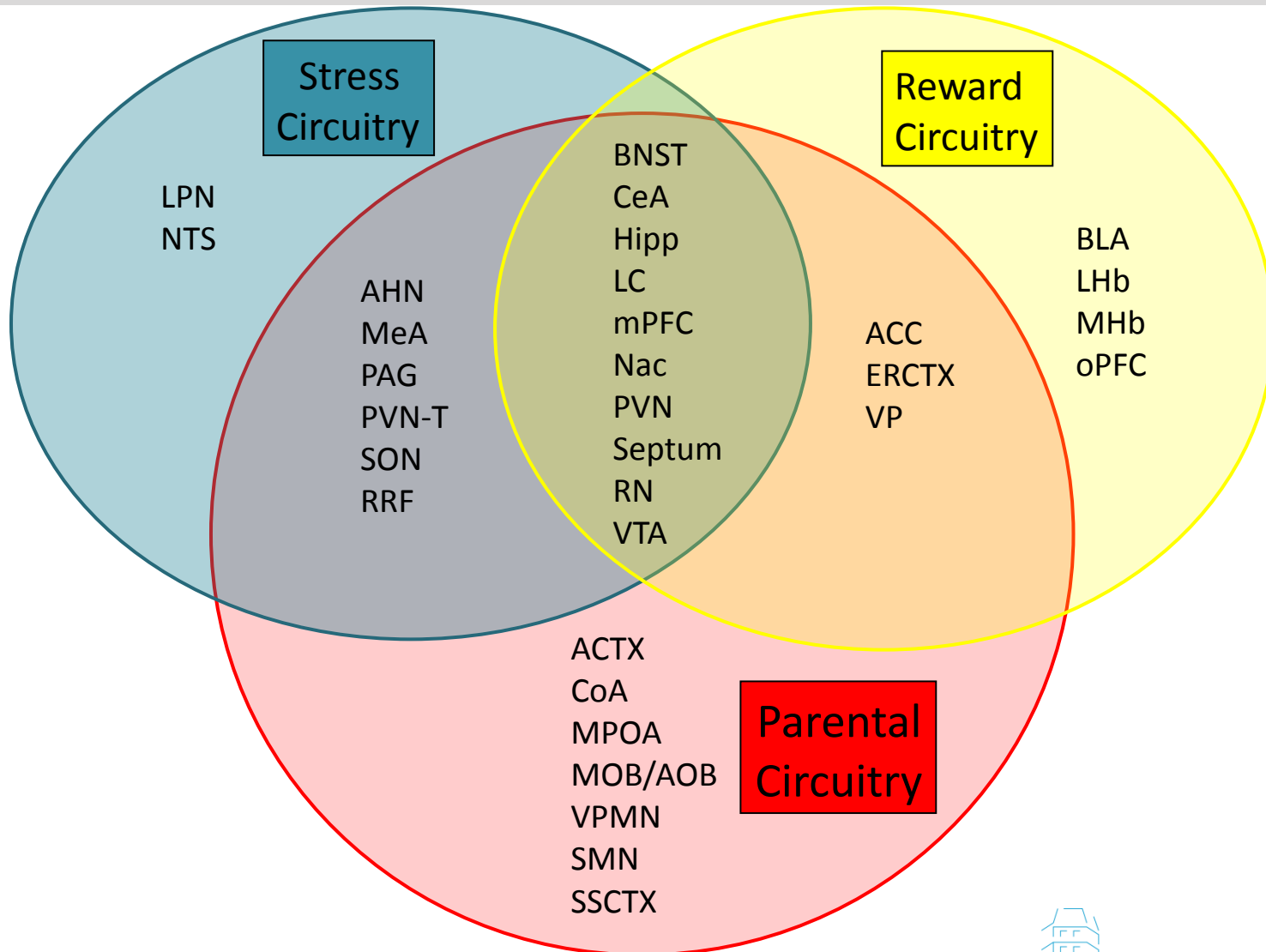


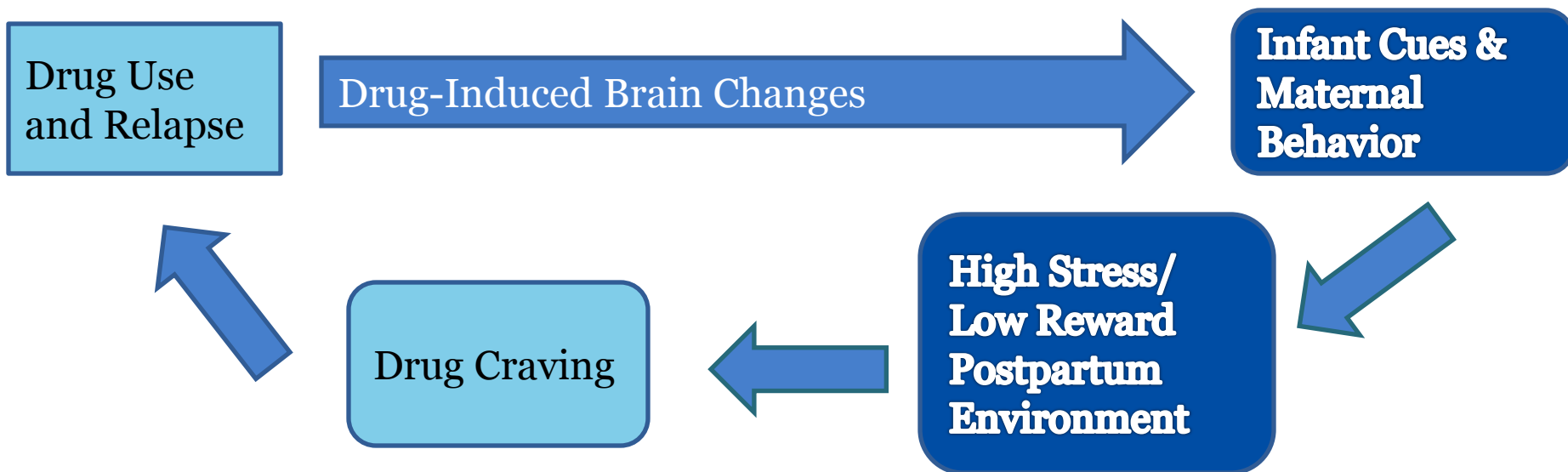
# Addiction and implications for parenting

- Co-optation of reward system may result in other rewards not being as salient
- These rewards may include social affiliation and relationships
- Hypothesis: caring for an infant may be less rewarding and more stressful



# Overlapping circuits of reward, stress & parenting





**Rutherford et al. (2011)**

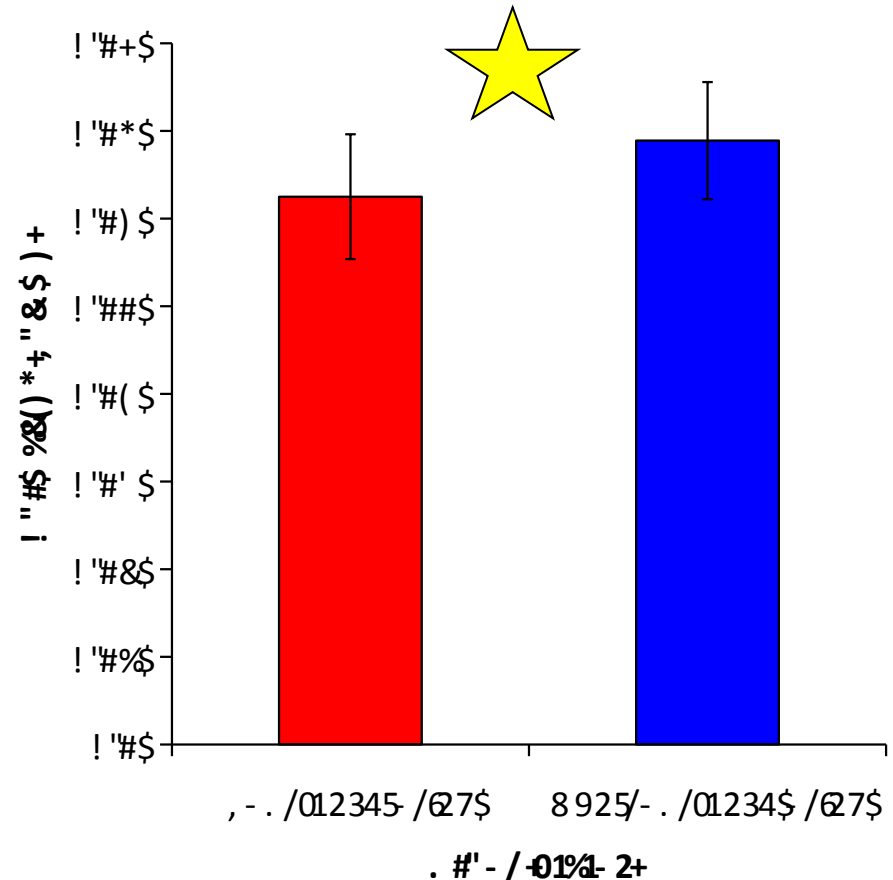
# Addiction and attachment hypothesis

- Addicted adults may experience infant cues as insufficiently rewarding and more stressful secondary to dysregulation of stress and reward systems in addiction

