Making Room in One's Mind for a Child: How the Brain and Mind Change with Parenthood

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Yale Child Study Center
October 25, 2013

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How minds are shaped in relationships & how personal mindfulness shapes ability to care for others

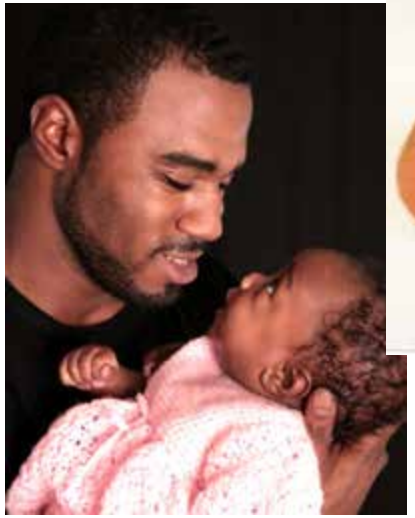
Psychoanalysis

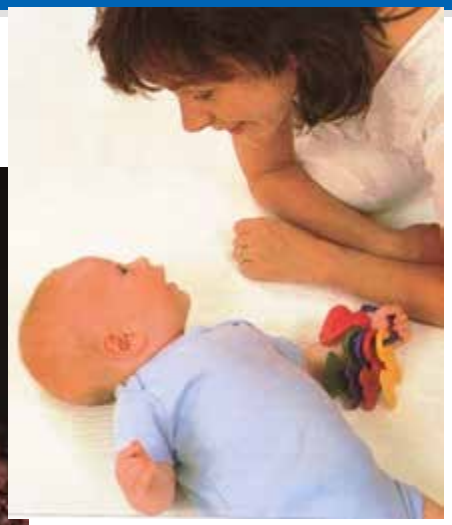
Developmental Psychopathology

Developmental Biology

Philosophy of Mind

Social Neuroscience





Parenting as an Adult Developmental Stage

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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

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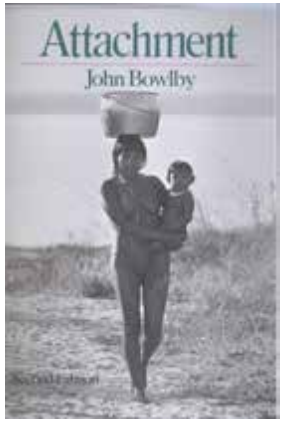
WHAT THESE TEXTS SUGGEST

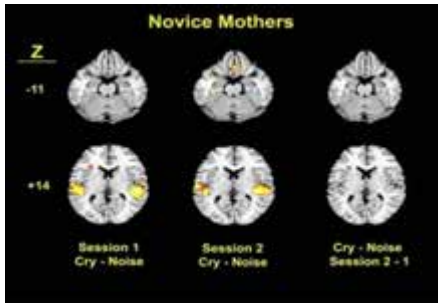
- Becoming a parent is a developmental process
- With transition to parenthood, there is a change in attentional focus, investment, what is rewarding, and what is stressful
- State of being "preoccupied" both reflects change in mental "economy" and also facilitates shift in attention and what is rewarding
  - i.e., "enhanced signal detection" or sensitivity to infant cues (Rutherford & Mayes, 2011)

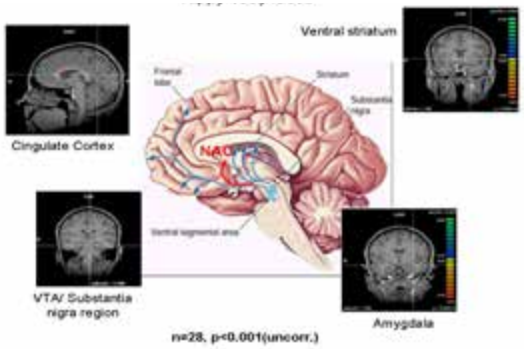
Basic Science of Parental Attachment

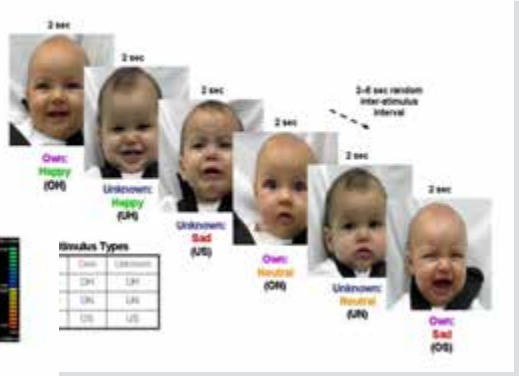


Decades of work on impact of parental care on child health and development, but…..

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







STRATHEARN, et al., 2007

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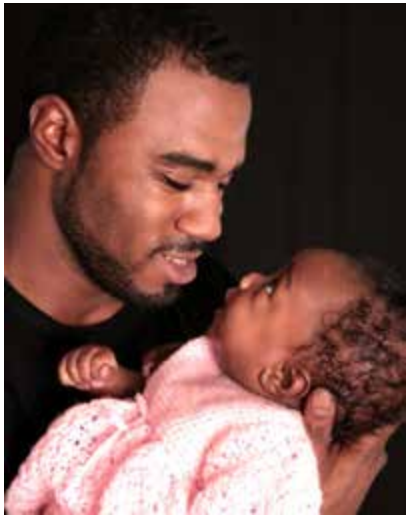
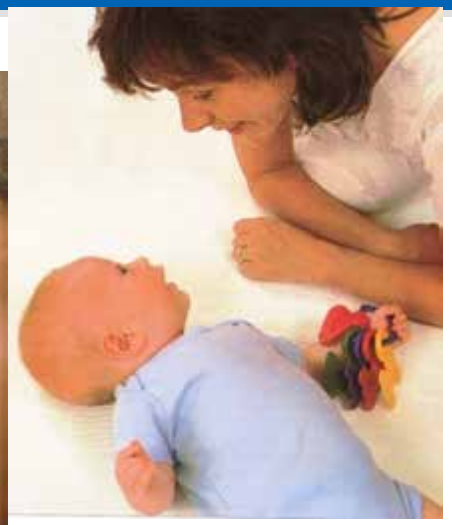
RETHINKING "PARENTING"






What's "beneath" or required for parental "sensitivity" and parental care?

Lines of Work: Parenting Research Program

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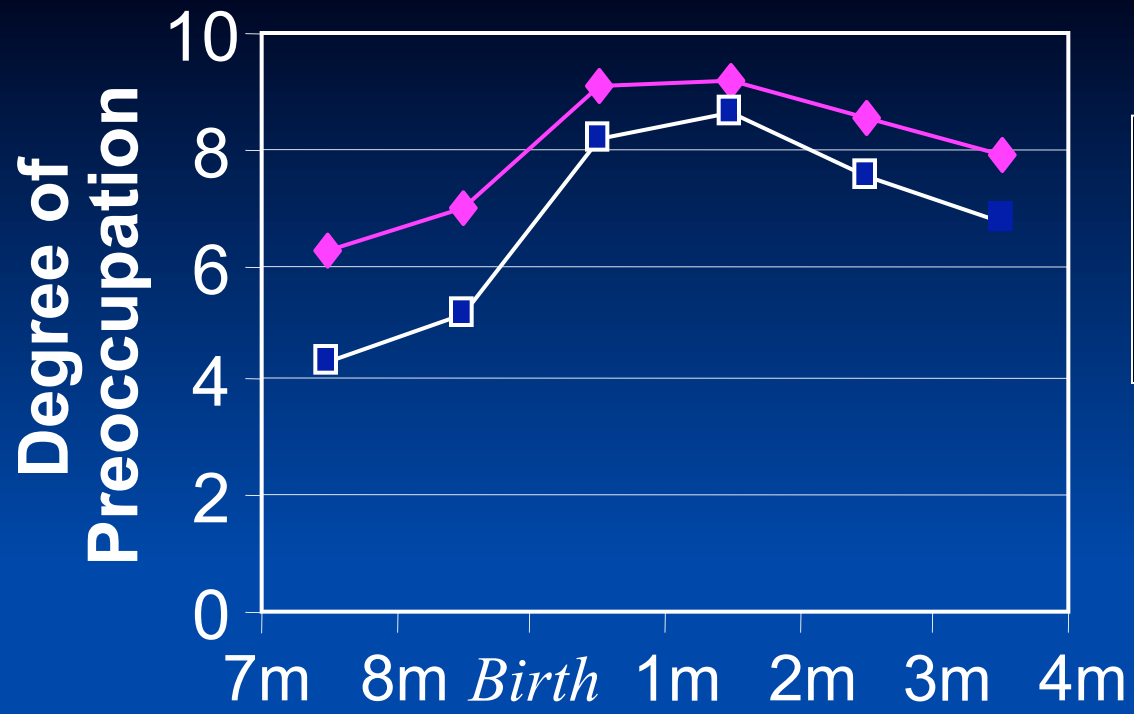
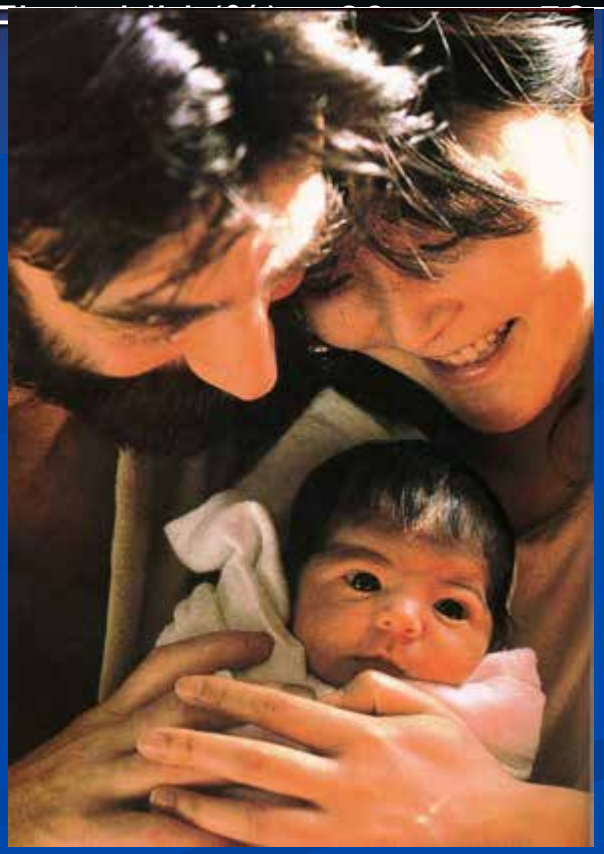
- Parental response to infant affect (MRI/EEG)
- Parental Emotional Regulation
- Parental Decision Making and Executive Fx
- Parental Distress Tolerance
- Impact on parenting of
  - Depression
  - Addiction
  - Early adversity/chronic stress
- Touch (with K. Pelphrey)
- Perception of caring motion (with P. Fearon)
- Parental Mindfulness (P. Luyten)
- Oxytocin impact on maternal sensitivy
- Parenting interventions
  - Mothering Inside Out (with Nancy Suchman)
  - Minding the Baby (with Lois Sadler, Arietta Slade)
  - Momba (with Megan Smith)
  - Discover Together

STUDYING PARENTAL PREOCCUPATION



	Mothers	Fathers
N	31	27
Age (yrs)	33± 5	35± 5



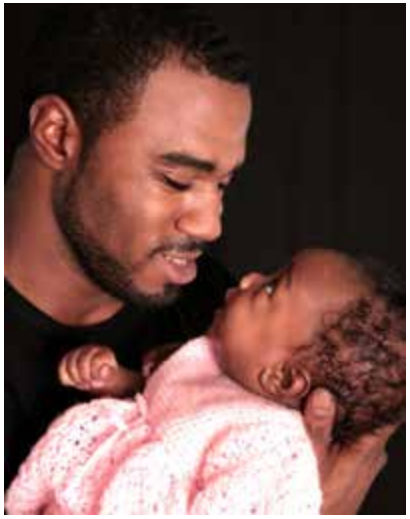
Leckman et al. , 1999

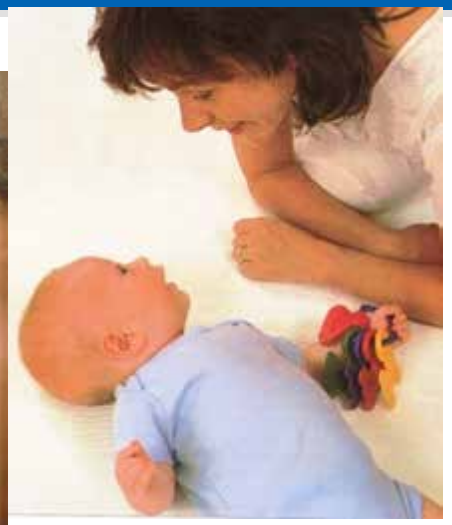
Preoccupation & Early Parenting Phase

- Between 2 wks and 3 mos: preoccupation and anxious thoughts decrease, positive thoughts and feeling of personal transformation increase
- Experience makes a difference (? Sensitization phenomenon in humans); experienced parents less preoccupied in beginning, behaviorally more like first time parents at three months
- Individual differences in the level of preoccupation
- Similar patterns between mothers and fathers
- Greater intensity of preoccupation = greater perception of “transforming experience”

Leckman, et al., 1999; Kim, et al., 2012, under review

RETHINKING "PARENTING"



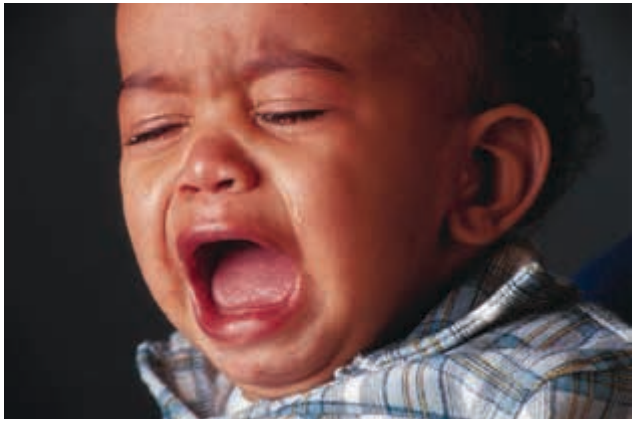



What's "beneath" or required for parental "sensitivity" and parental care?

