How Stress Impacts Parental Care and the Intergenerational Transmission of Parenting Abilities

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Subtext/Case Example:

How Addiction Compromises Parenting

Orienting Points -- 1

- Increasing appreciation for relationship between prenatal and early childhood adverse events/exposures and chronic health conditions in adulthood:
  - Cardiovascular disease
  - Cancer
  - Depression/Mood disorders
  - Drug abuse/addictive disorders

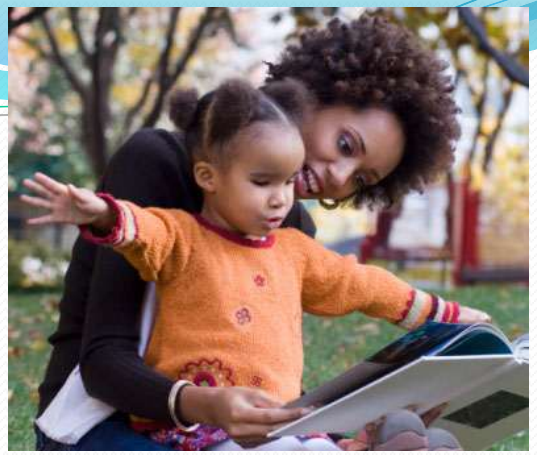
- Broad “mechanisms” include:
  - Exposure during biologically sensitive periods with change in developmental trajectory of brain systems
  - Accumulating damage over time (e.g., one adversity increases risks for others)
  - Gene by experience interactions

Orienting Points -- 2

- Parallel evidence for intergenerational "clustering" of adverse health outcomes
  - Cardiovascular disease
  - Drug Abuse/additive disorders
  - Anxiety and depression

- "Broad" mechanisms may include:
  - Clustering of "risk" genes with increased expression under adverse/stressful conditions
  - Accumulated chronic stress in families perpetuate chronic adversity in offsprings' early experience
  - Compromised parenting secondary to parents' own early adverse experiences