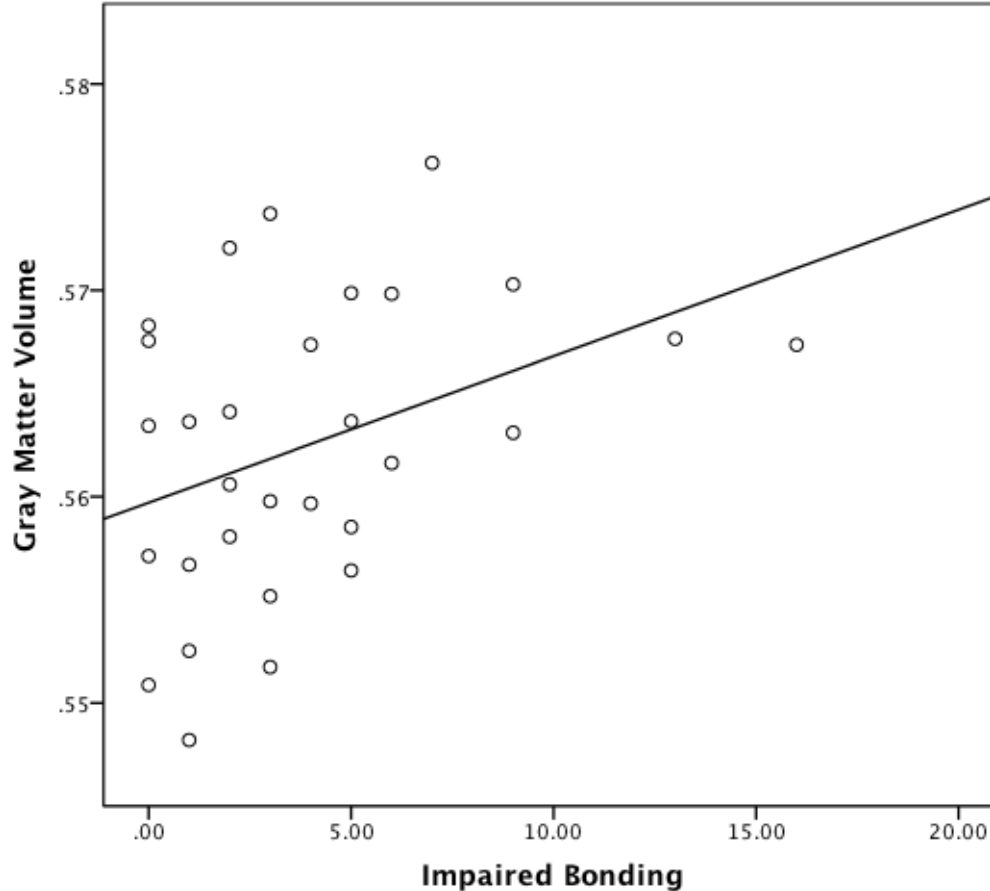
# MRI Structural Data

(Rutherford, Potenza, Mayes et al., in prep)

- Total gray matter reduced in substance using mothers,  $t(62)=3.71, p < .001$
- No differences in total white matter volume,  $t < 1$



# Gray matter volume correlates with self-reported impaired bonding in substance-using mothers



Rutherford et al. (under review)

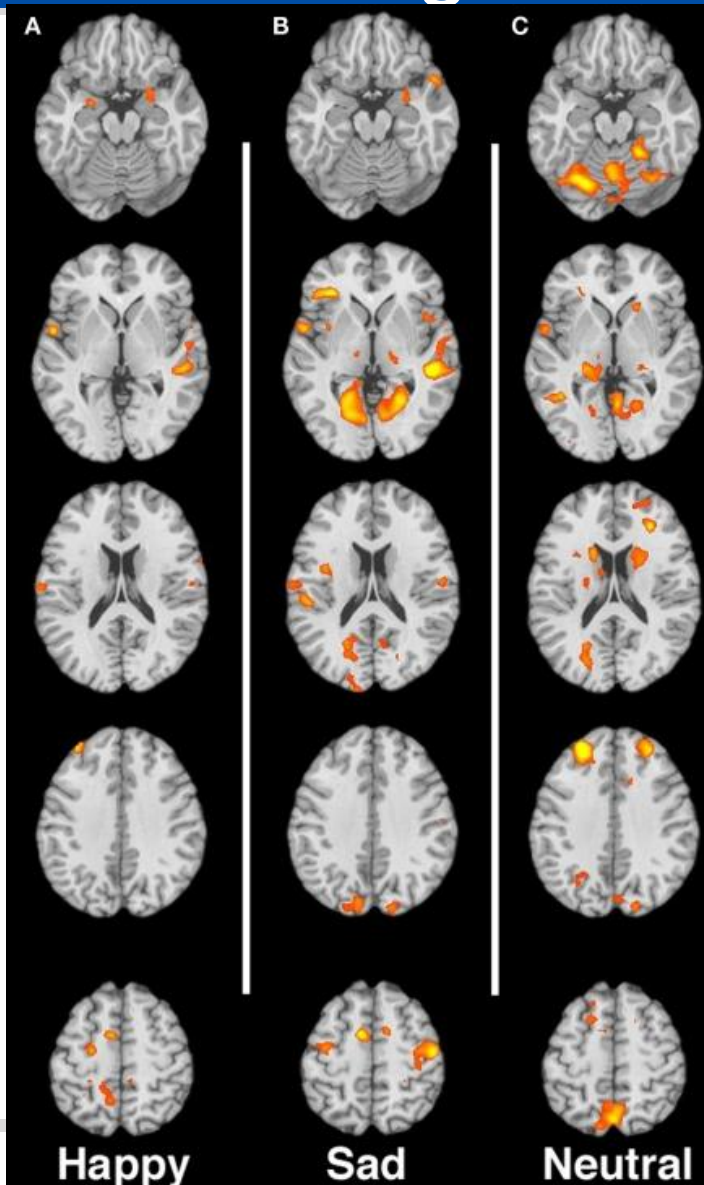


# Functional MRI: Substance Use and Parenting

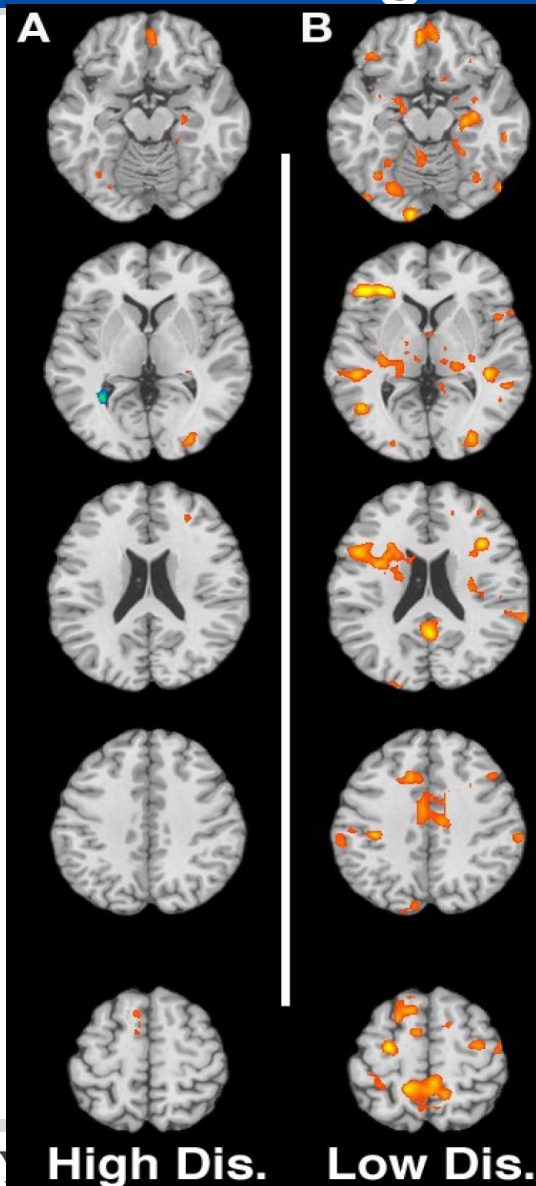
## Infant Face Perception

Substance using mothers evidence reduced activity in prefrontal regions, as well as visual processing, and limbic regions (parahippocampus and amygdala).