Two critical pieces of parenting

Reward

Stress



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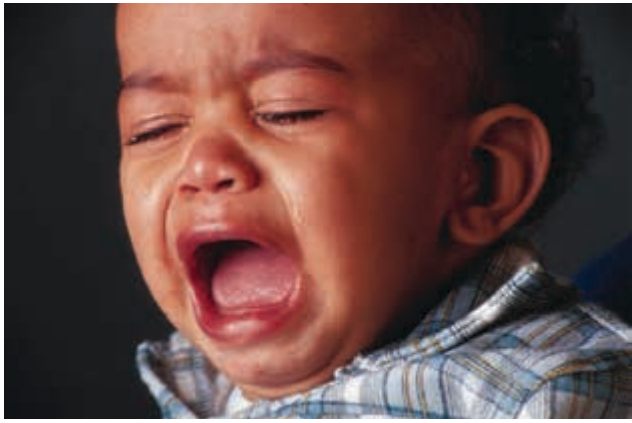
Two critical pieces of parenting

Reward

Stress



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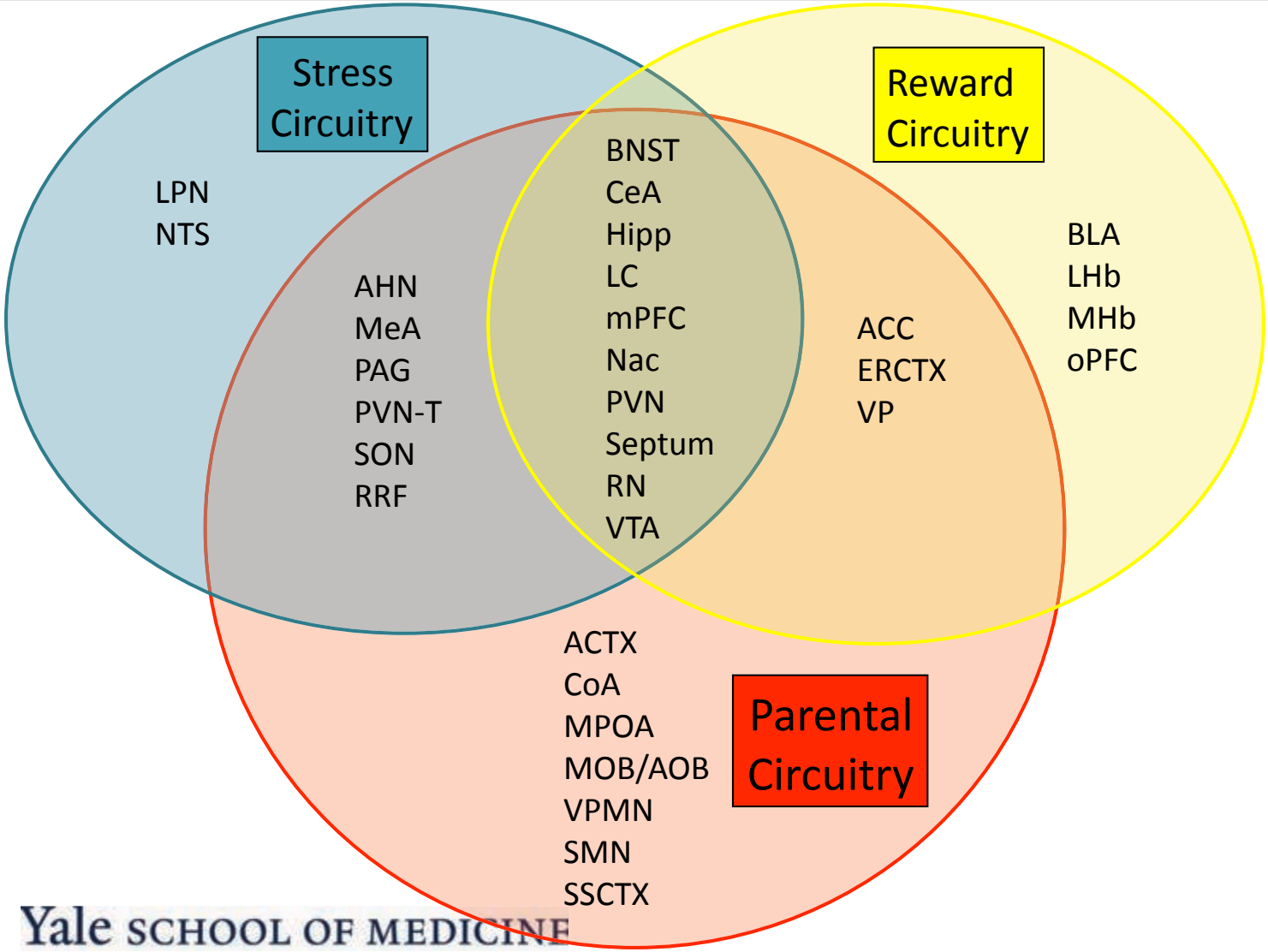
Overlapping circuits of reward, stress & parenting



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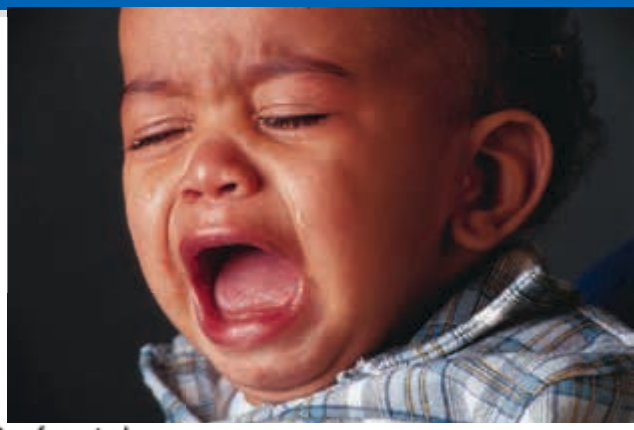
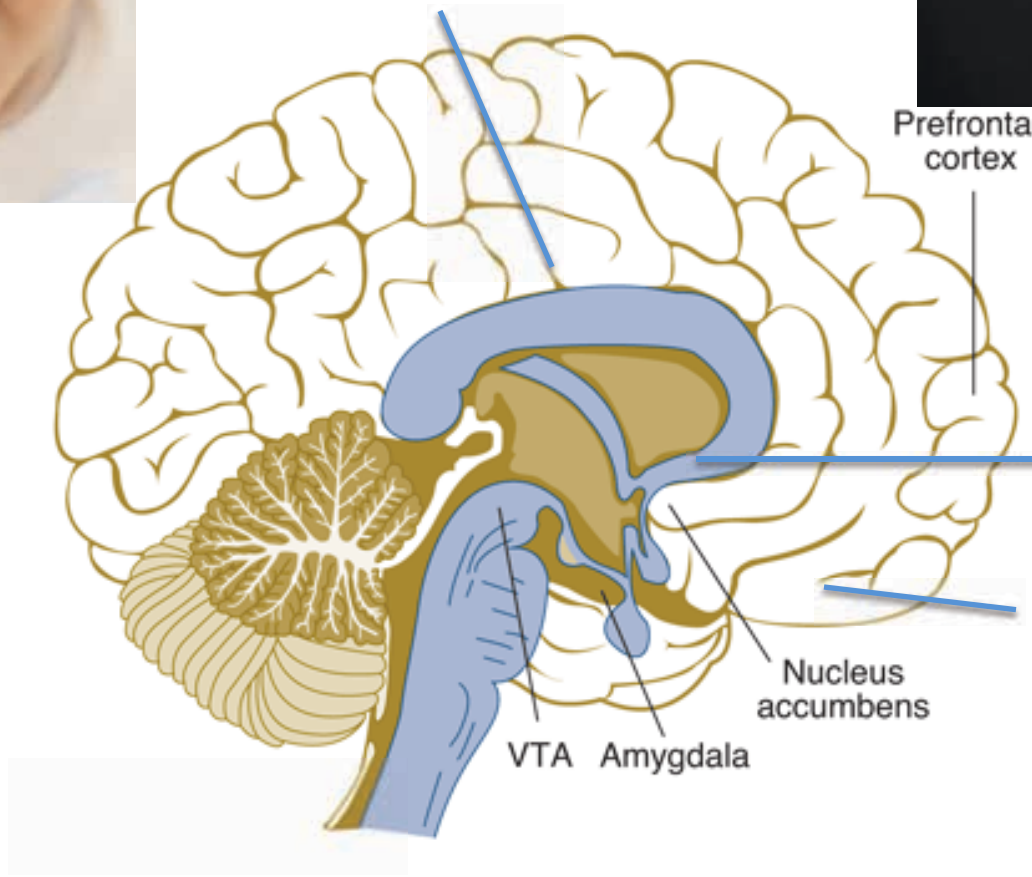
Rutherford, Williams, Moy, Mayes & Johns (2011)

Stress and reward brain regions in parenting

Reward



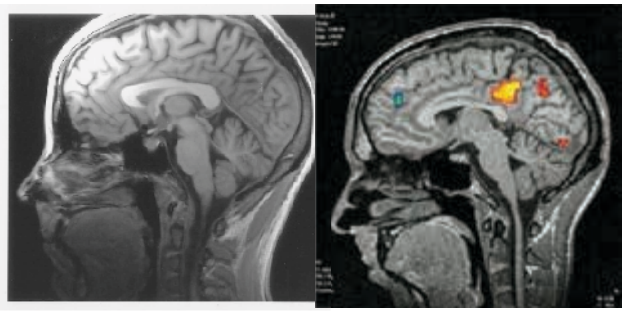
Stress



Measuring the adult brain and reward and stress: fMRI and EEG/ERP

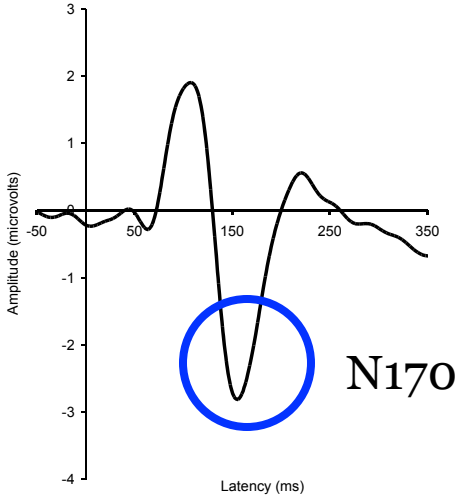
Measuring the adult brain: fMRI and EEG/ERP

Where?



Functional Magnetic Resonance Imaging (fMRI)

When?

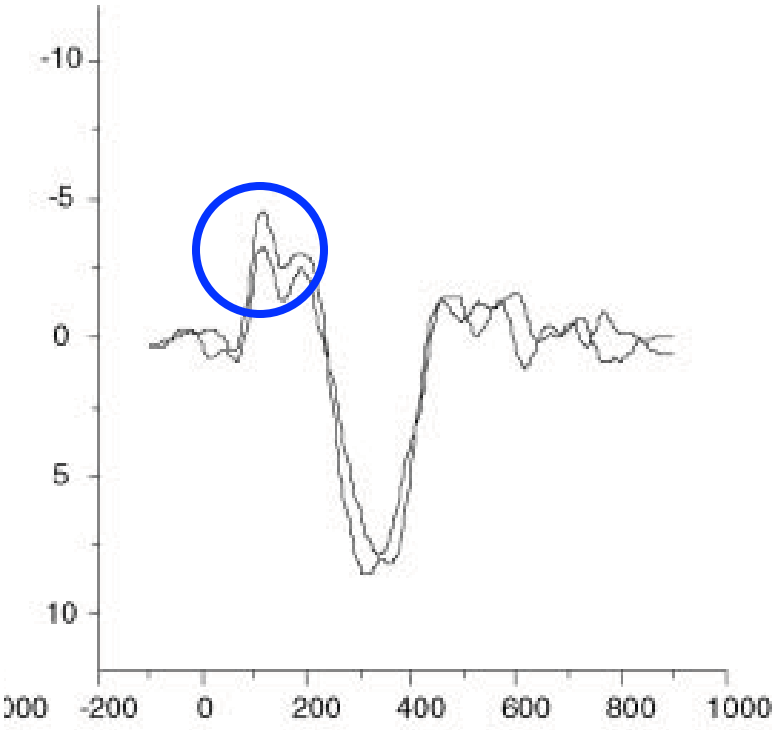


Electroencephalography (EEG) / Event-Related Potentials (ERPs)

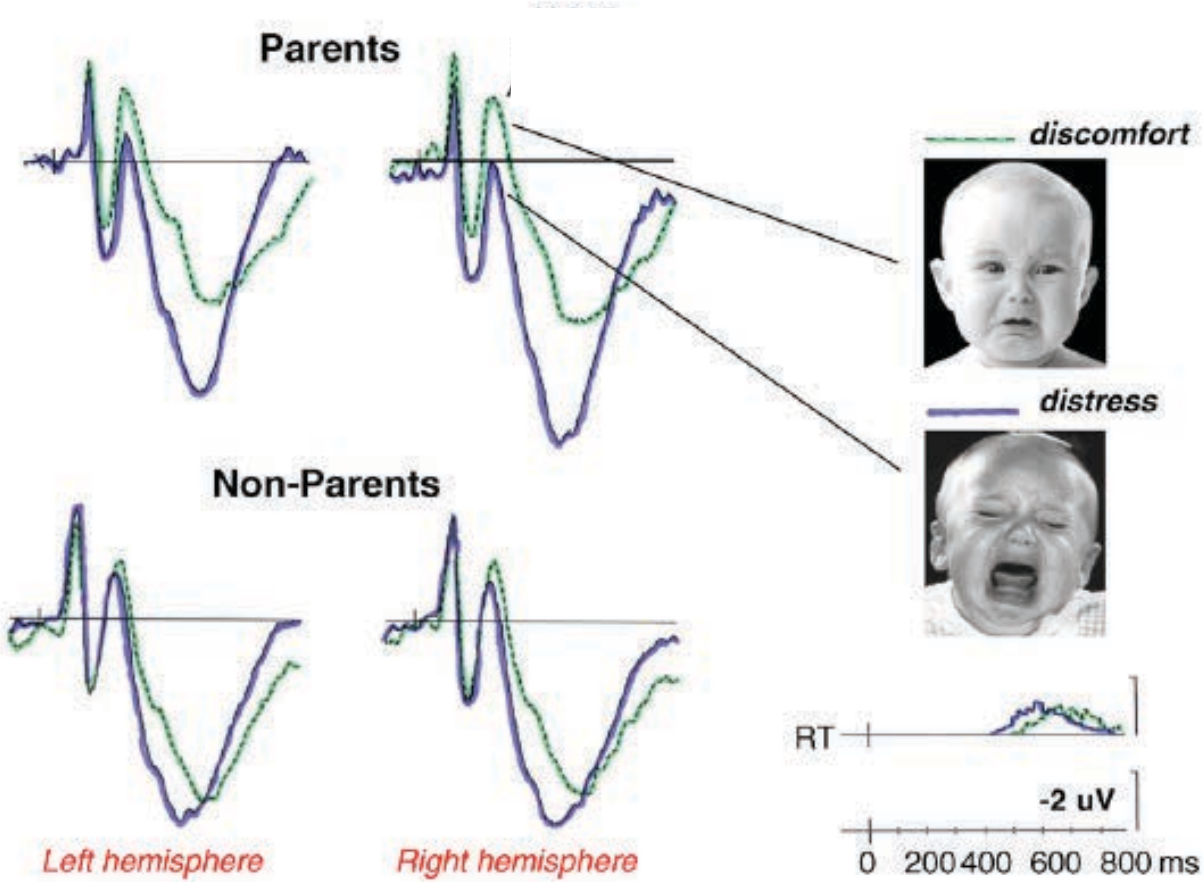
How do parents perceive infant expressions of emotion relative to non-parents?