KEY MESSAGE



- EARLY CHRONIC 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

- THIS HAS IMPORTANT IMPLICATIONS FOR INTERVENTIONS FOR CHILDREN AND THEIR PARENTS

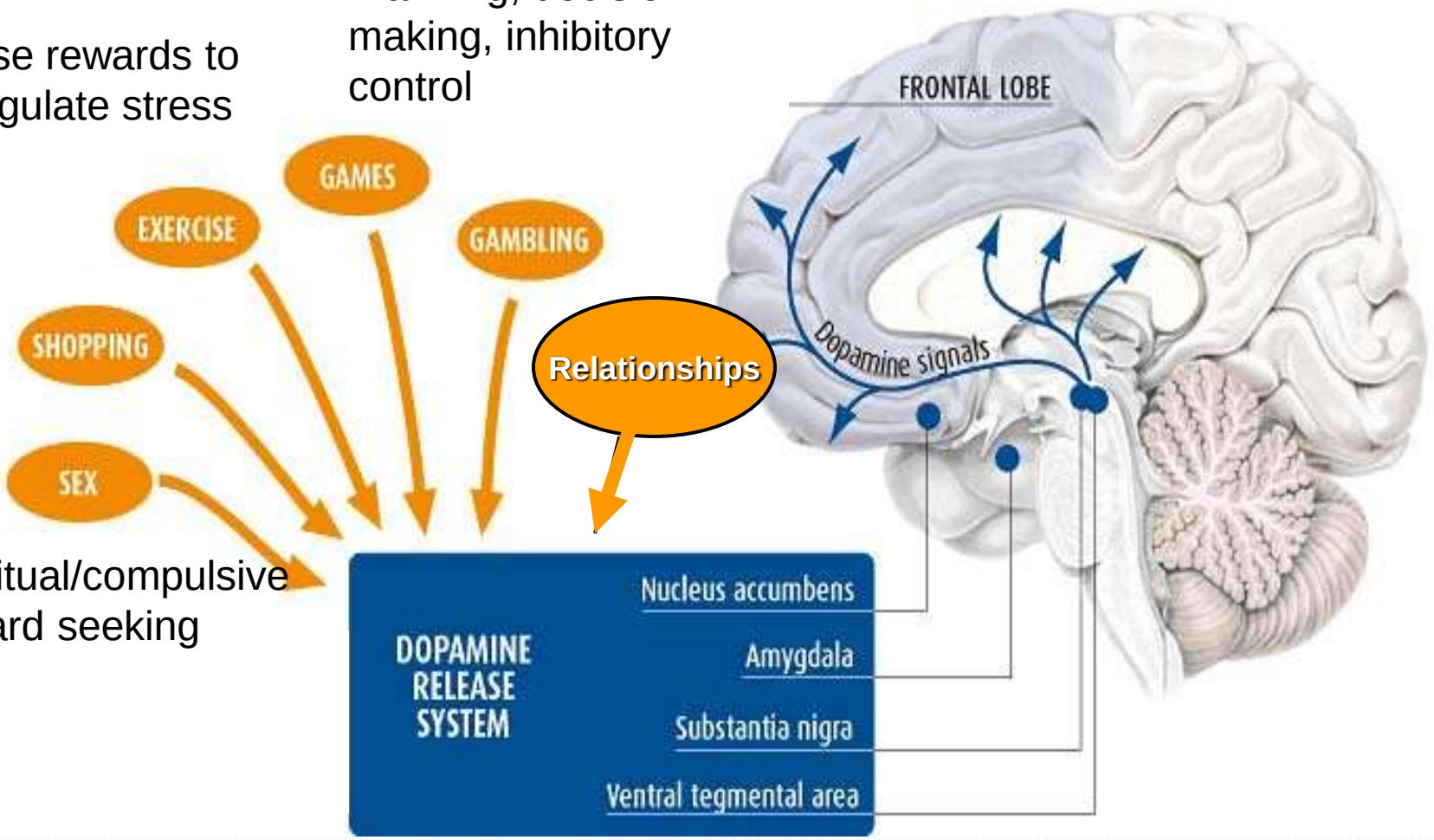
Outline

- Model for relationship of stress, self-control, and reward seeking
- Rethinking parenting
  - Neural circuitry of attachment
  - How parenting “gets” into the body of the infant and child
- Clinical example of addiction and parenting
  - Addiction/addictive processes as “stress” disorders
  - Parenting among addicted adults
- How early adversity impacts parental behavior
- Intervention implications

REWARD SYSTEM

Use rewards to regulate stress

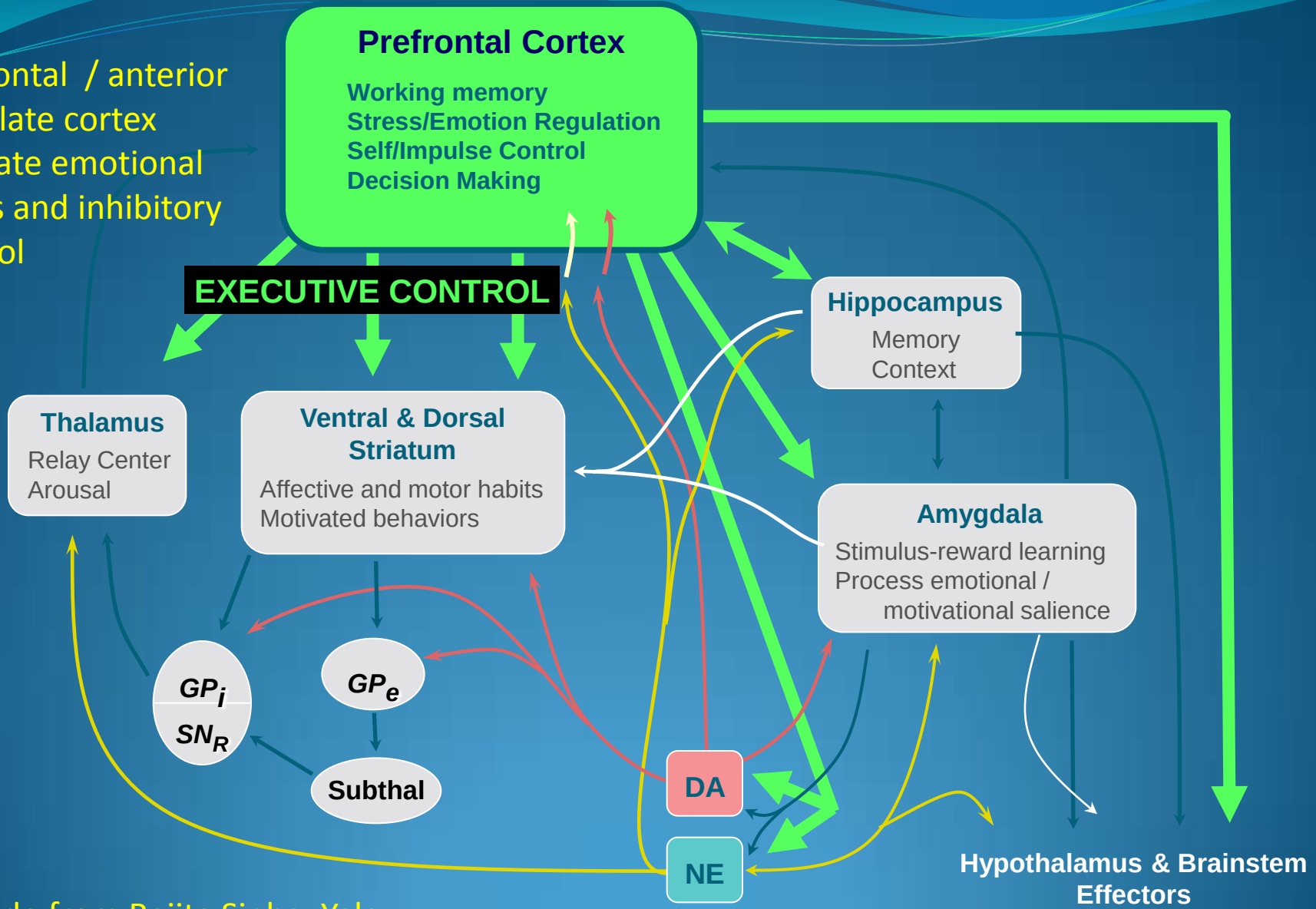
Planning, decision making, inhibitory control