Landi et al. (2011)



# Functional MRI: Substance Use and Parenting



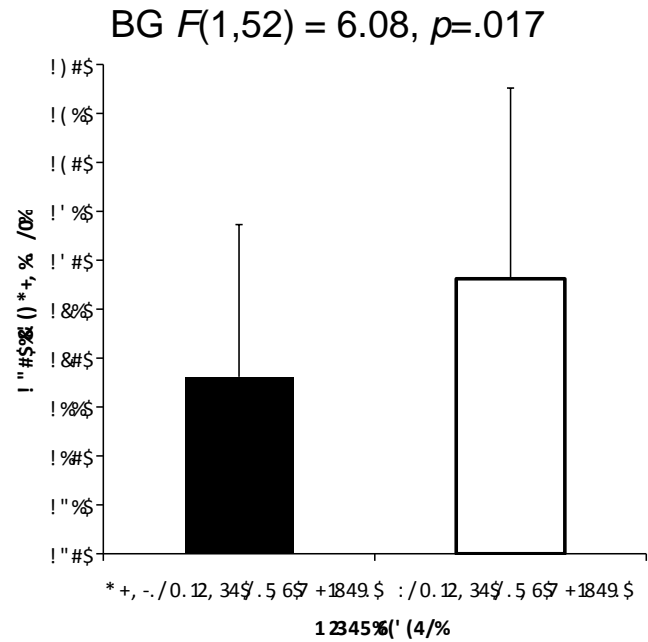
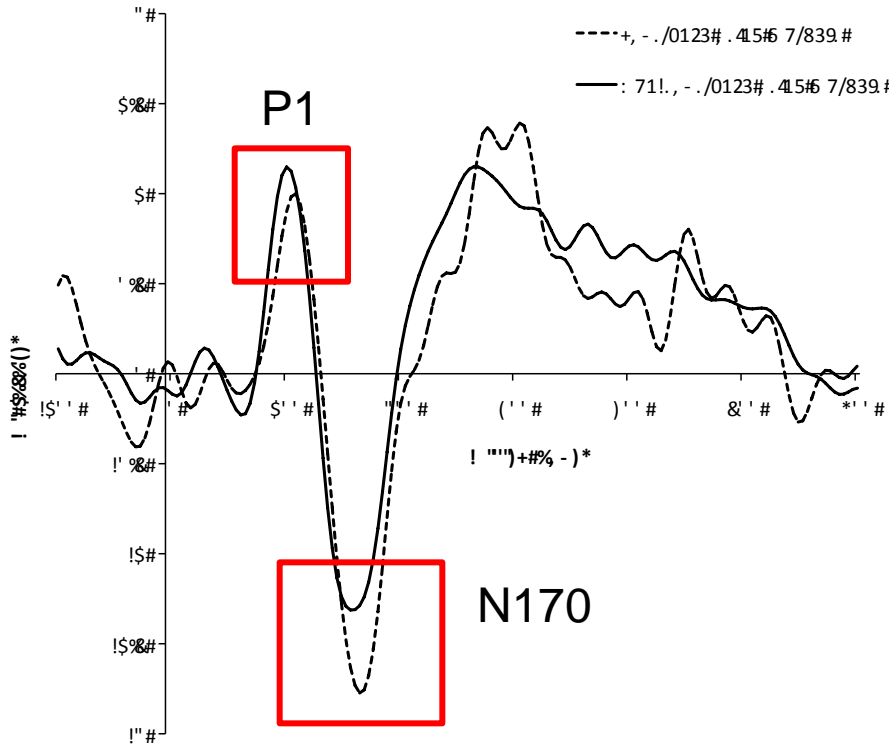
## Infant Cry Perception

Substance using mothers evidence reduced activity in prefrontal regions, auditory sensory processing regions, insula and limbic regions (parahippocampus and amygdala).

Landi et al. (2011)

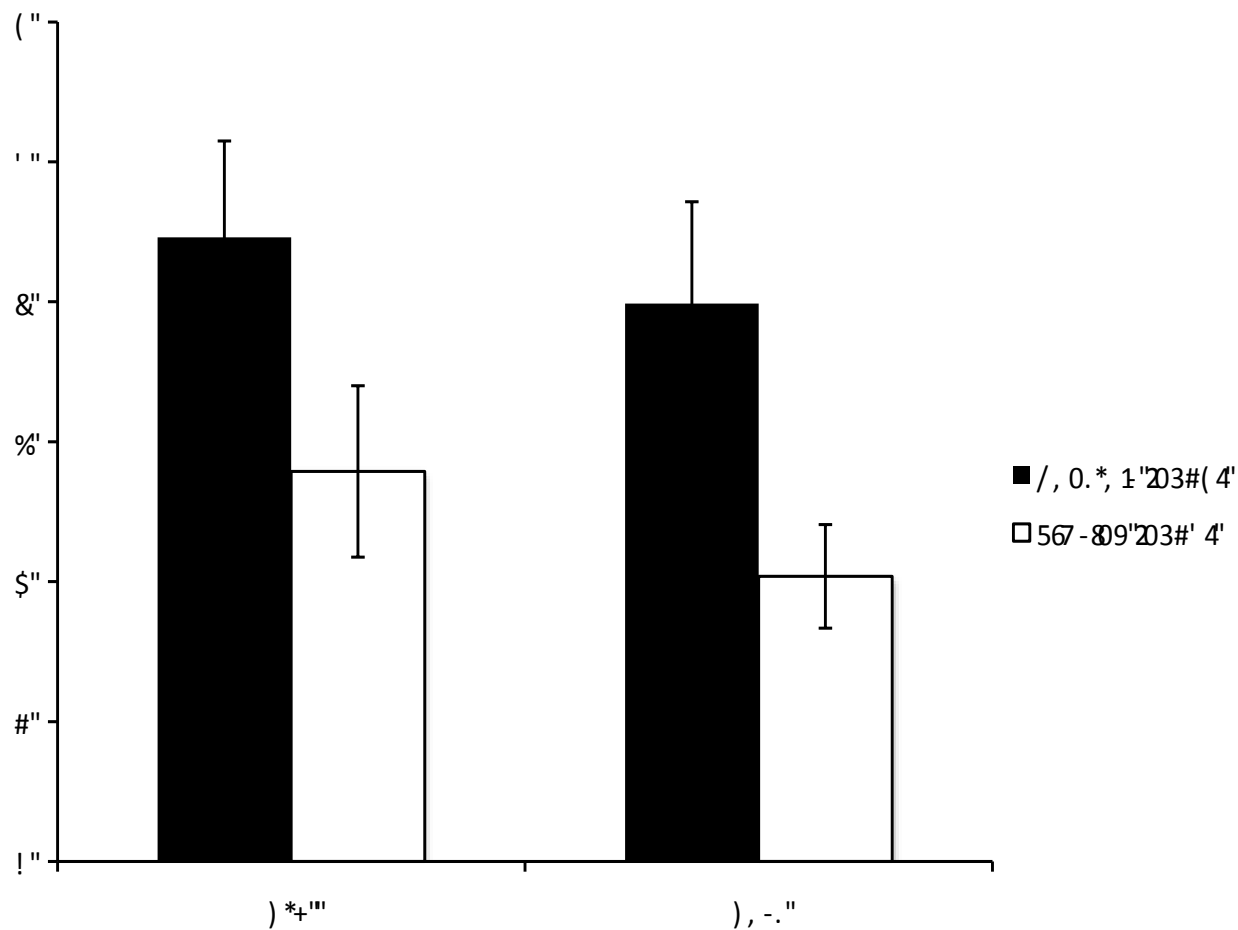


# ERPs, substance use and parenting



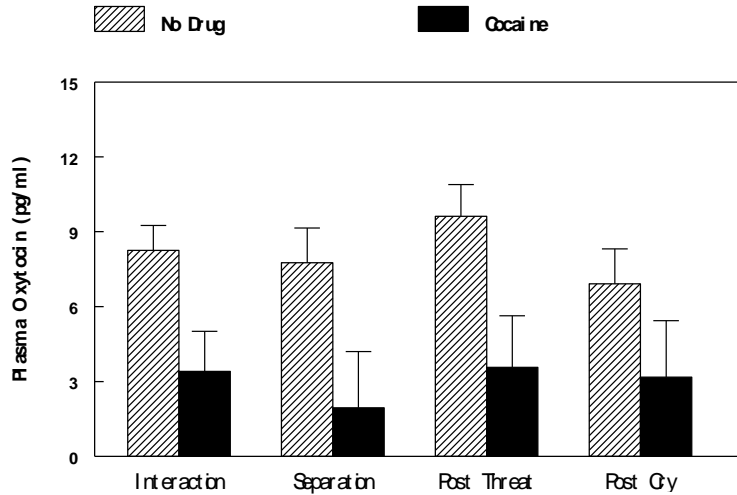
Rutherford et al. (in prep)