Parents and Non-Parents: Cry Perception

- ERPs heightened in mothers for infant cries compared to non-mothers (Purhonen et al., 2001; 2008)

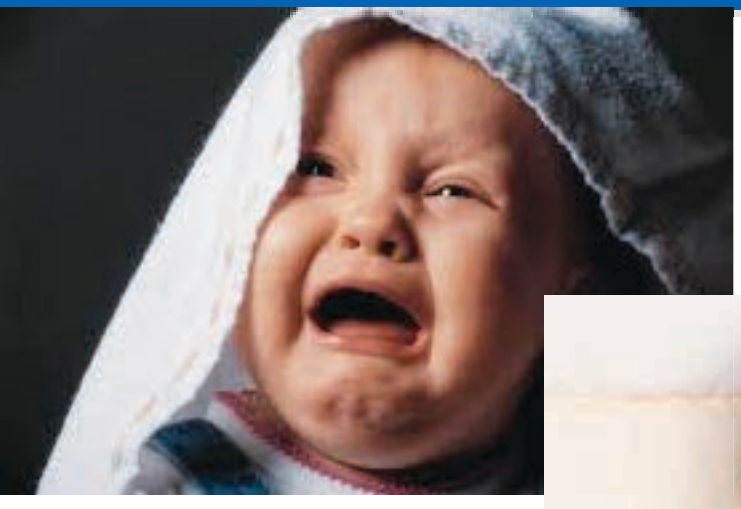


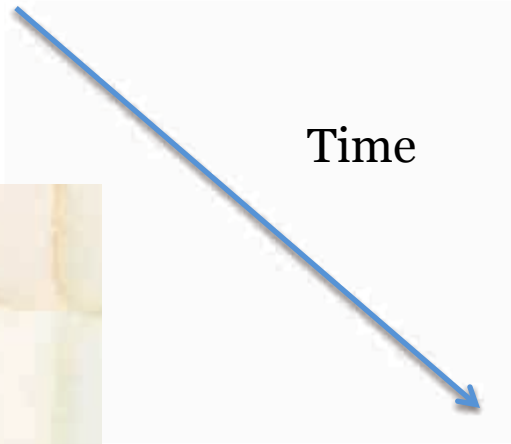
Parents and Non-Parents: Face Perception



ERPs are sensitive to parental status when viewing infant faces and to differences in facial affect (Proverbio et al., 2006)

Parents and Non-Parents: Emotion Regulation

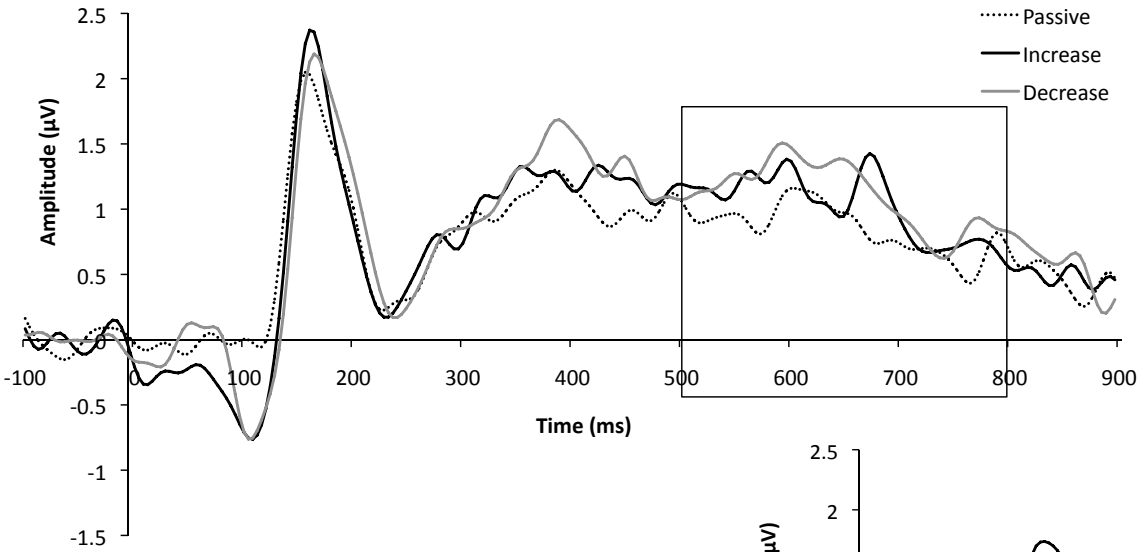




Instructions:
Passively watch
Up regulate
Down regulate

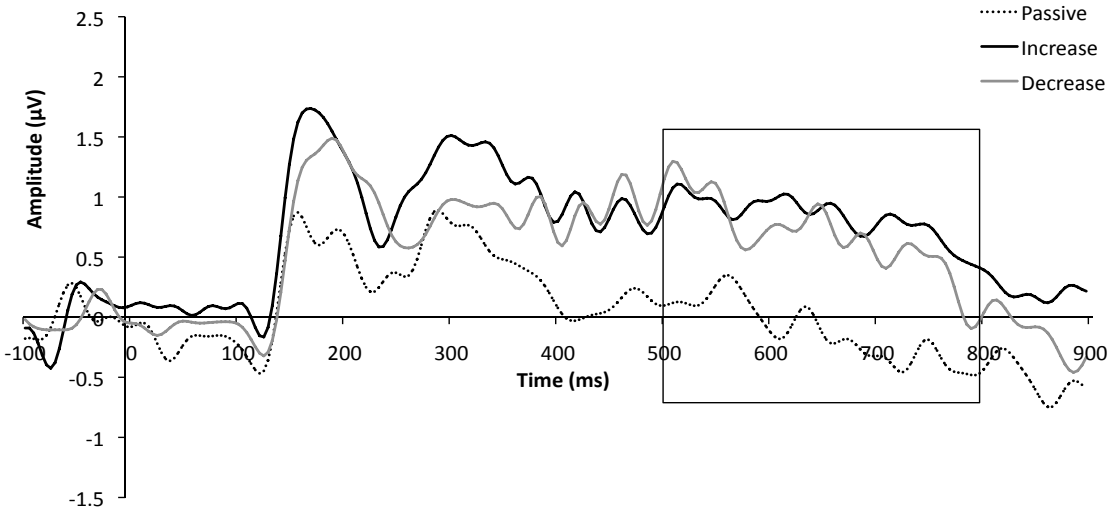
Evidence of Differences between Parents and Non-Parents

- LPP marker of emotion regulation differentiates mothers from non-mothers (Rutherford et al, under review)



Mothers

Non-mothers



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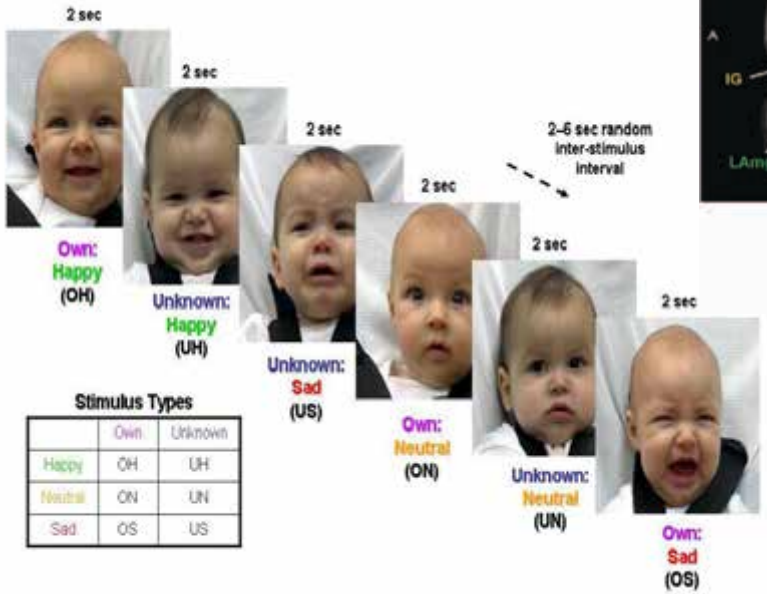
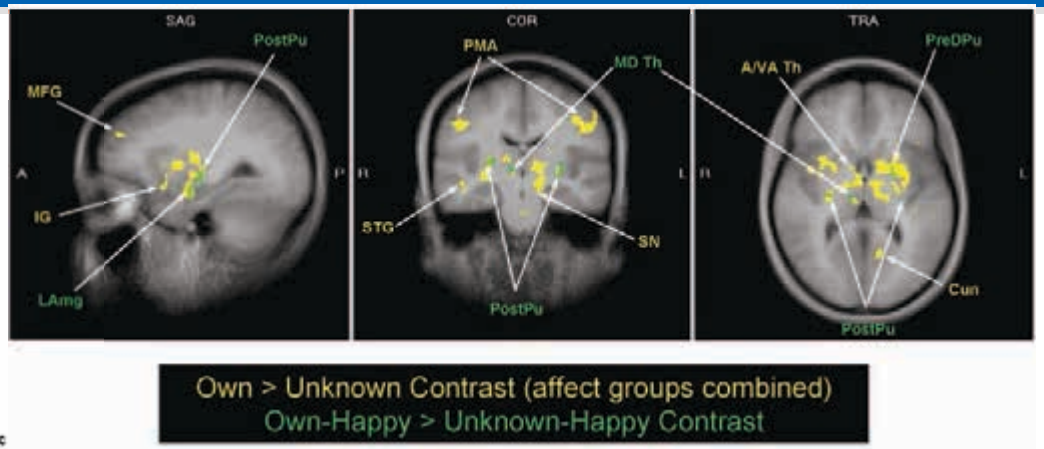
What do we know about mothers and their brain responses to infant signals?

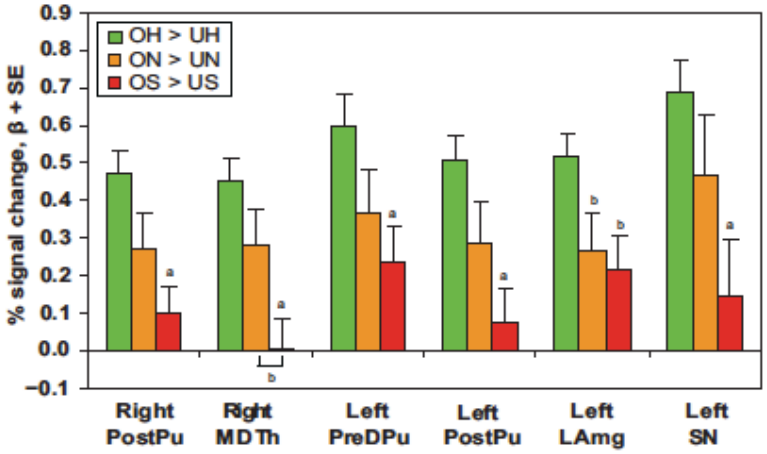
OWN BABY VISUAL CUES ACTIVATE NEURAL REWARD CIRCUITS





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

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

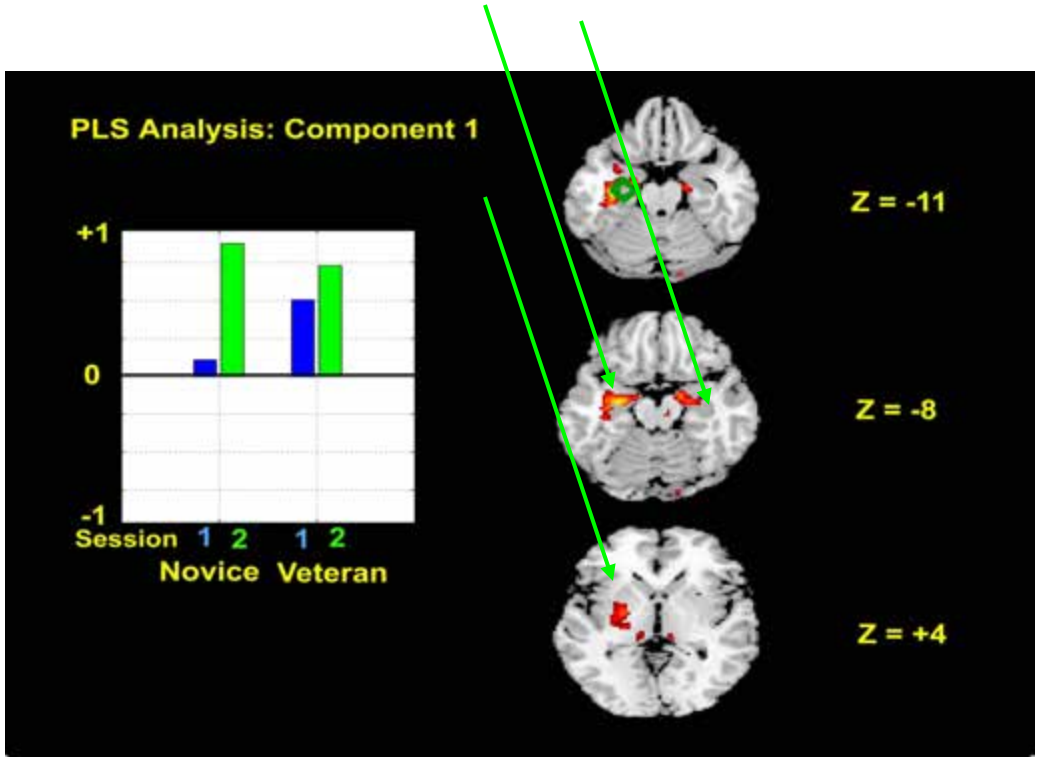


STRATHEARN, et al., 2008

MATERNAL CIRCUITS ENHANCED WITH EXPERIENCE

- ❑ Functional relation between R hippocampus (memory) and regions related to reward and stress regulation

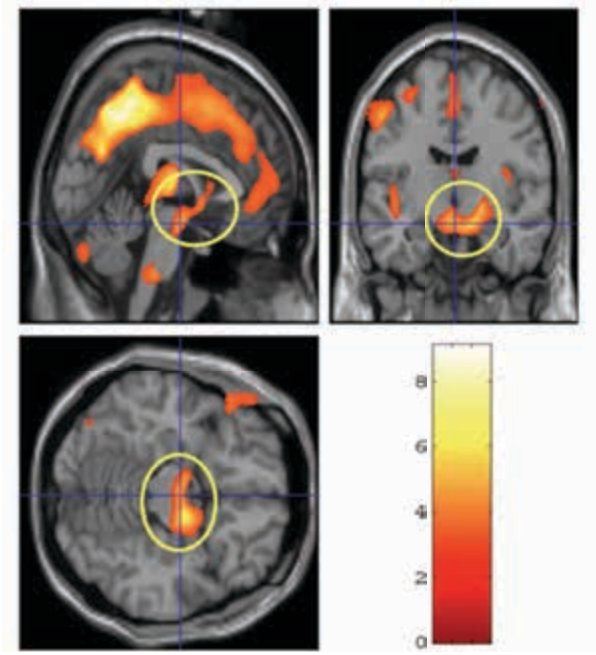
- ❑ Increasing connectivity for novice mothers between 2 wks -3 mos
- ❑ More modest increase for veteran mothers
- ❑ Experience based learning



Analyses conducted by Leslie Jacobsen; Data from Swain, Leckman, Mayes, 2008

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



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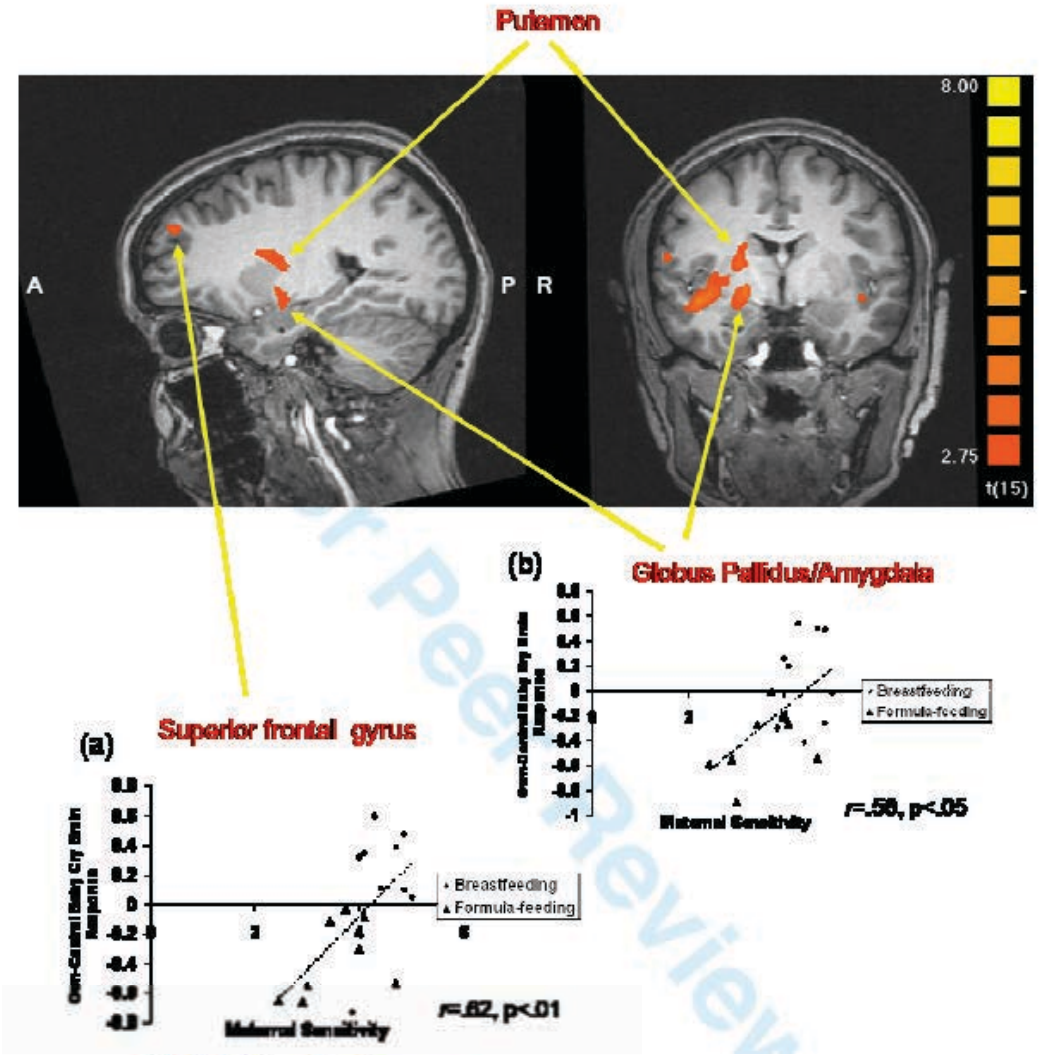
Predicting Maternal Sensitivity at 3-4 months with neural response to infant cries (Kim, Feldman, Leckman, Mayes, and Swain, 2011, JCPP.