Habitual/compulsive reward seeking

REWARD AND STRESS REGULATION

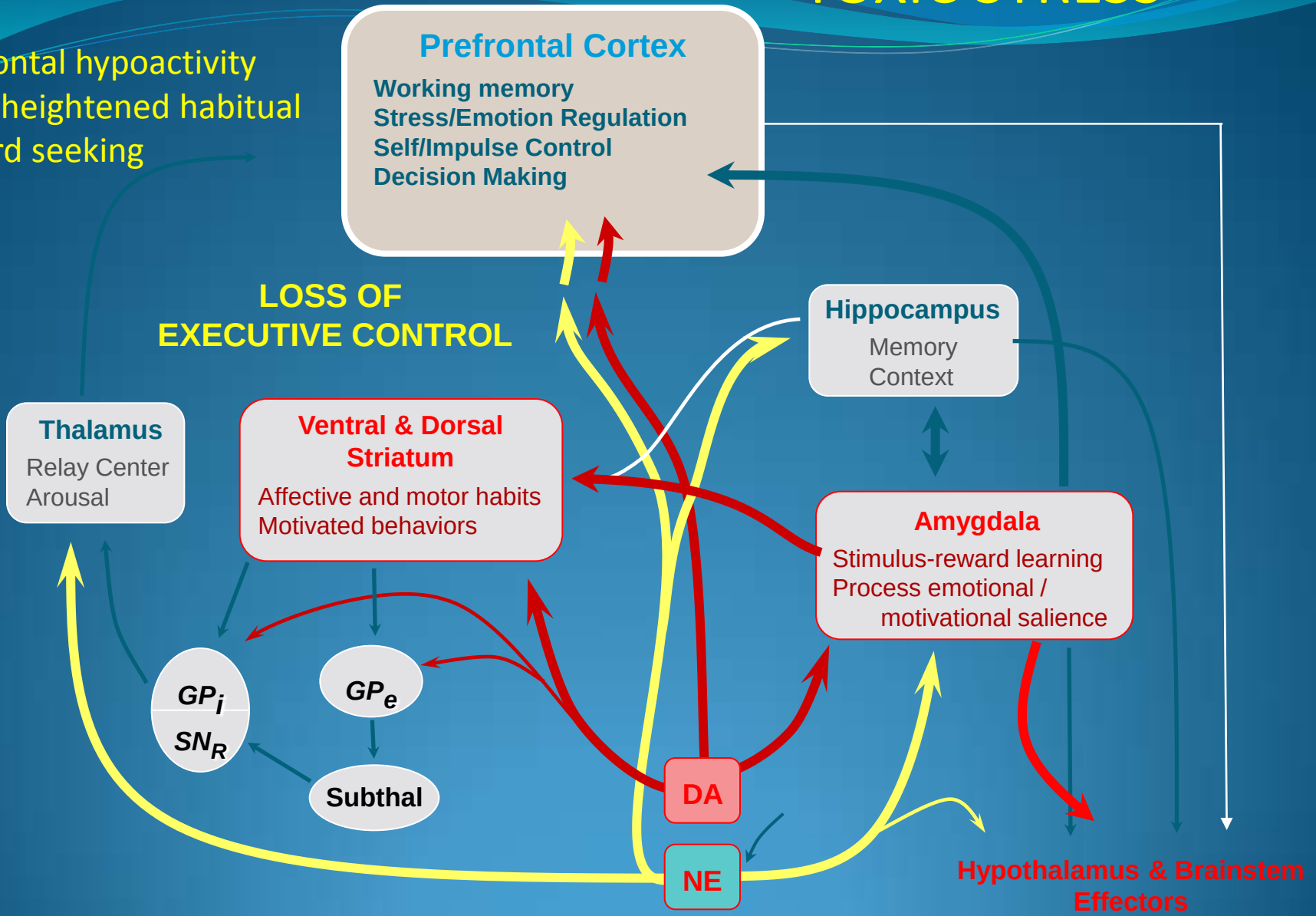
Prefrontal / anterior cingulate cortex regulate emotional stress and inhibitory control