# Oxytocin and substance use



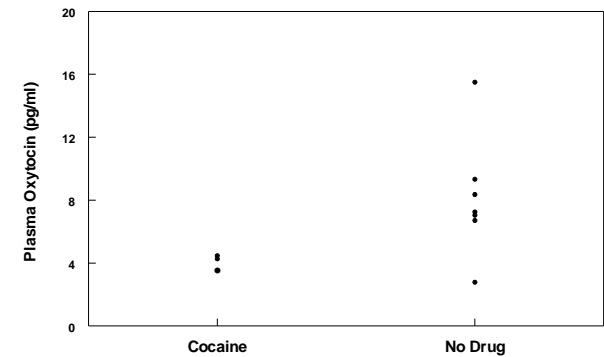
Salivary levels of oxytocin lower in substance using mothers relative to non-substance using mothers,  $p = .009$

# Cocaine-Using Mothers Show Diminished Oxytocin Response and Greater Perceived Stress

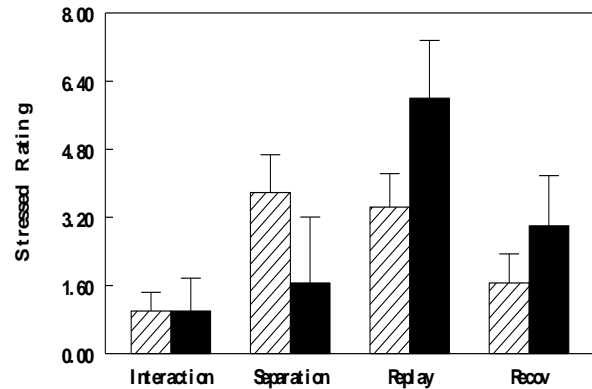


Adjusted for Feeding Group, Between Subjects Effect of Cocaine:  $F=6.98$ ,

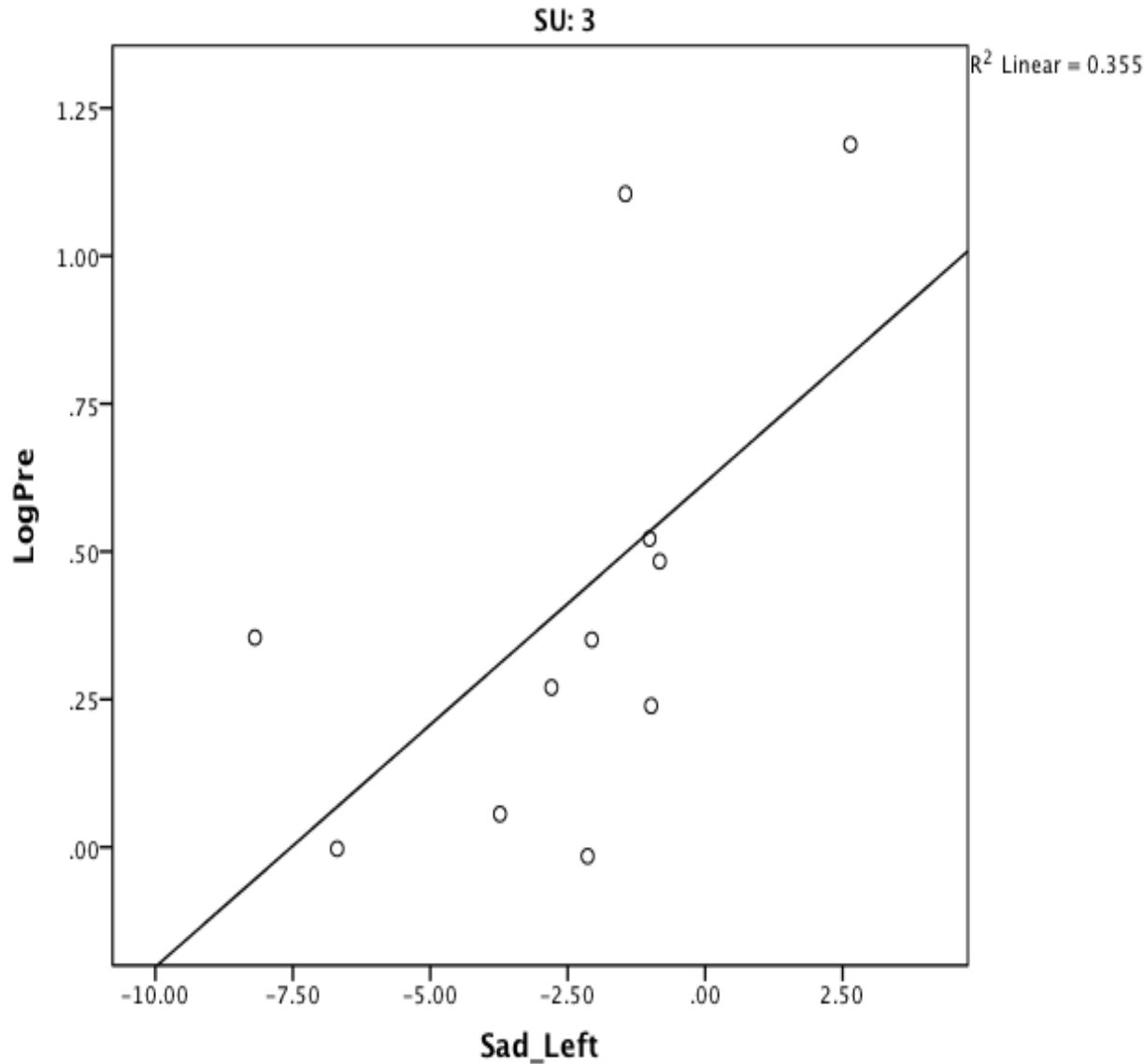
Oxytocin during SPEECH REPLAY



Legend:  No Drug  Cocaine



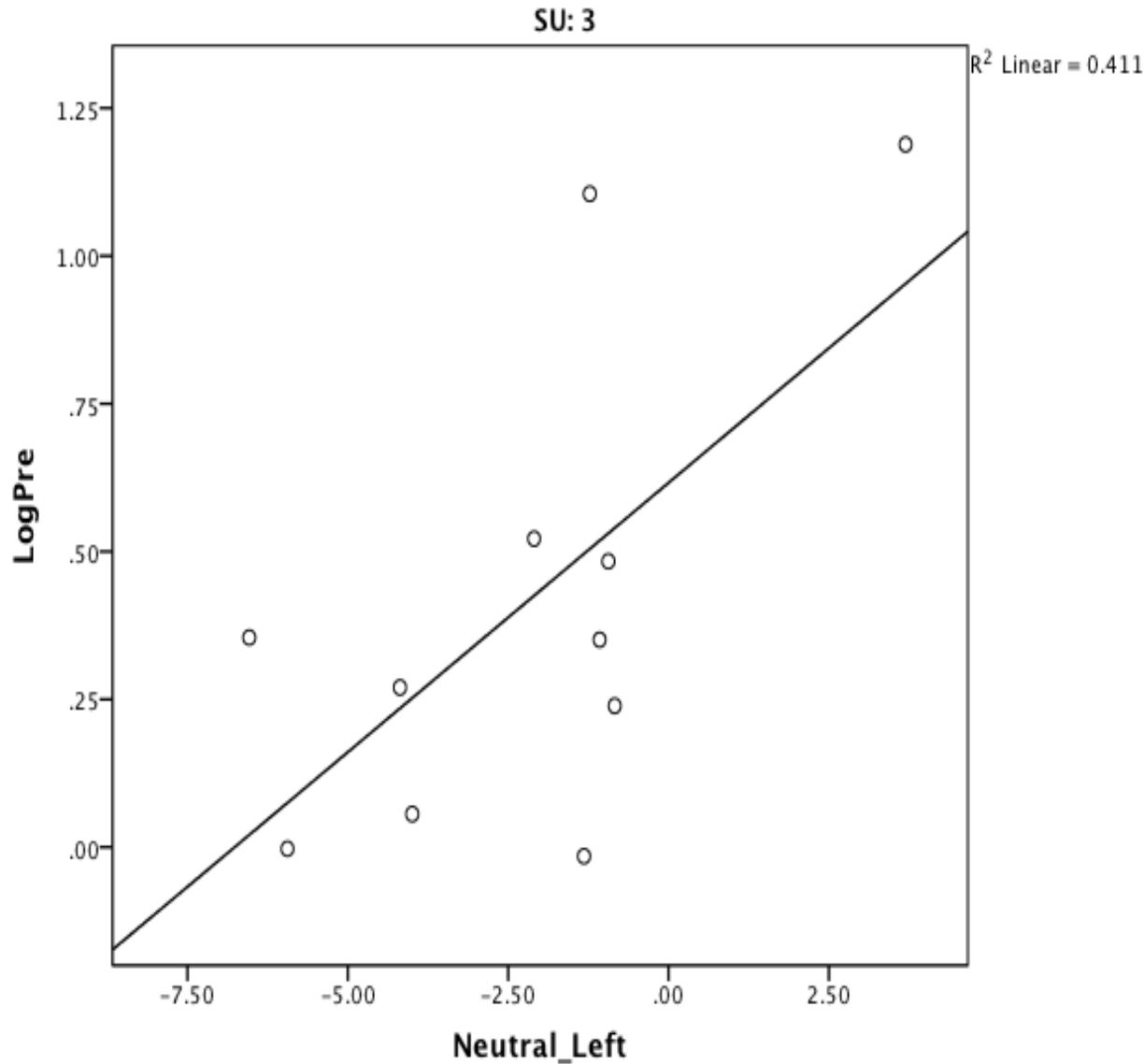
# Oxytocin and N170 amplitude: SU mothers



Positive correlation  
between salivary oxytocin  
and N170 amplitude to  
sad infant faces in  
substance-using mothers,  
 $r(11) = .64, p = .03$



# Oxytocin and N170 amplitude: SU mothers



Positive correlation between salivary oxytocin and N170 amplitude to neutral infant faces in substance-using mothers,  $r(11) = .60$ ,  $p = .05$

# Interim Summary

- Addictive processes reflect dysregulation of stress reactivity and reward sensitivity