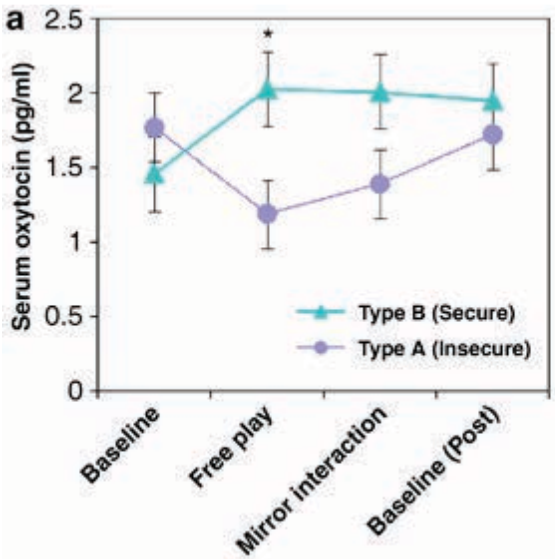
- Measured neural response to own vs other infant cry at 2-4 weeks postpartum
- Maternal sensitivity at 3-4 months postpartum positively correlated with activations in right superior frontal gyrus (r=.62, *p<.01),* and right lateral globus pallidus/ amygdala (r=.53, p<.05)

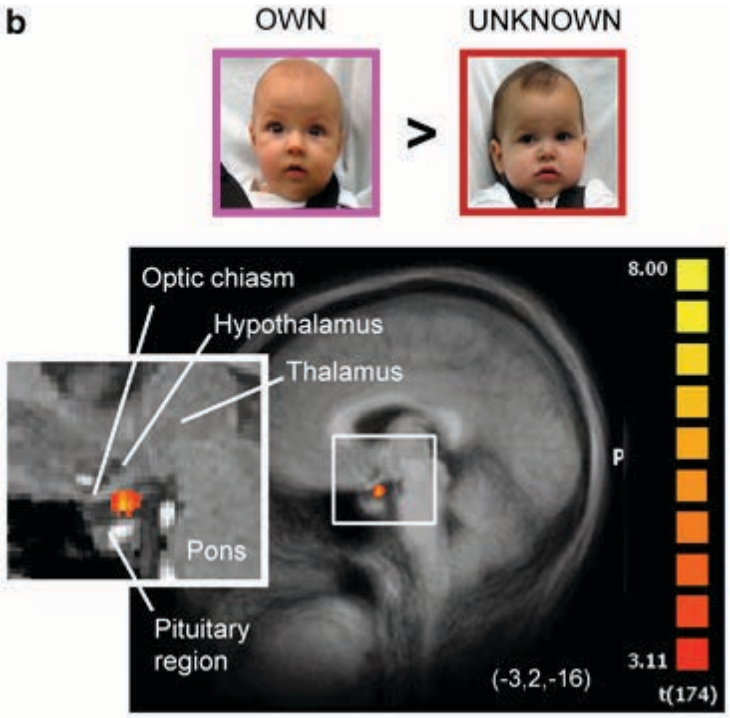
Key Points

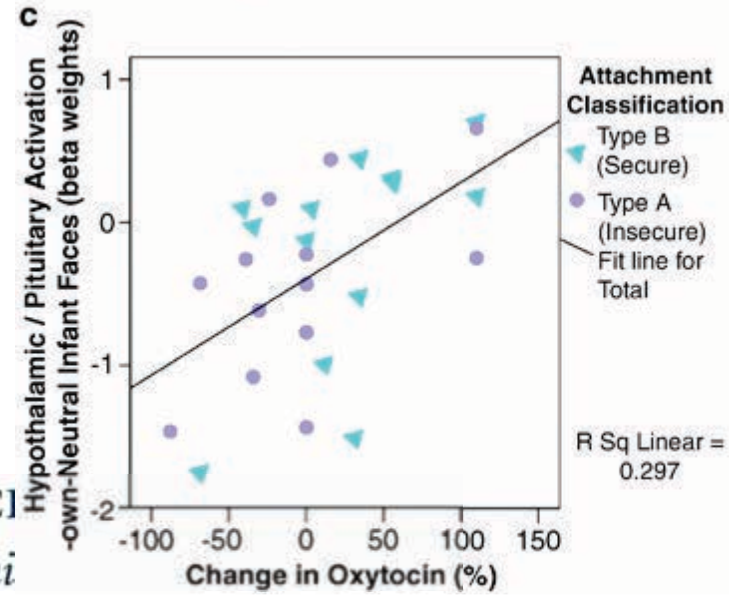
- Consistent differences with parents vs non – parents in patterns of neural activation
- Activate components of reward circuitry
- Own infant especially salient & motivating
- Negative cues such as cries activate both reward as well as stress systems
- May be consolidation/changes in connectivity in circuitry over time with exposure to infant

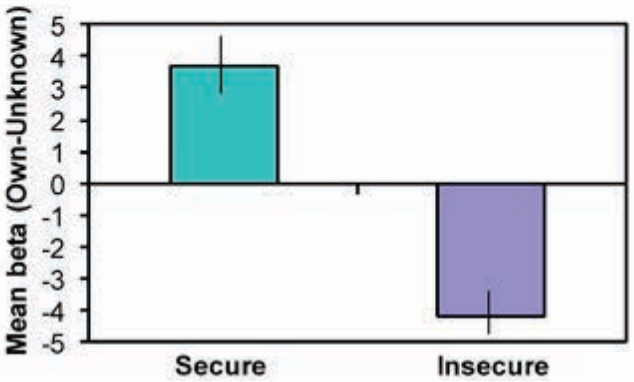
SOURCES OF INDIVIDUAL DIFFERENCES IN MATERNAL RESPONSE TO INFANT CUES

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

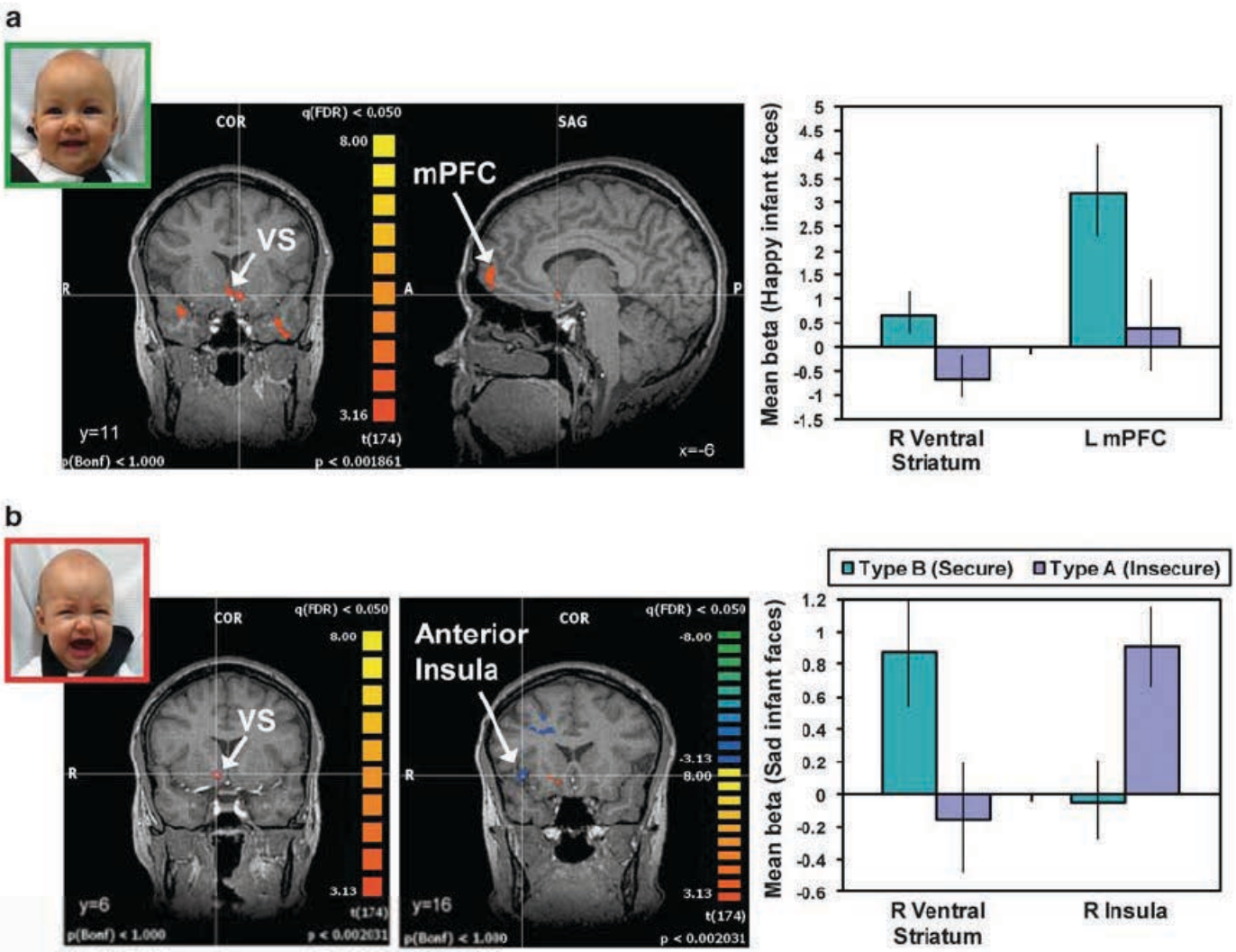




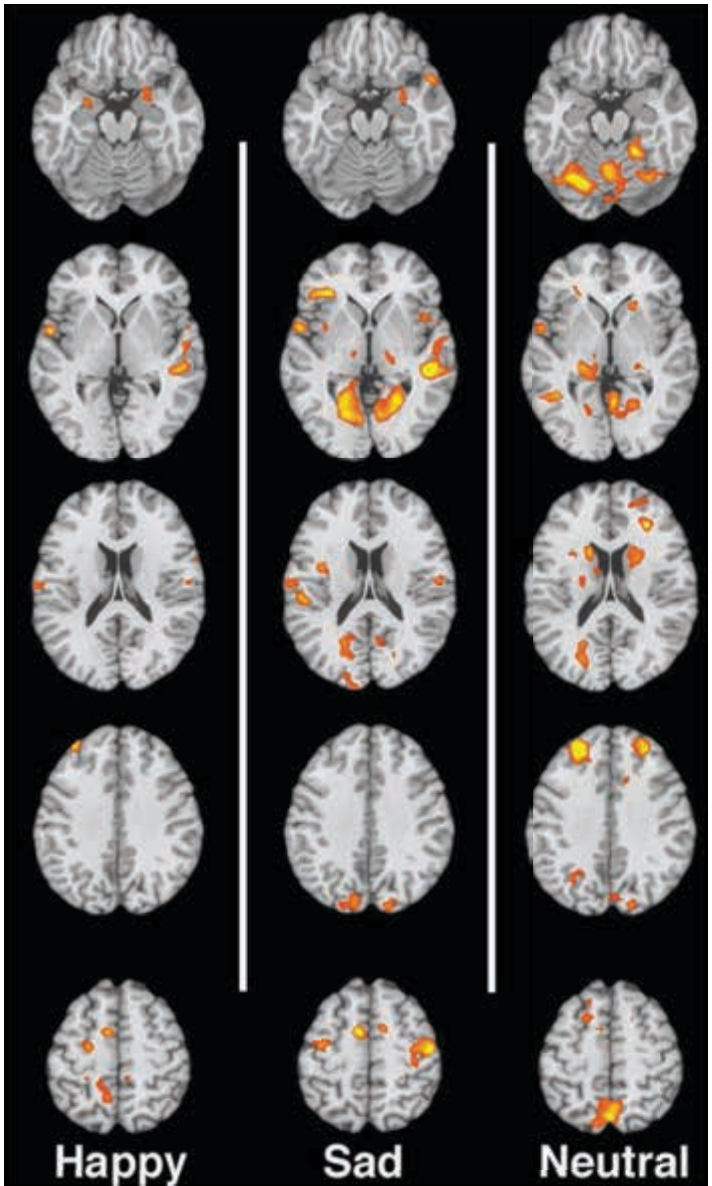




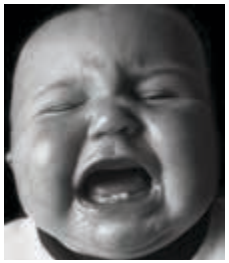
Differential Response to Infant Affect by Attachment Profile (Strathearn, et al, 2010)



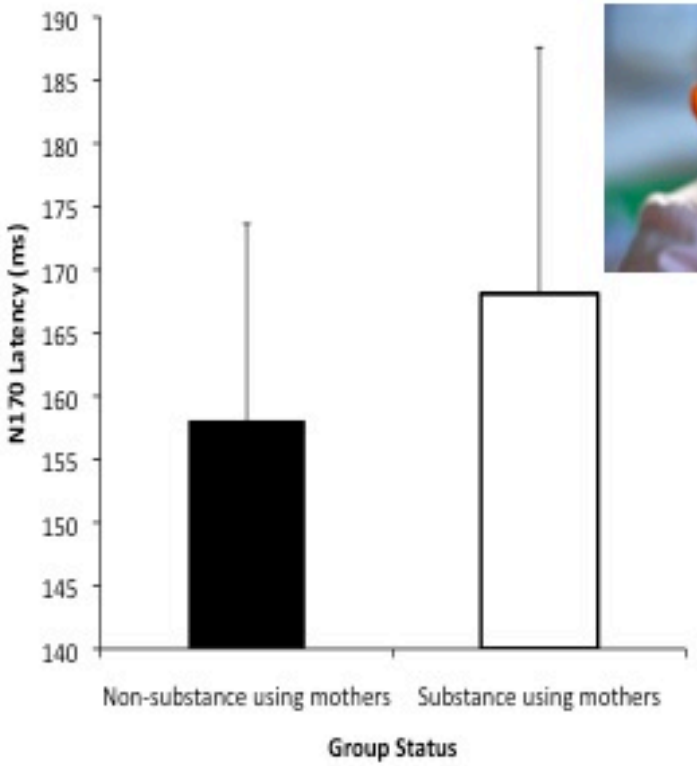
Differences within parents: Substance use & fMRI