Slide from Rajita Sinha, Yale Interdisciplinary Stress Consortium

TOXIC STRESS

Prefrontal hypoactivity with heightened habitual reward seeking



Slide from Rajita Sinha,
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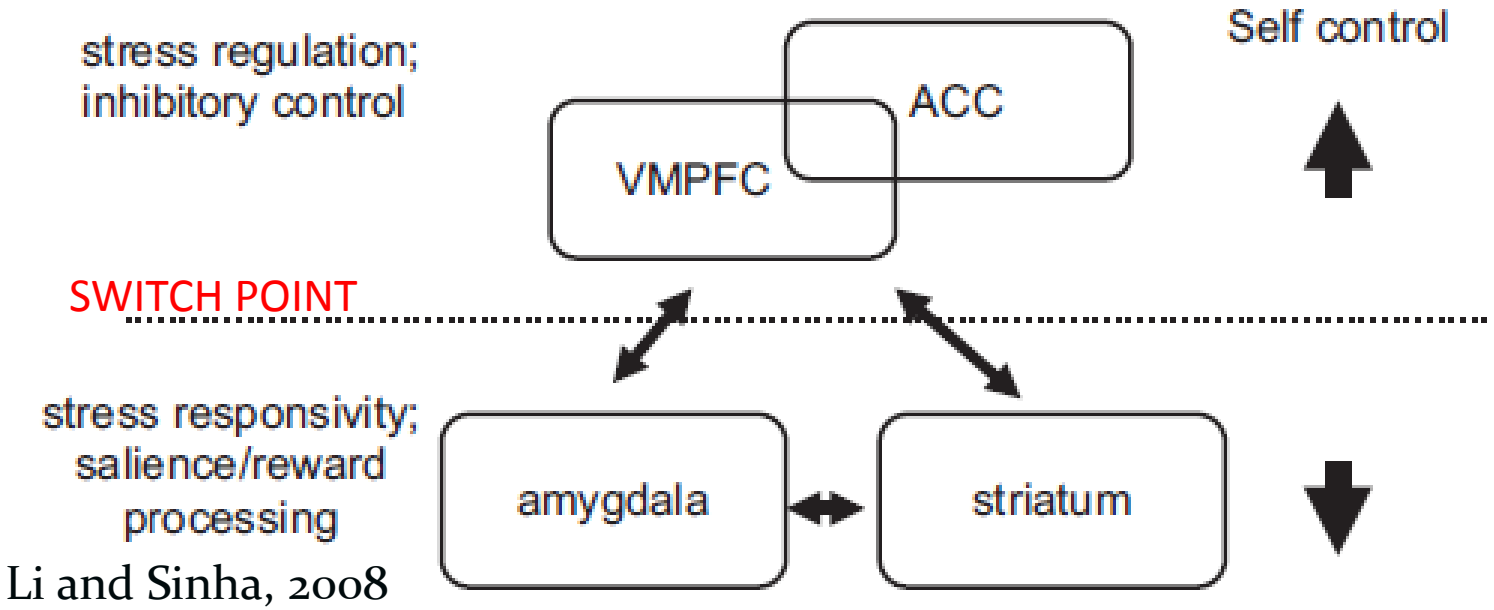
BALANCE BETWEEN SELF-CONTROL AND STRESS SENSITIVITY