- Early adversity increases risk for addiction
- Addiction reduces parental sensitivity to infant cues (and enhances parental stress)

# UNDERSTANDING HOW ALTERED REWARD SENSITIVITY AND STRESS REACTIVITY IN ADDICTION IMPACTS PARENTING



# TEXTS OF PARENTING

“I can’t quite describe it but something is different in me since she came into our lives. She is center of nearly every waking moment, my thoughts, my plans – and when I wake up at night, she’s the first thought in my head. Everything I thought was important before has slipped down the list... Not only have I centered around her but somehow she has made me a different person....and I don’t want to be without her every new day.”

New mother

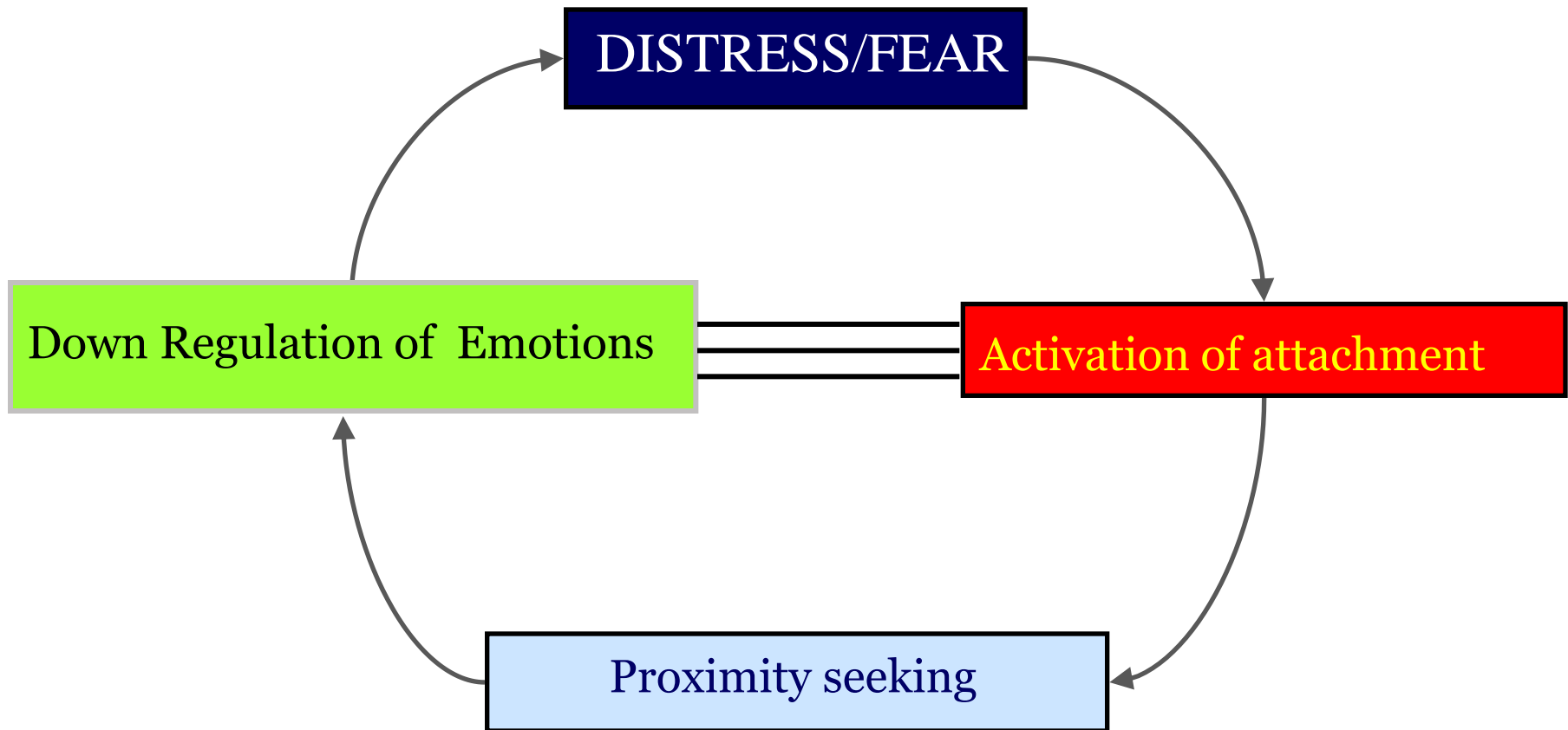


“She cries all the time, I don’t know what to do, I just get all nervous and edgy and think if I only had a cigarette or a beer. I just want to put her in a room and go smoke – there’s just nothing I can do but she just keeps crying – it really bugs me”