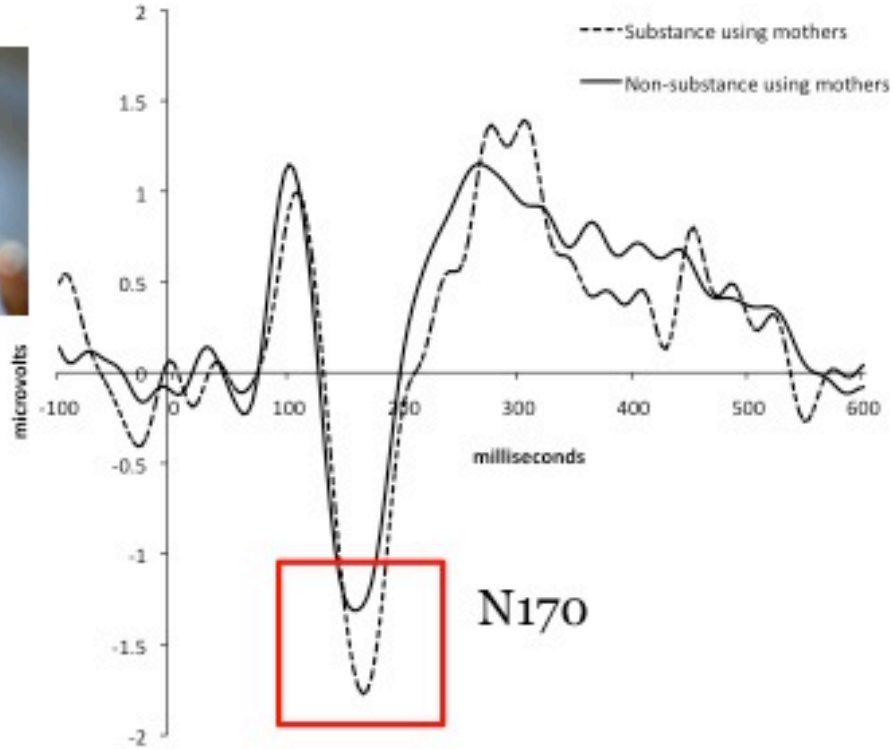


Substance users showed reduced activation in prefrontal regions, including the dorsolateral and ventromedial prefrontal cortices and limbic regions (Landi et al., 2011)



Differences within parents: Substance use & ERP





Substance users have slower response to infant faces (Rutherford et al, in prep)

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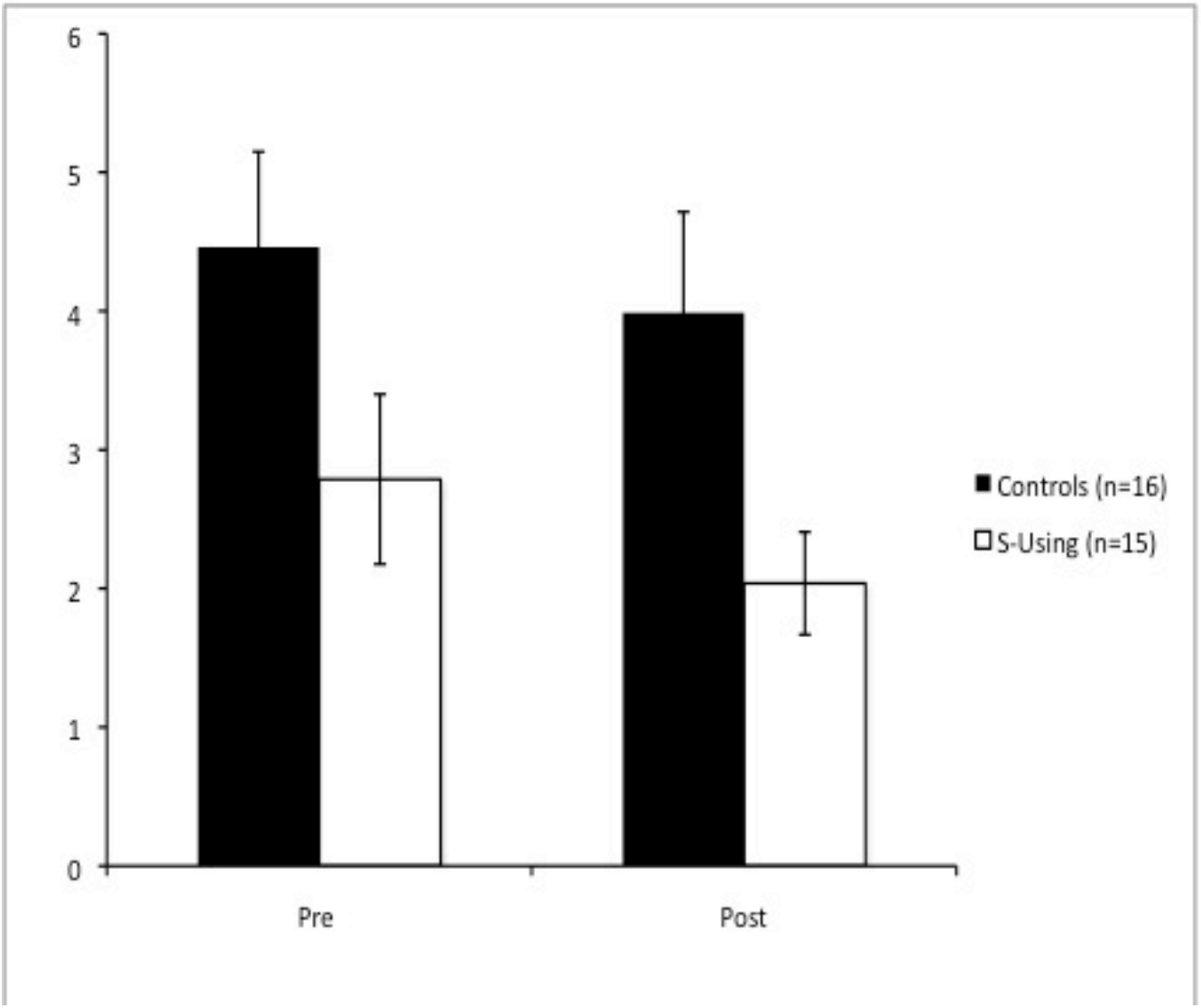
Oxytocin and substance use

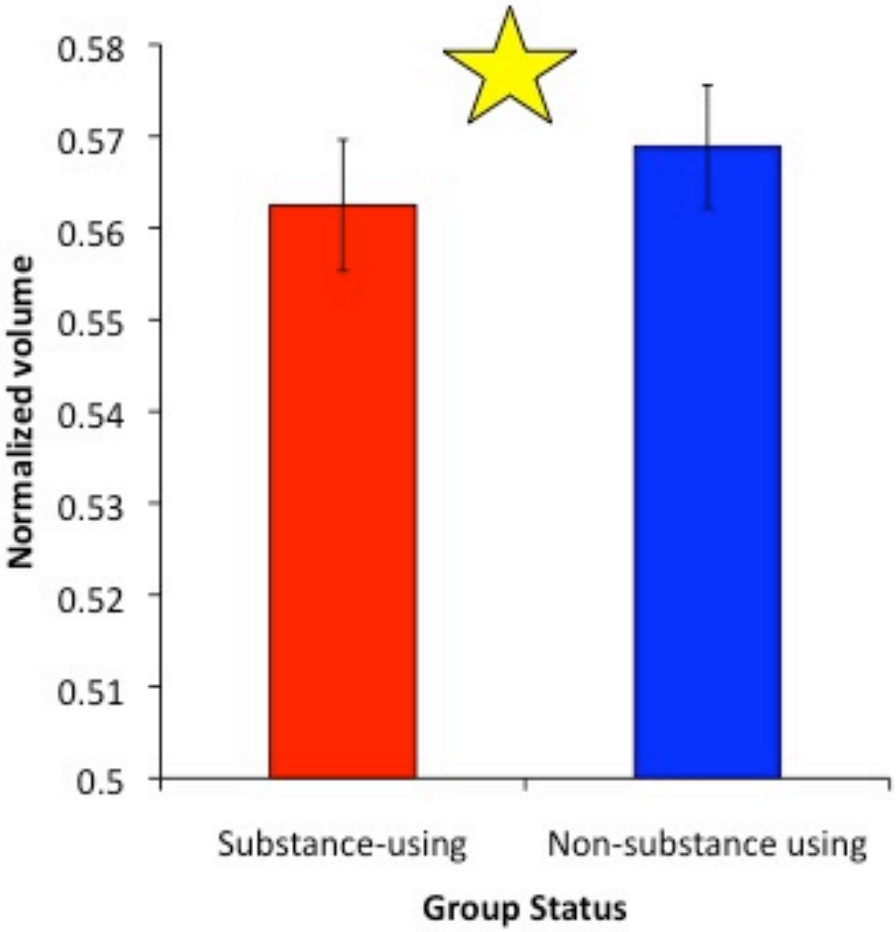


Salivary levels of oxytocin lower in substance using mothers relative to non-substance using mothers, p = .009

MRI Structural Data (Rutherford, Potenza, Mayes et al., submitted)

- Total gray matter reduced in substance using mothers, $t(62)=3.71$, $p < .001$

- No differences in total white matter volume, $t<1$



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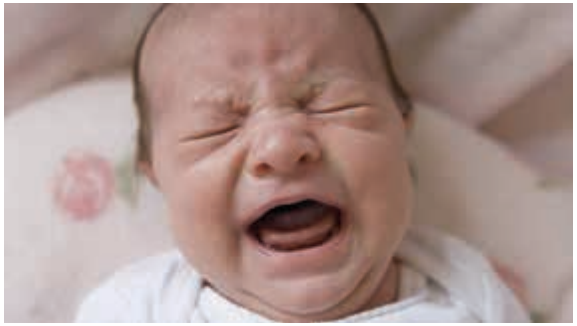
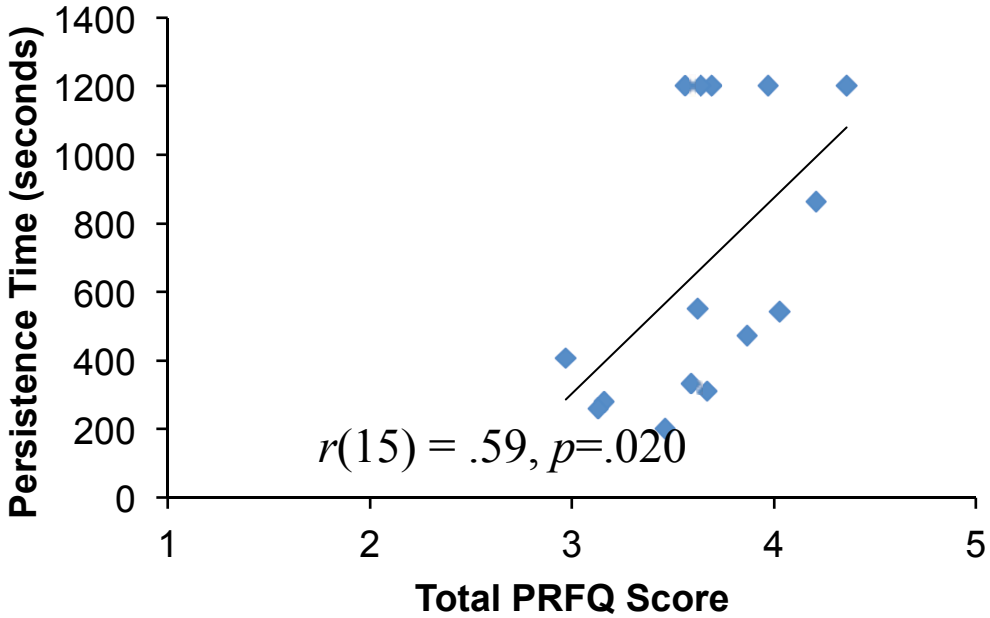
Parenting brain to parenting behavior

- **What is the relationship between changes in the parental brain and observed parenting behavior?**
  - *Tolerance of infant distress*



Katherine

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

Rutherford, et. al., 2012, under review

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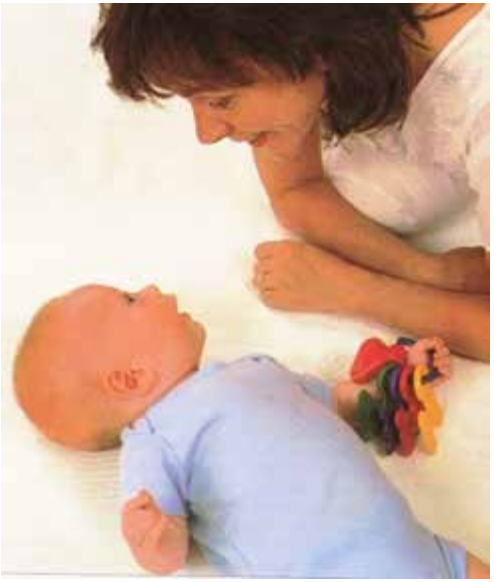
Key Points

- Consistent differences with parents vs non – parents in patterns of neural activation (e.g., reward salience and stress sensitivity)
- Number of sources of individual differences in changes in parental sensitivity at neural & behavioral level
- Addiction reduces parental sensitivity to infant cues (and enhances parental stress)
- Parental capacity to respond to infant's stress (e.g., crying) also related to own ability for reflectiveness (and emotion regulation)

TRANSLATION OPPORTUNITY

How Basic Science of Detecting and Responding to Infant Emotion Refines Prevention and Intervention Programs for Parents



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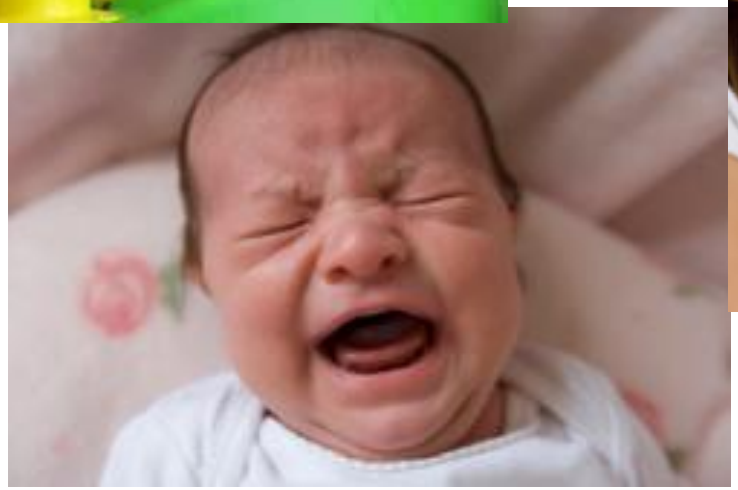
A Common Parenting Story



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Attachment Models

DISTRESS/FEAR

Down Regulation of Emotions

Activation of attachment

Proximity seeking

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

Opening up the "Blue Box"

DISTRESS/FEAR

Down Regulation of Emotions

Activation of attachment

Caregiver "regulates" own distress

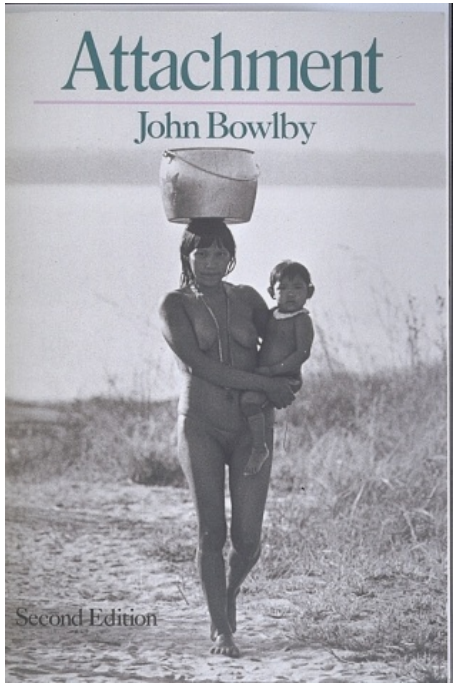
Caregiver recognizes child's distress

Proximity seeking

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

The adult transition to parenthood

- Becoming a parent brings a change in mental "economy" with a shift in attention ("enhanced signal detection" or sensitivity to infant cues—greater reward) and increased emotional responsiveness