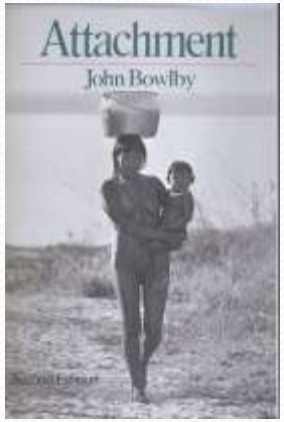
Li and Sinha, 2008

- With early adversity/chronic, toxic stress, switch point moved "earlier" so more likely to decrease prefrontal function under stress
  - Impulsivity
  - Poor decision making
  - Lowered distress tolerance

Behavioral and Neural Impact of Chronic Stress

- Stress induced effects on neural structure and function in key regions – prefrontal cortex (executive control), hippocampus, amygdala
- Expressed functionally/behaviorally as:
  - Increased anxiety
  - Decreased mental flexibility
  - Poor emotional control
  - Poor decision making/increased impulsivity
  - Impaired memory
- Expressed structurally as:
  - Decreased hippocampal volume
  - Decreased dendritic branching in cortex

Basic Science of Parental Attachment

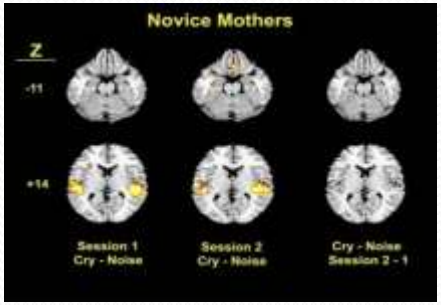


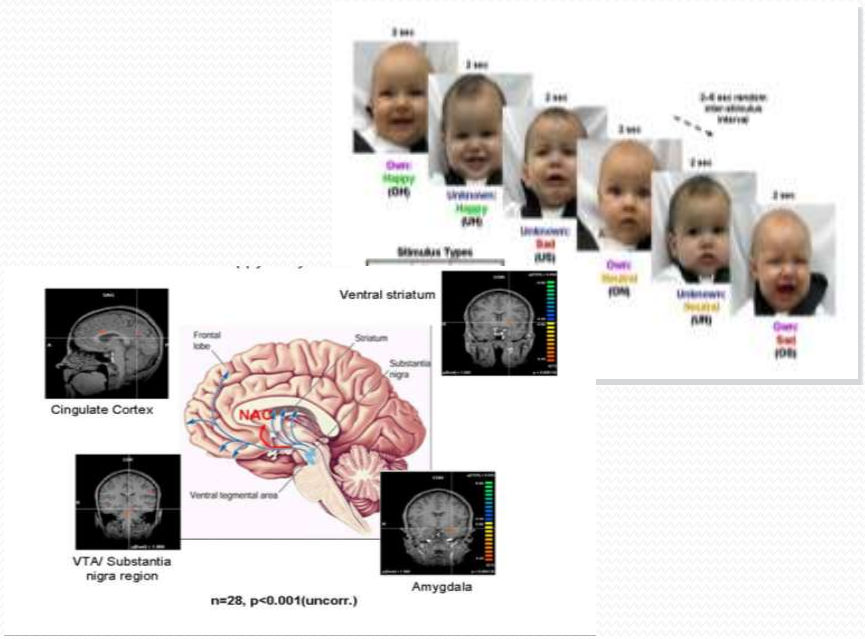
Decades of work on impact of parental care on child health and development, but…..

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

• Presence of a new infant activates specific neural circuitry involved in balance between reward seeking and stress modulation

•Enhancement in neural circuits with increasing time with infant





STRATHEARN, et al., 2007

RETHINKING “PARENTING”

What’s “beneath” or required for parental “sensitivity” and “contingent responding”?