# Attachment and Emotional Regulation



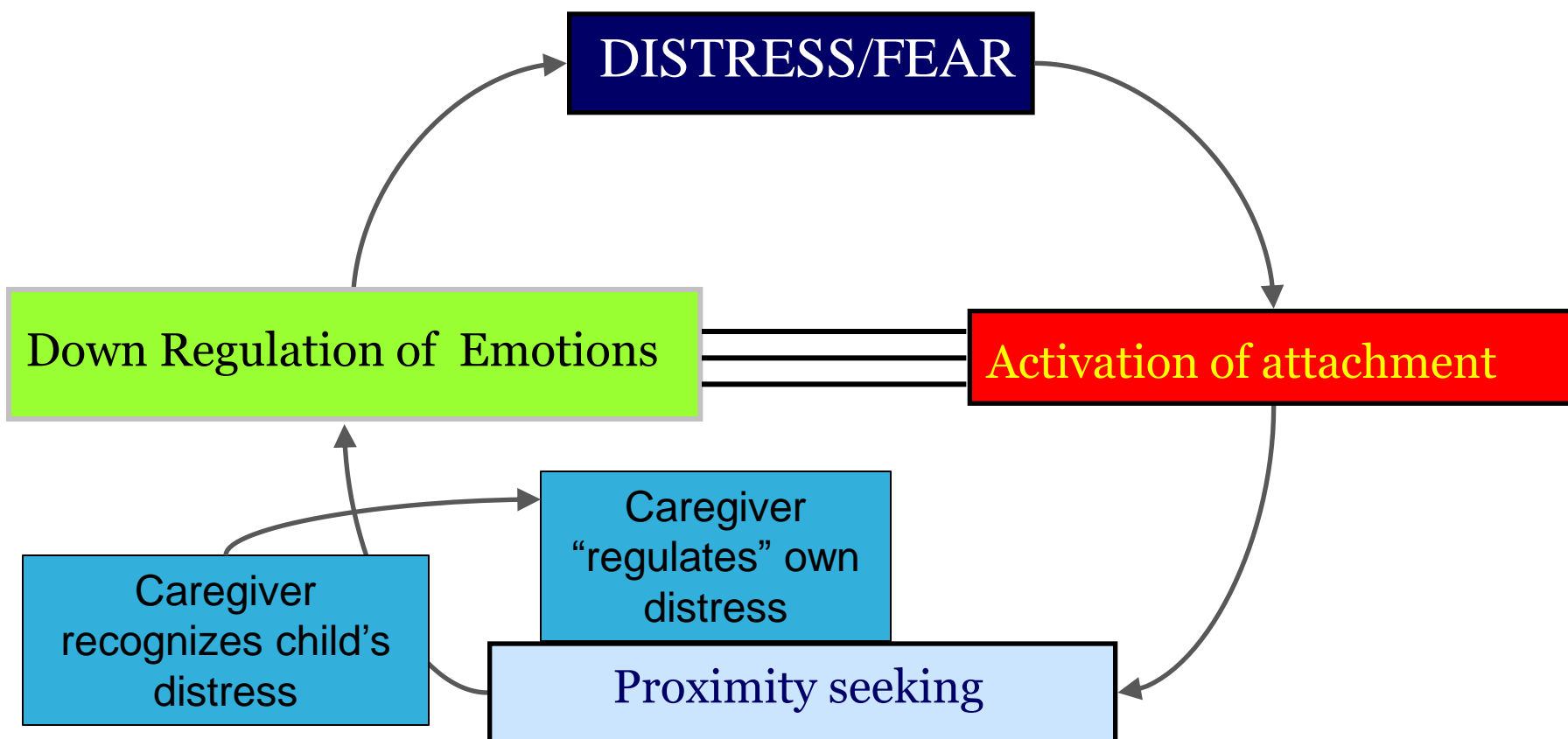
# Attachment Theory for Child & Parent



\*Luyten, P., Mayes, L.C., Fonagy, P., & Van Houdenhove, B. (2012). The interpersonal regulation of stress.

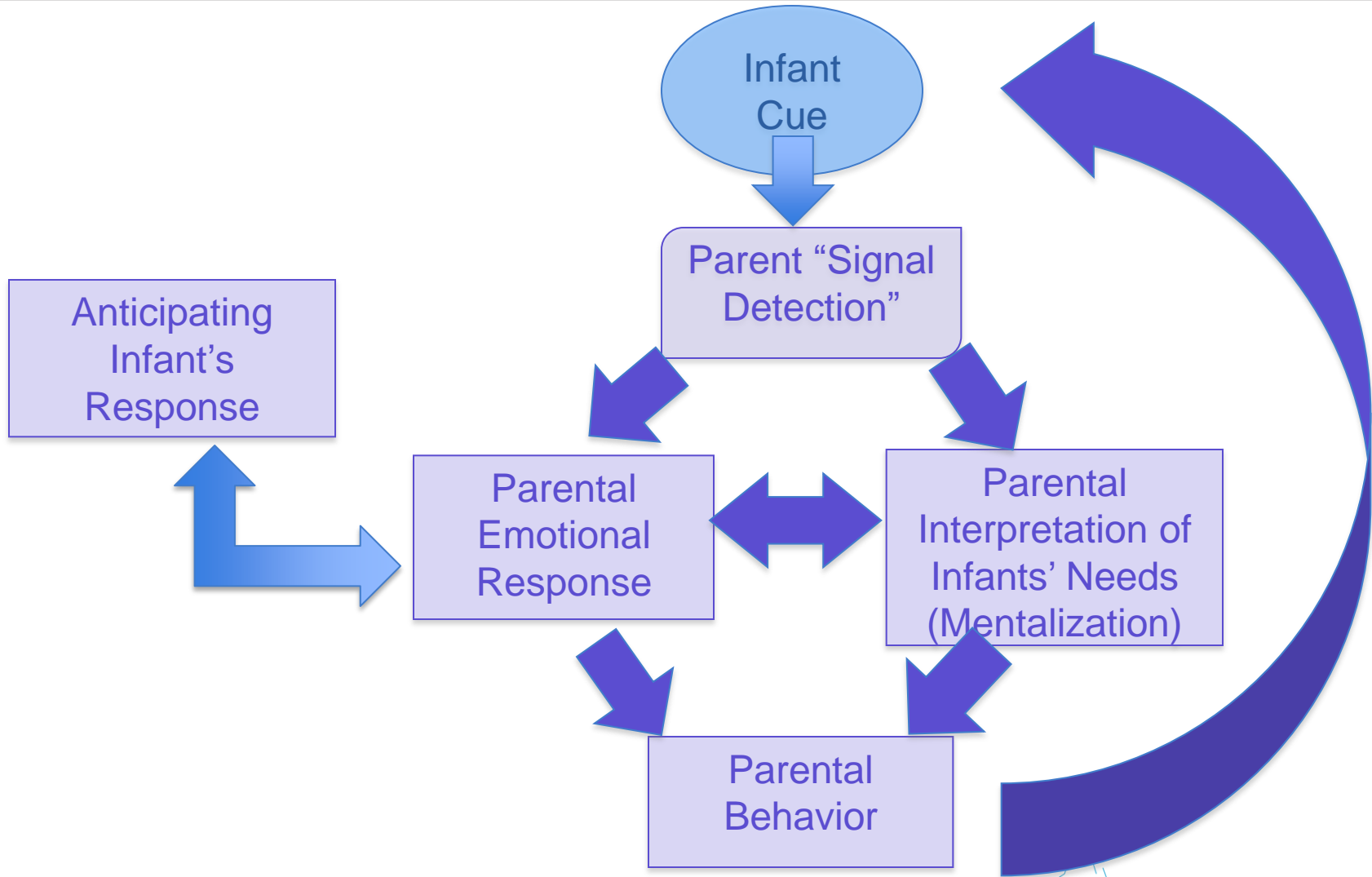


# Opening up the “Blue Box”

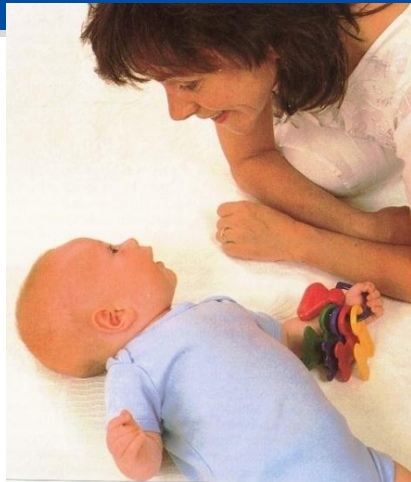


\*Luyten, P., Mayes, L.C., Fonagy, P., & Van Houdenhove, B. (2012). The interpersonal regulation of stress.

# Parenting Side of Attachment Response



# WHAT IS MENTALIZATION?



- Mentalization or Reflective Functioning = ability to think about others and oneself in terms of mental states
- Ability that allows individuals to perceive behaviors in terms of mental state constructs, thereby making them meaningful, explicable and predictable.
- Effective mentalization acquired in the context of secure attachment relationships (Allen, Fonagy & Bateman, 2008; Fonagy, Target, & Gergely, 2007; Sadler, Slade, & Mayes, 2006; Sharp & Fonagy, 2008; Sharp, Fonagy, & Goodyer, 2008; Slade, 2005)

# Examples of Parental Mentalization

Attributing intentions and feelings to self and the baby



“He feels sad and he misses me, and so he clings to me and begs me to stay. That makes me want to hold him forever.”

Or

“He’s so bad, he just cries to irritate me.”