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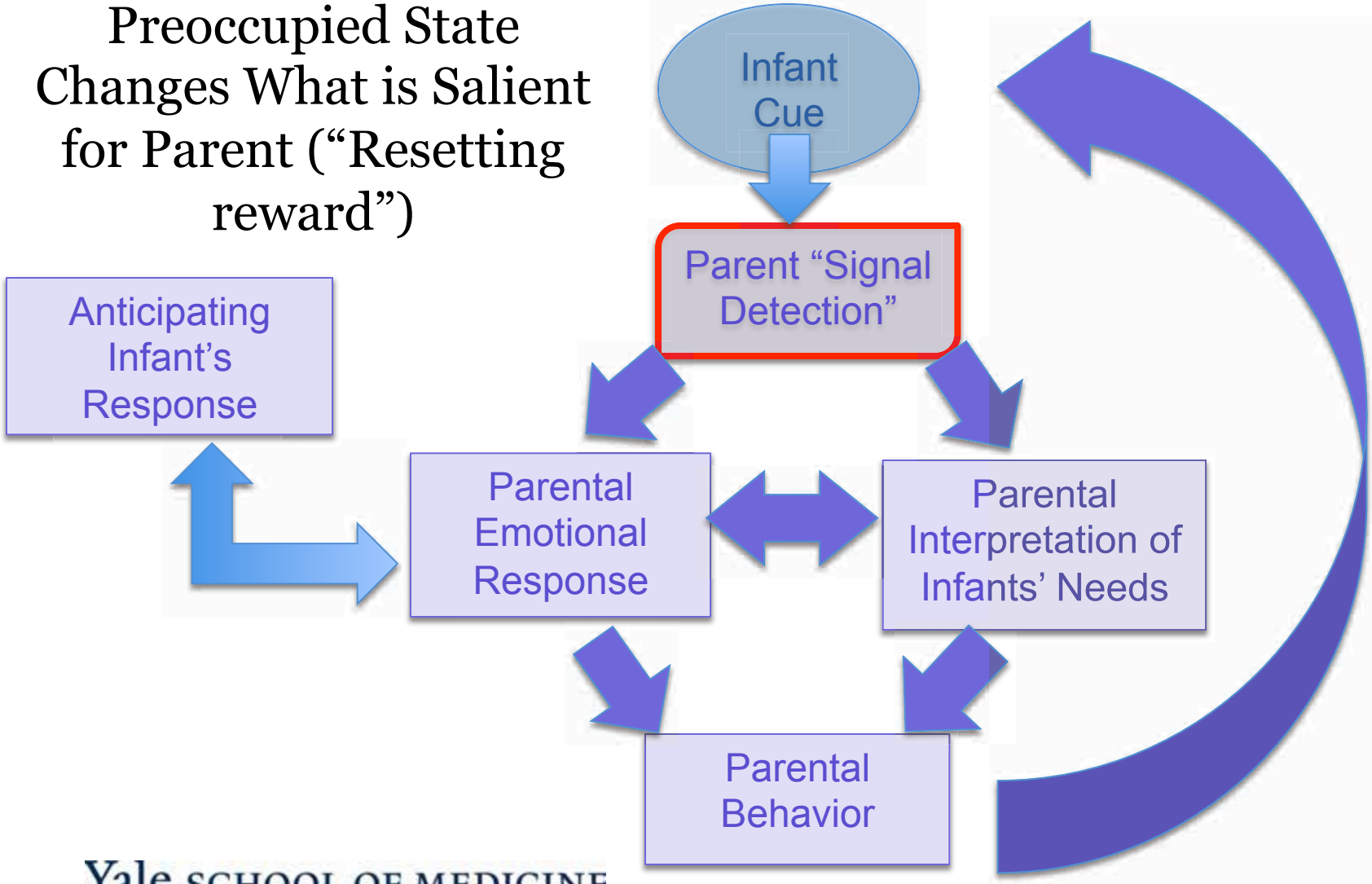
Parenting Side of Attachment Response

Preoccupied State Changes What is Salient for Parent ("Resetting reward")



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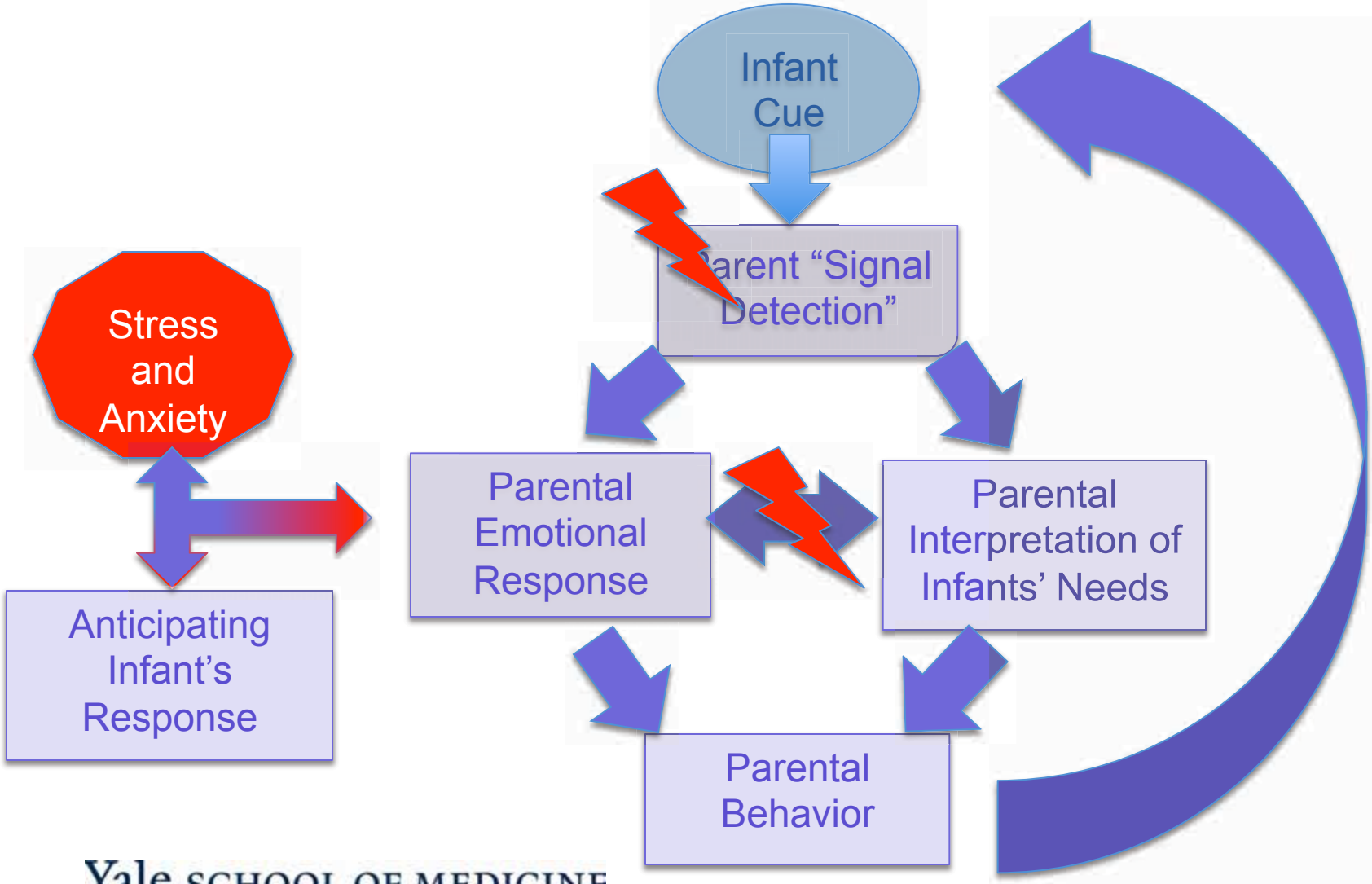
THREATS TO CHANGING PARENTAL MENTAL ECONOMY

- Early Adversity in Parent's Own Childhood Impacting Stress & Reward Response Systems
- Current Depression, Addiction, Anxiety
- Chronic Stress related to Poverty, Domestic Violence

How Early Adversity/Chronic Stress Disrupts Parental Responding



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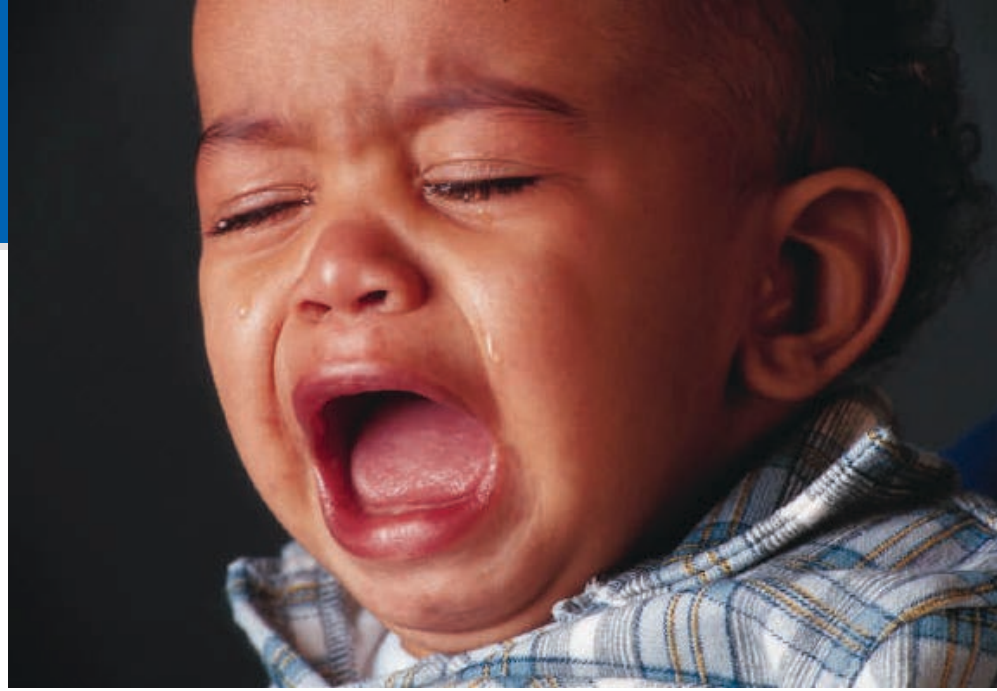
Addiction and the addictive process

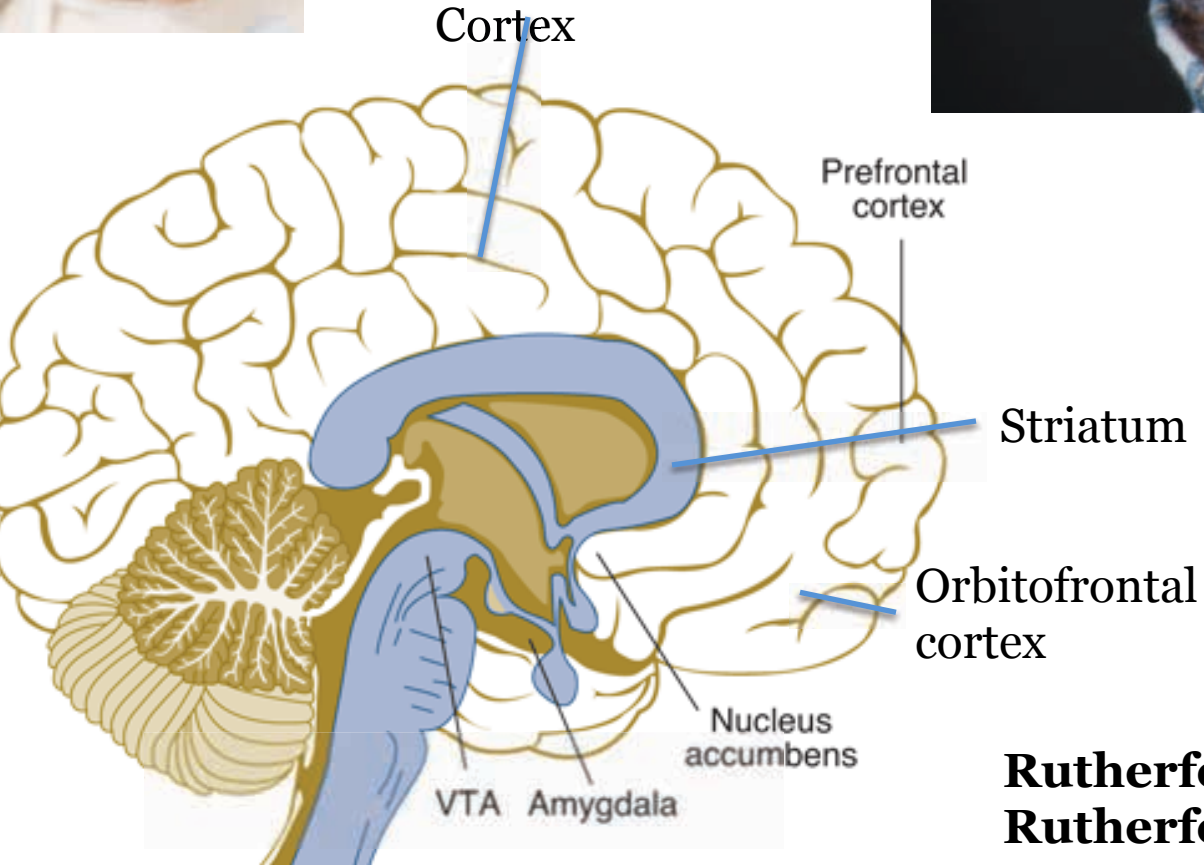
- Addiction represents the dysregulation between reward and stress neural circuitries
- Transition from positive reinforcement to negative reinforcement:
  - Initial reward of substance use
  - Continued drug use to relieve the negative affective state of abstinence, leads to habitual use
- Reward system is “co-opted” to maintain habitual behavior associated with relief of negative affect and stress; co-opting may mean some rewards such as social relationships not as salient

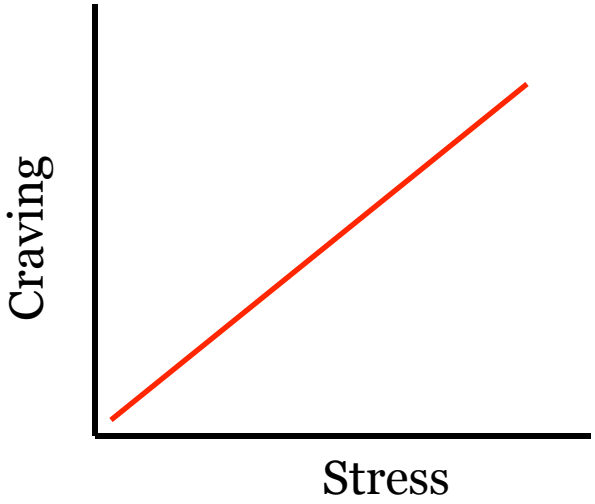
(Koob & LeMoal, 2001; Koob & Volkow, 2009)

Addiction, stress, and reward

Hypothesis: With an addicted parent, caring for an infant is more stressful and less rewarding

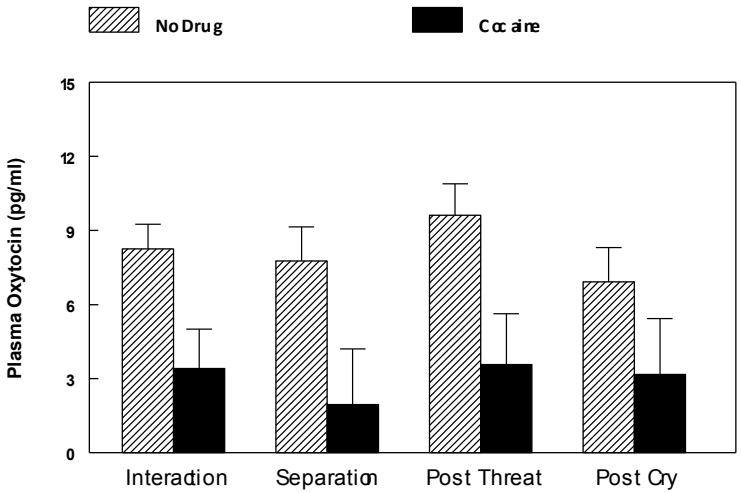




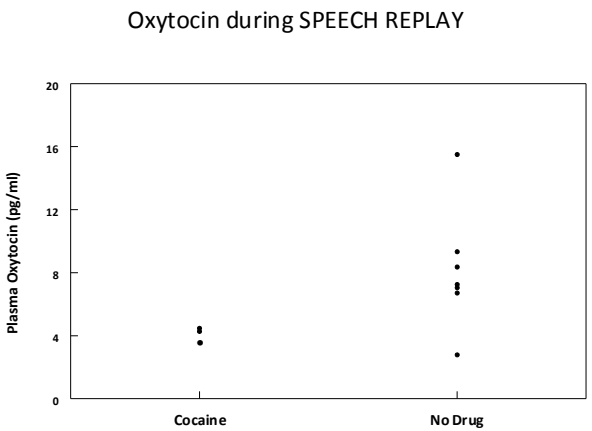


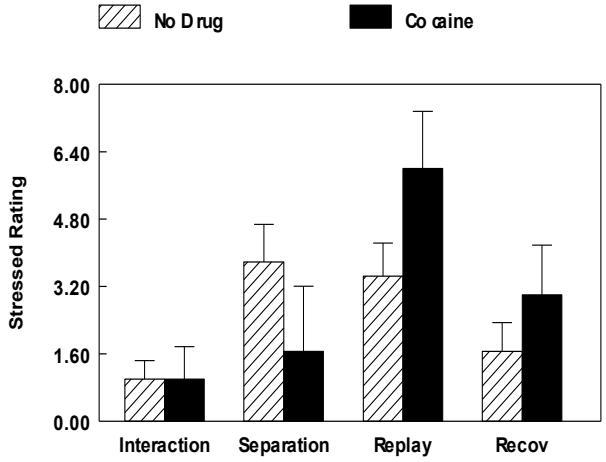
Rutherford et al. (2011)
Rutherford, Potenza, & Mayes (in pre

Cocaine-Using Mothers Show Diminished Oxytocin Response and Greater Perceived Stress in Response to Infant Cries



Adjusted for Feeding Group, Between Subjects Effect of Cocaine: F=6.98, p=.0298





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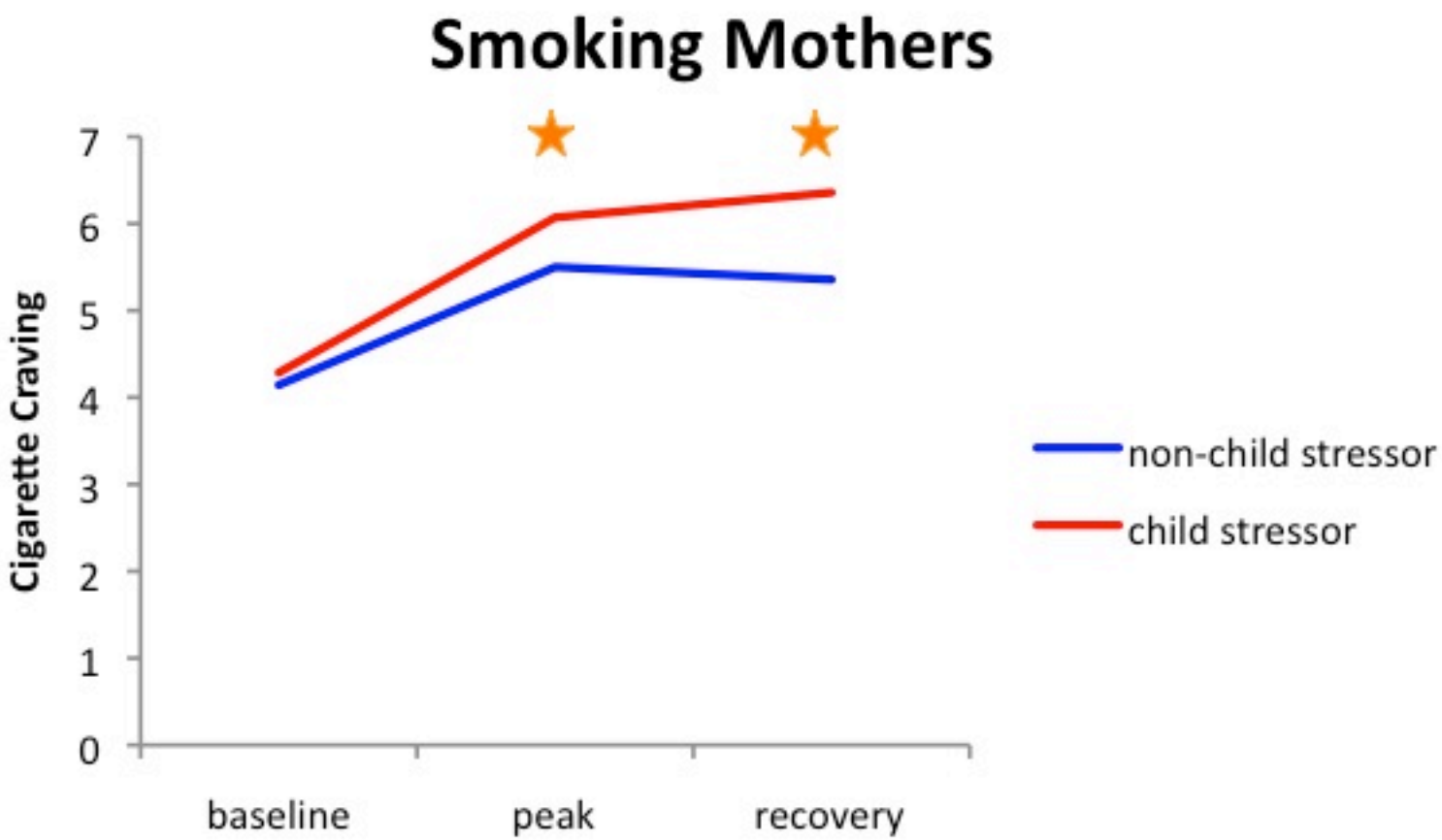
Light et al. (2007)

Craving for Cigarettes



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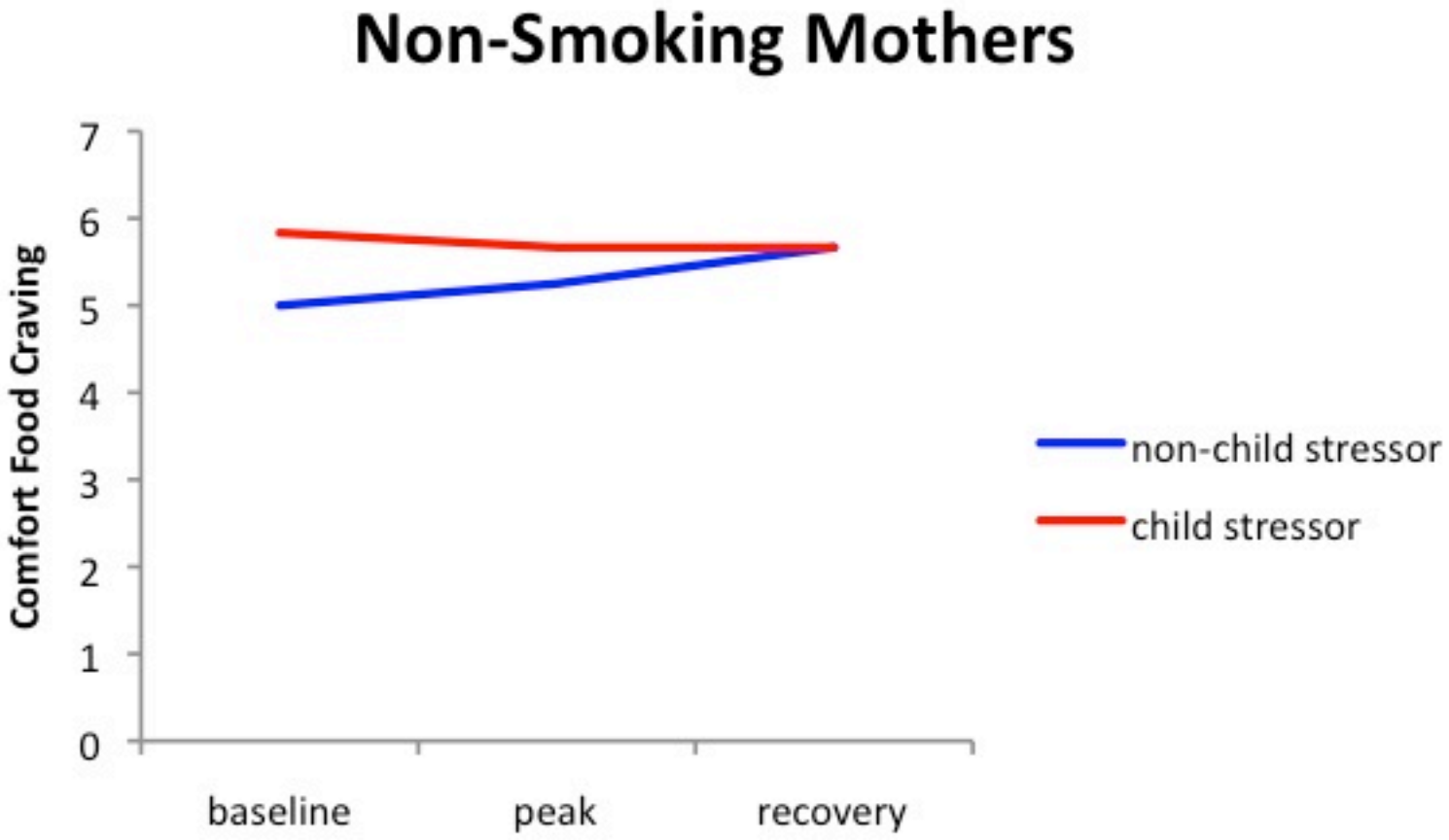
Craving for Comfort Food



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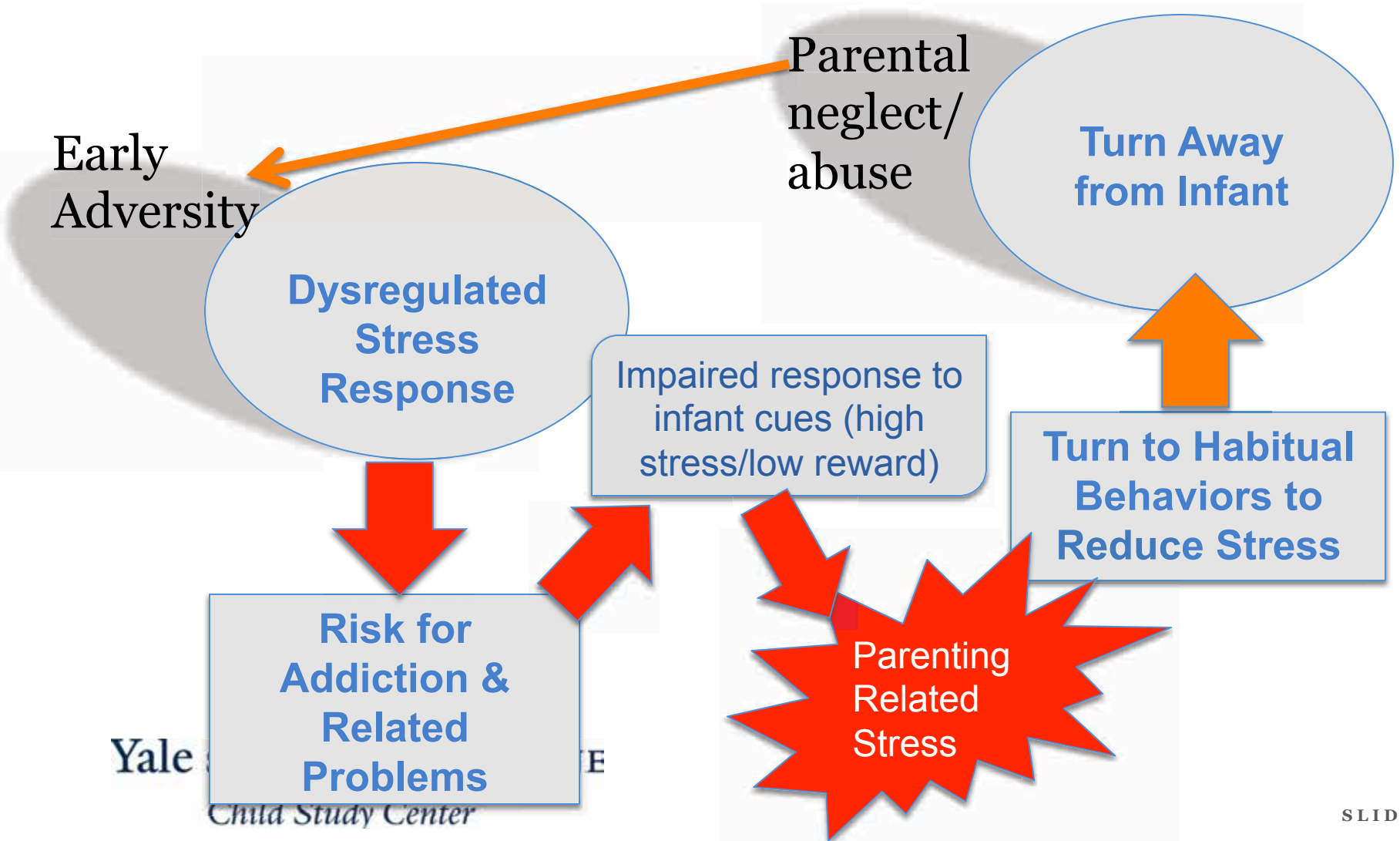
How Early Adversity Impacts Parenting and for the Intergenerational Transmission of Early Adversity



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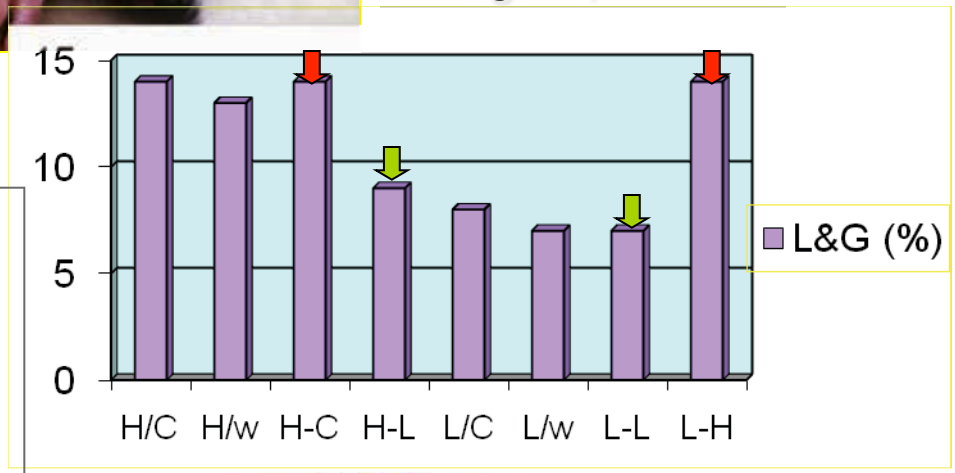
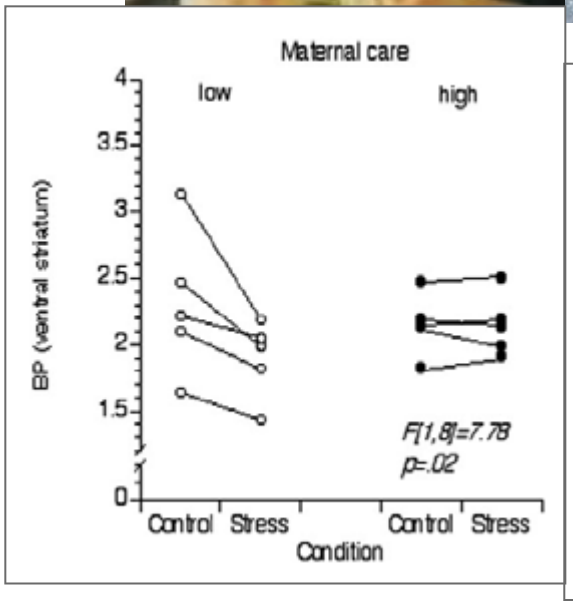
Intergenerational Transmission of Parental Care

Individual differences in maternal behavior related to rearing, rather than biological, mother



Francis, et al, 1999



Low Maternal Care in Humans Associated with Greater Striatal Dopamine Response to Stressor as Adult (Pruessner, et al, 2004)*

Individual differences in early care change regulation of gene expression

"Parent as we were parented…."