Intrinsic to emotional regulation

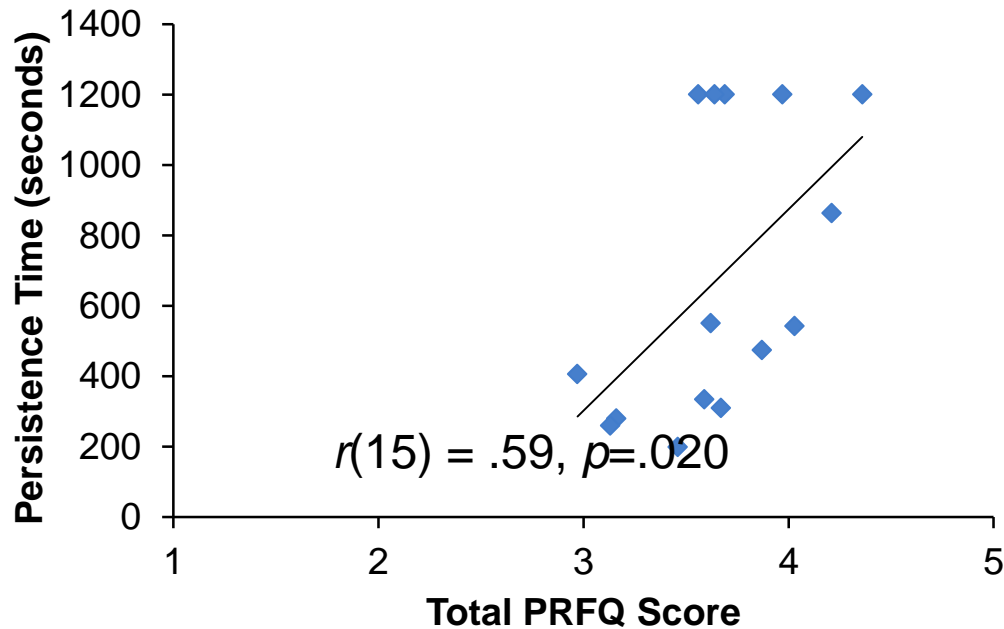


“Oh poor baby, you’re so sad; mommy feels sad when you are unhappy; you want mommy to....”

Or

“Stop crying.... I don’t know what do do with you...”

# MOTHERS WITH HIGHER “MINDFULNESS” SKILLS PERSIST LONGER COMFORTING A “SIMULATED” BABY



Time with simulator associated with increases in heart rate ( $p = .016$ ) and systolic blood pressure ( $p = .002$ ) pre- compared to post-interaction

## Simulator Performance

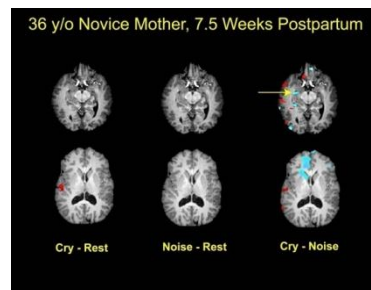
- Positive correlation between persistence times and total parental reflectiveness score
- Also seen for high-low subscale,  $r(15) = .53, p = .043$

Rutherford, et. al., 2012, under review

# Threats to Parental “Mental Economy”

Impact of parental depression, substance abuse, and other conditions when reward circuitry dampened or co-opted

- Dampened “signal detection” components of mentalization circuit that is sensitive to “mental state” cues



Impact of early deprivation/neglect with heightened stress reactivity

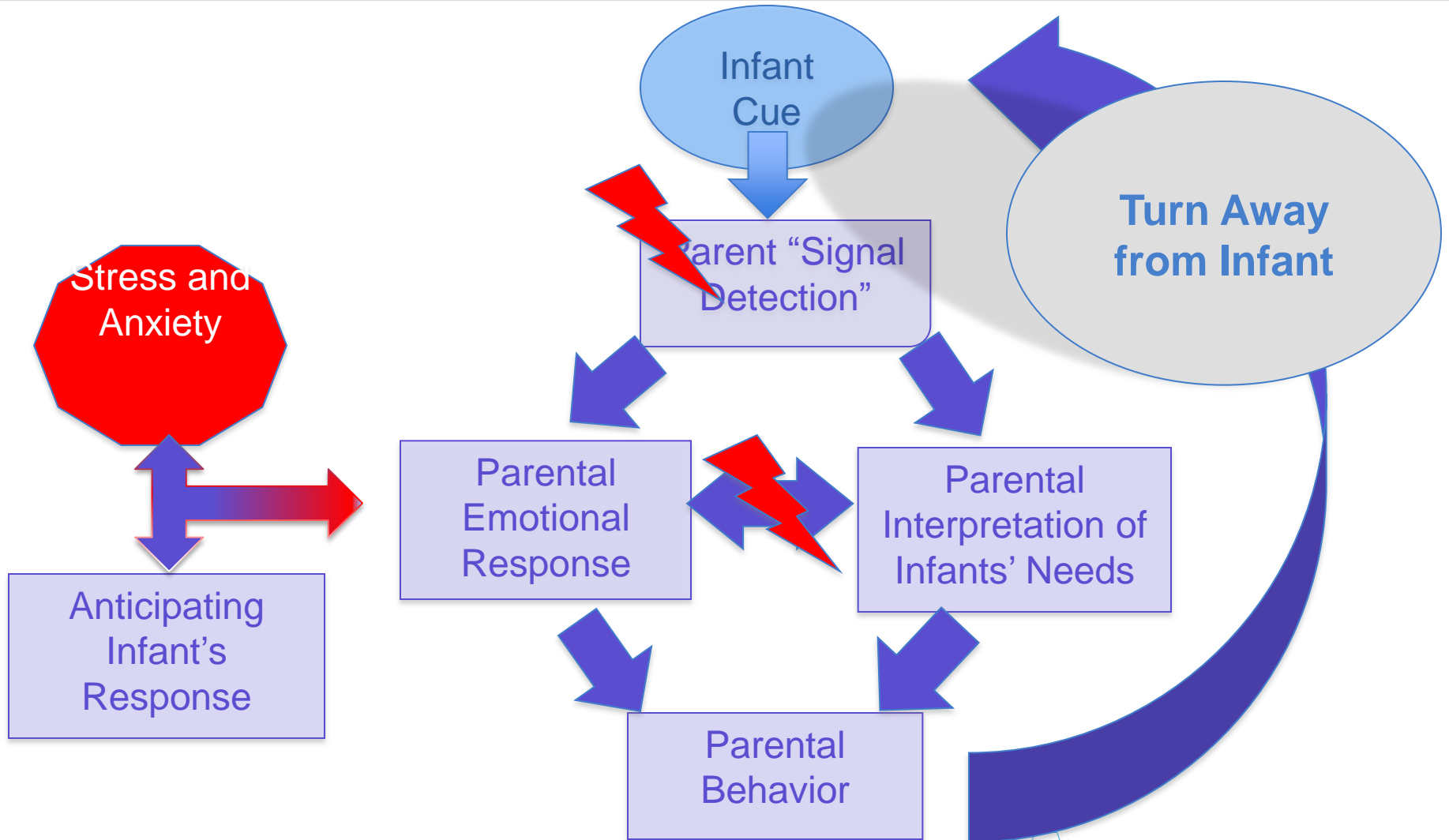


- Infant cues such as cries are stressful
- Less effective “top down” processing of mental state cues