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INTERVENTION APPROACH

- Focus on adult's needs as a parent
- Focus changes from "what baby needs" to how demands of caring for infant are stressful and impact understanding infant's needs and how parent perceives and experiences the infant's cries
- Focus on increasing adults' distress tolerance/ capacity to maintain decision making in face of stress/ remain mindful of own and child's emotional states

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COMMUNITY PROGRAMS & PARENTING IN CSC & COLLABORATING DEPARTMENTS

- Discover Together
- Minding the Baby
- Moms Partnership (Megan Smith)
- Mothering from Inside Out (Nancy Suchman)
- MOMBA (Smith & Mayes)
- Family Support Services and Family Based Recovery (Jean Adnopoz)
- Family and Child Resilience Project
- Fathers Involved in Domestic Violence (Carla Stover)
- Fathers and Substance Abuse (Tom McMahon)

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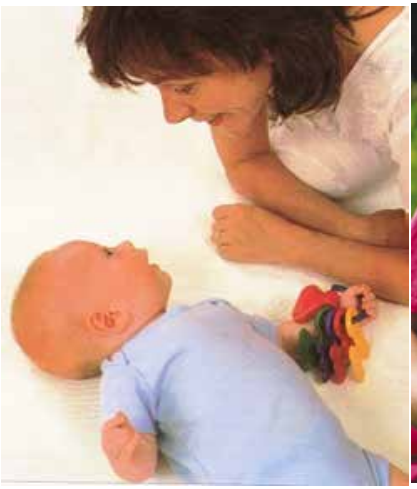
Two Complementary Approaches in Programs for Parents

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

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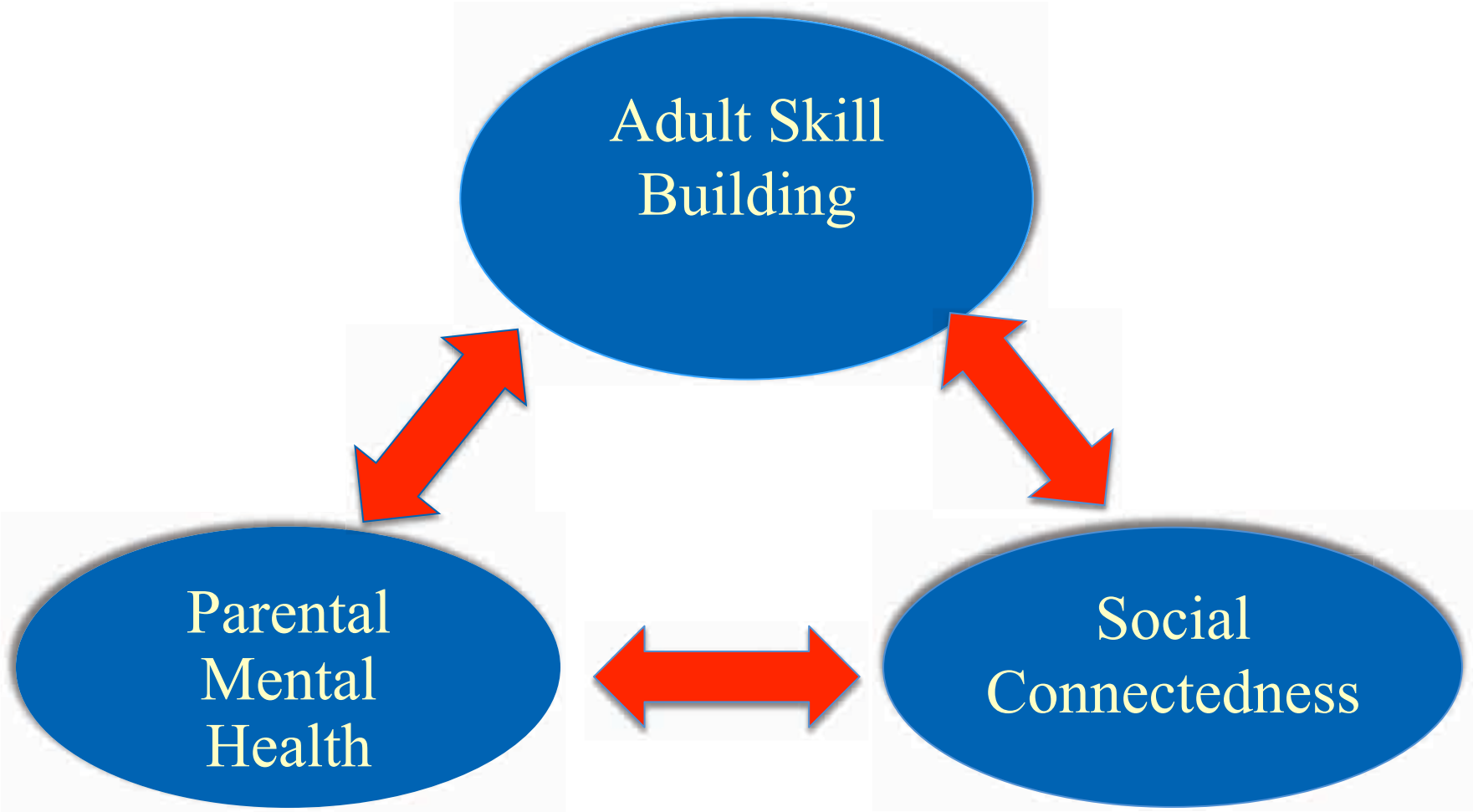
Helping Parents at Many, Interconnected Levels



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MINDING THE BABY

A Reflective Parenting Program for Young Families

Window of opportunity before and after infant's birth to enhance understanding of infant cues, "model" parental mindfulness skills about self and baby and connect parents to a network of other parents

Lois Sadler, Ph.D., Arietta Slade, Ph.D., Nancy Close, Ph.D.

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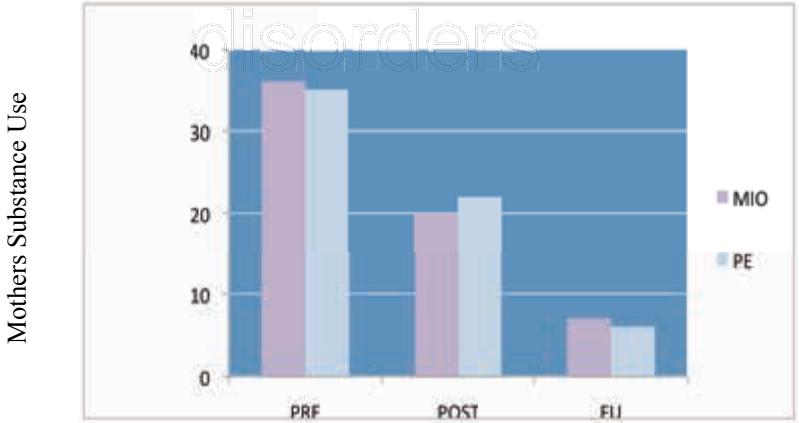
Mothering from the Inside Out

Relationship/ reflectiveness-based therapy for mothers with substance use



Nancy Suchman and colleagues

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Megan Smith

THE NEW HAVEN MOMS PARTNERSHIP

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Ensuring the Emotional Health of Our City's Families

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The New Haven Mental health Outreach for MotherS (MOMS) Partnership

- All Our Kin
- Clifford Beers Guidance Clinic
- Housing Authority of New Haven
- New Haven Health Department
- New Haven Healthy Start
- State of CT Department of Children & Families
- State of CT Department of Social Services
- The Diaper Bank
- Yale Child Study Center & Psychiatry
- Advisory Committee of 40+ local and state leaders

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THE NEW HAVEN MOMS PARTNERSHIP

Connectors: Community Mental Health Ambassadors

- Unique understanding of the experience, language and/or culture of low-income mothers
- Conduct culturally appropriate mental health care and outreach in public housing complexes, schools, shelters, local businesses, neighborhood parks, and community centers

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- MANUALIZED

THE NEW HAVEN MOMS PARTNERSHIP

One Approach: Innovation in Location

- Locate evidence-based mental health services in locations where families live, learn, work, play and network

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THE NEW HAVEN
MOMS PARTNERSHIP

MOMBA: Harnessing smartphone technology to improve maternal social connectedness and mental health

Linda Mayes, Fred Shic, & Megan Smith

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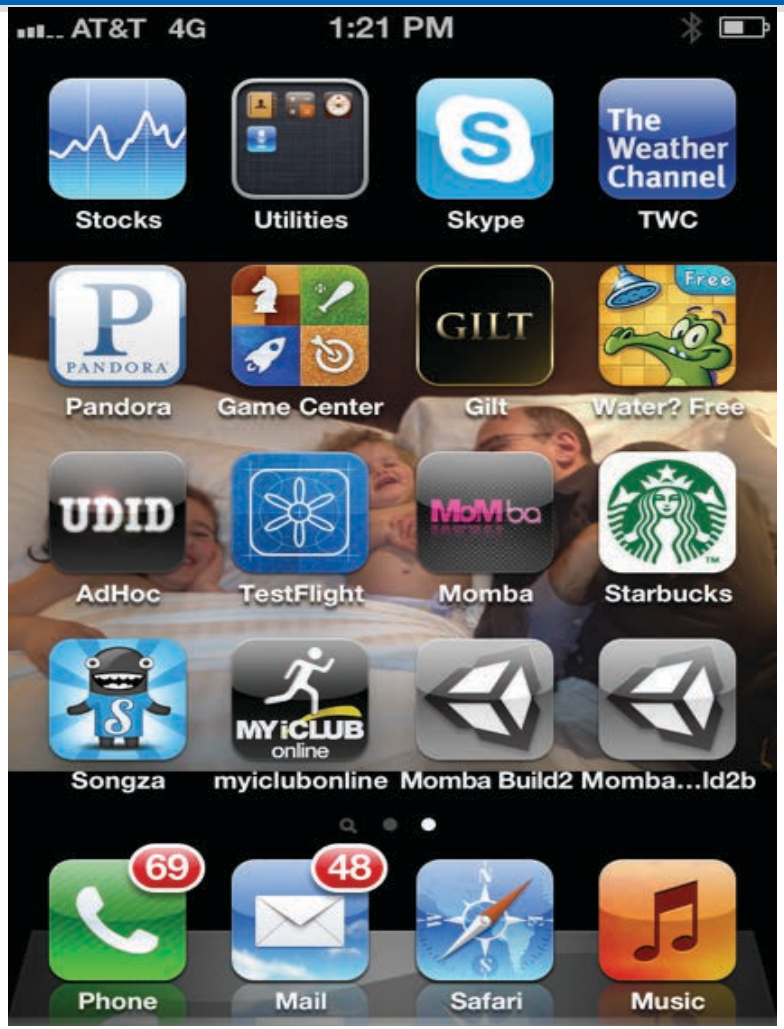
Promoting the Social Connectedness & Mental Health of Mothers



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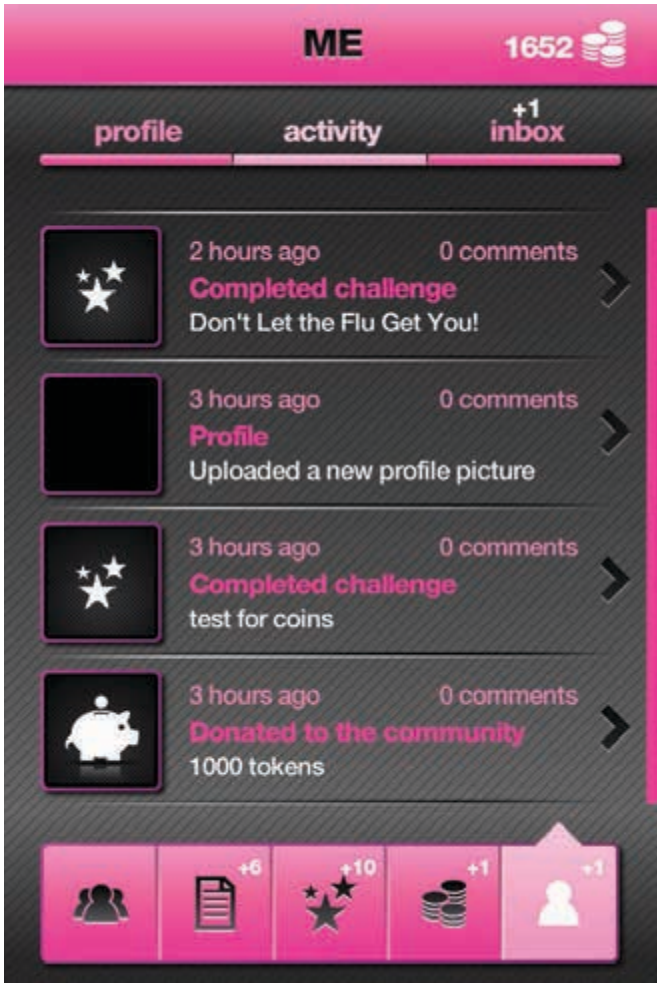
MoMba's Goals

- Connect new mothers to each other (social support and networks)
- Connect new mothers to infants (attachment theory)
- Connect new mothers to local resources (community connectedness)
- Connect new mothers to information about their health and the health of their children (health behavior)
- Incentivize pro-social, health promoting behaviors (behavioral economics)

Token-based Economy & Challenge System

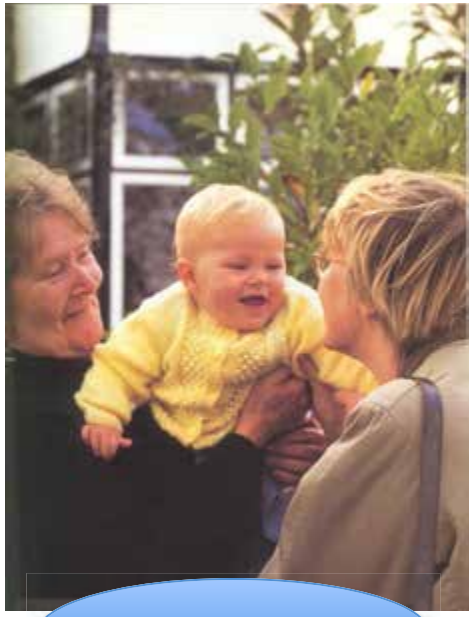
- Build and test trust
- Users challenge other users to do baby-focused, social capital-promoting activities by wagering their personal tokens.

- If the other user completes a challenge, the challenger is rewarded.



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 (preoccupation), in perceptual sensitivity, and in neural reward and stress systems
- Understanding the psychobiology of parent development informs the shape of prevention and intervention programs for families
- 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 Research Program

- Yale collaborators: Marc Potenza, Rajita Sinha, Nancy Suchman, David Reiss, Megan Smith, Lois Sadler, Arietta Slade, Nancy Close, Nicole Landi, Einar Mencl, Hedy Kober, Jessica Montoya, Patrick D. Worhunsky, James Leckman, Tara Chaplin, Kevin Pelphrey, James McPartland, Carla Stover
- London Collaborators: Eamon McCrory, Pasco Fearon, Peter Fonagy, Mary Target, Essi Viding, Tessa Baradon
- UNC Collaborators: Joey Johns, Sandy Zeskind, Karen Grewin, Guido Gerig
- Baylor: Lane Strathearn and Thomas Kosten
- U. Illinois: David Bridgett
- U. Maryland: Carl Lejuez
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THANK YOU

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