# INTERVENTION IMPLICATIONS

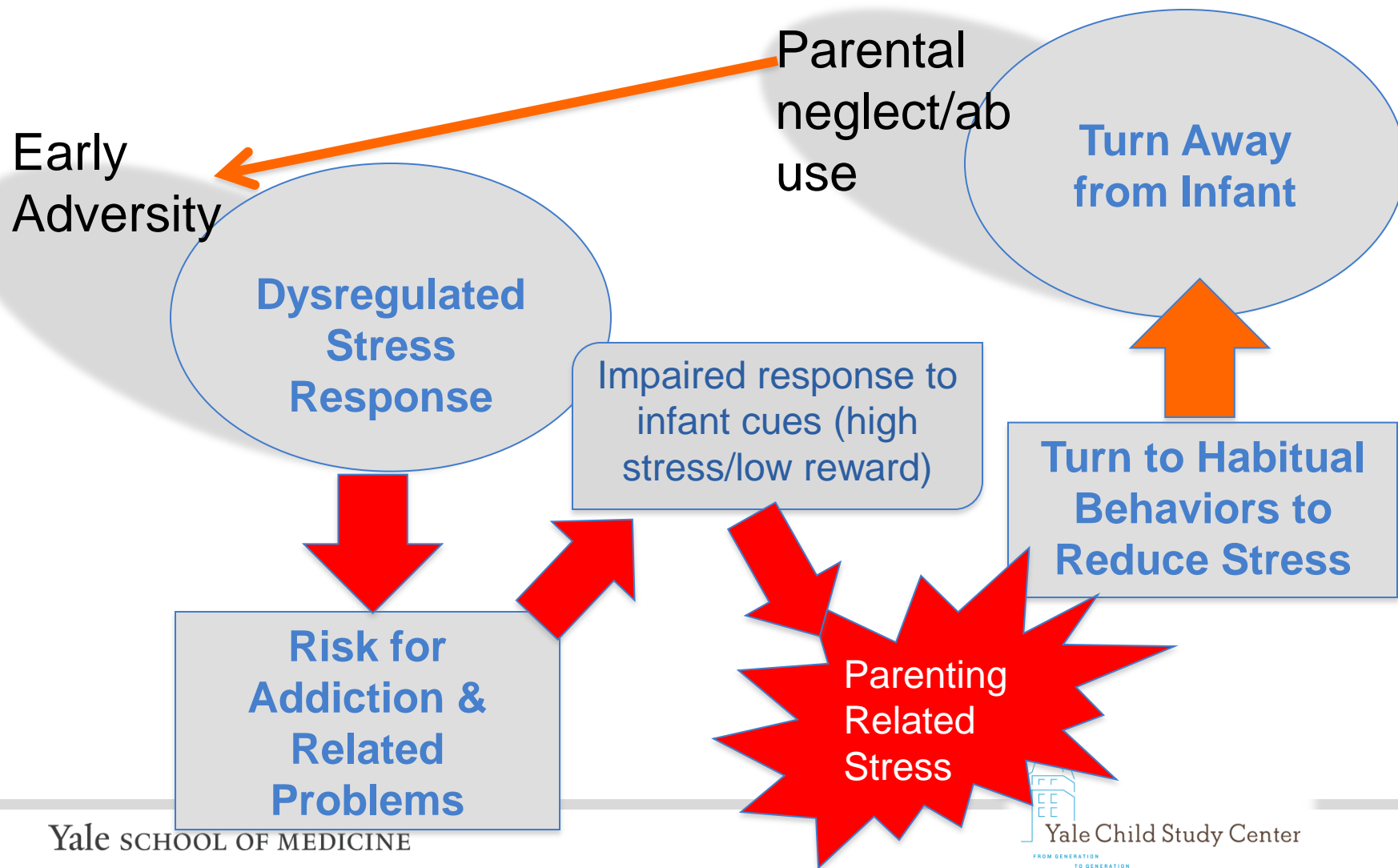
- Consider caring for a crying infant
  - Cry is stressful, eliciting a range of adaptive, decision making, prefrontally regulated processes –or top down interpretive processes
  - “Reward” of responding to cry is in the future – capacity to be mindful of consequences of actions
  - Mindfulness, consequence appraisal modulates stress of caring for crying infant
- But in addicted adult with increased stress sensitivity, infant cues are less salient and increasingly stressful
  - capacity to anticipate actions is diminished

# How Addiction Disrupts Parental Responding





# How Early Adversity Impacts Parenting and for the Intergenerational Transmission of Early Adversity



# Intervention Implications

- Mechanism for clinical observation of increased drug use/relapse in adults after birth of infant
- Changes or amplifies intervention focus
  - Decrease drug use-----improve parenting or.....
  - Improve parenting----decrease drug use
- Improve parenting – improve self-control, distress tolerance, decision making
- Nancy Suchman and Team: “Mothering from the Inside Out” for substance abusing mothers
  - Focus on changing response to parenting stress and more generally stress reactivity

# Two Complementary Approaches in Programs for Parents

## Parental Mindfulness/Mentalization



Psychological ability allowing us to make sense of the actions of others as well as our own actions by reference to desires, thoughts, memories, feelings

## Parental Social Networks/Building Community



Social relationships, or the relative lack thereof, constitute a major risk factor for health—rivaling the effect of well established health risk factors such as cigarette smoking, blood pressure, ..... obesity and physical activity

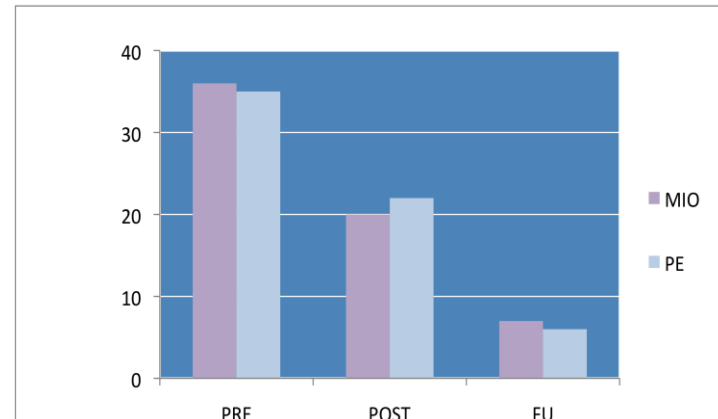
*House, Landis, & Umberson; Science 1988*

# Mothering from the Inside Out



## Mentalization or Attachment-based therapy for mothers with substance use

Mothers Substance Use



Nancy Suchman and colleagues

# Mental Health Outreach for Mothers (MOMS) Partnership



Megan Smith

Creating new social networks by uniting young, low-income, racially and ethnically diverse, pregnant and parenting women in New Haven with those individuals and institutions dedicated to the emotional and physical wellness of women



THE NEW HAVEN  
**MOMS PARTNERSHIP**





# MOMBA: Connecting New Mothers with Information, Resources and Each Other

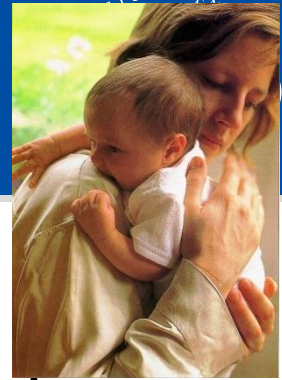


- Using virtual “space” and technology to increase maternal connectedness
- The platform is designed to:
  - Connect new mothers to each other
  - Connect new mothers to their infants
  - Connect new mothers to local resources
  - Connect new mothers to information about their health & the health of their children
  - Connect new mothers with health promoting activities



Megan Smith and Linda Mayes

# Intervention Approach

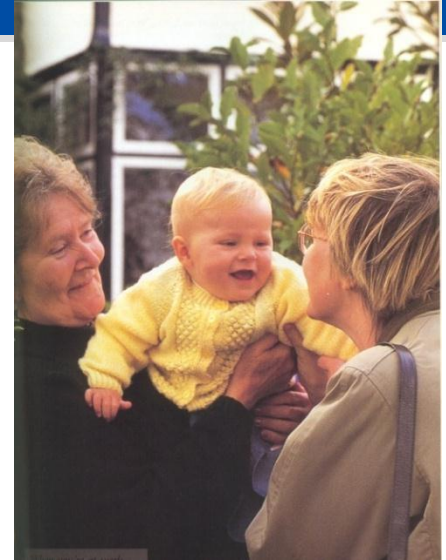


- Focus on adult as parent
- Focus changes from “what baby needs” to how demands of caring for infant are stressful and impact understanding infant’ s needs
- Focus on increasing adults’ distress tolerance/capacity to maintain decision making in face of stress/ remain mindful of own emotional states
- Focus on increasing social networks



# Parenting as an Adult Developmental Stage

- Transition to parenthood is a key adult developmental phase; and an adult's development as a parent is key to healthy child development
- Transition to parenthood involves key changes in mental economy, in perceptual sensitivity, and in neural reward and stress systems
- Addiction impacts both sensitivity to infant cues and ability to manage stress of parenting focus key to parenting and ability to mentalize about self and child
- Interventions with addicted mothers need to focus on parental mentalization/stress regulatory abilities as step toward development as parent (in addition to focus on drug use)
- Integration of services for adults as parents with services for children offers the opportunity to impact multiple generations and especially the parenting by those children when they are adults





# Collaborators and Support for Parenting Studies



- Mayes Lab: Michael Crowley, Kara Holcomb, Max Greger-Moser, Jia Wu, Sarah Nicholls, Marion Mayes, Rebecca Hommer, Emily Simpson, Laura Noll, Amanda Ng, Dorotea Amador, Ann Thomasson, Laura Logan, Chetna Chandrasekaran, Scott McCreary, Julia Blood, Kathy Armstrong, Patricia Miller, Eliza Sholtz, Caroline Gambell
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- U. Illinois: David Bridgett
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- Belgium: Patrick Luyten
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# THANK YOU

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