Rethinking Parenting

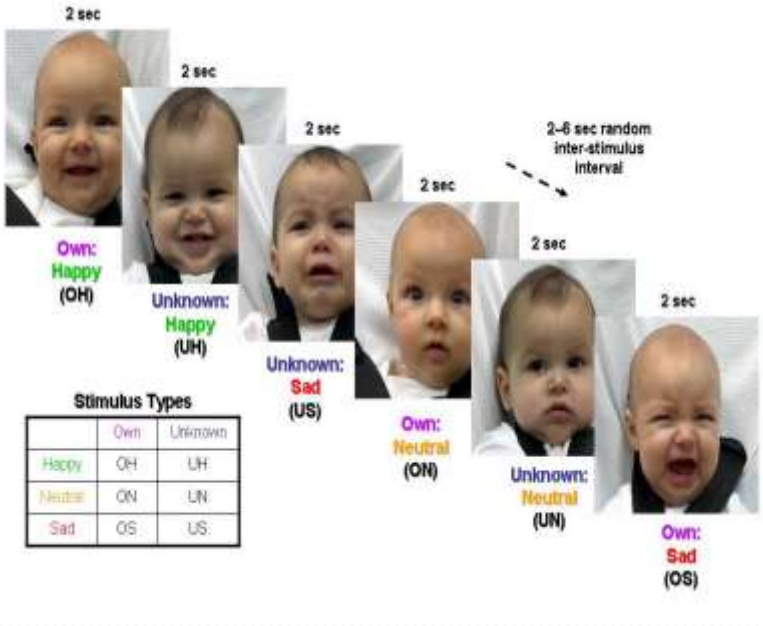
- Parental function involves key capacities and neural circuits involved in stress regulation and reward responsivity:
  - Capacity to maintain executive control under heightened arousal (or stress responsivity)
  - Self-control (versus impulsivity)
  - Emotional regulation or distress tolerance
  - Decision making/Consequence appraisal

- Individual differences in these capacities in parents impact similar functional capacities in offspring
- Neural or brain circuits related to capacities for attachment/caring for infants also involve reward and stress regulatory circuits

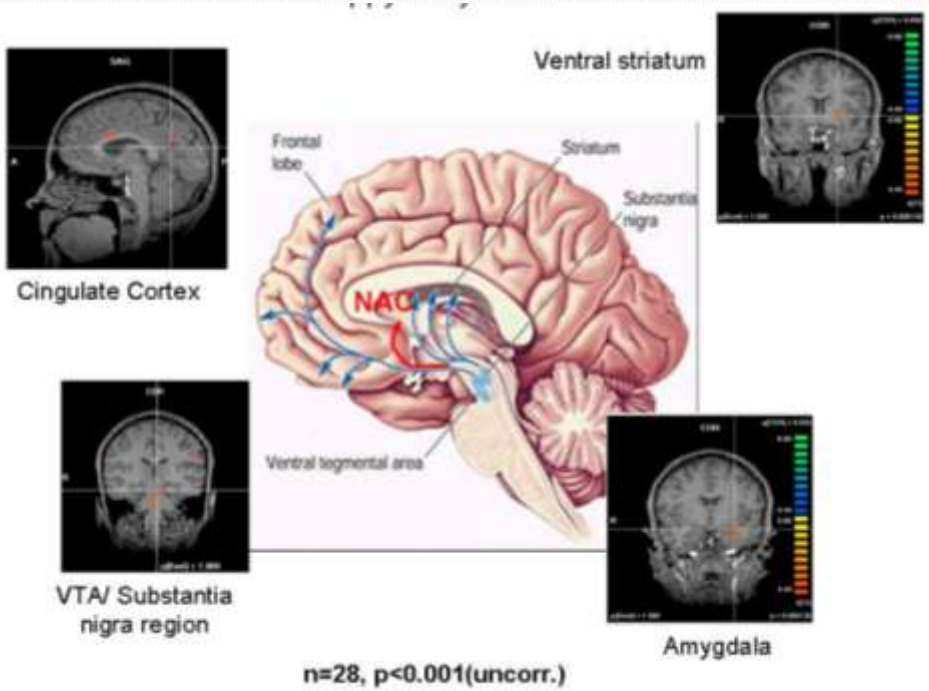
Neurobiology of Parental Behavior

- **Extensive data from rodents regarding "affiliative" circuits:**
  - 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

OWN BABY VISUAL CUES ACTIVATE DOPAMINE REGULATED REWARD CIRCUITS



STRATHEARN, et al., 2007

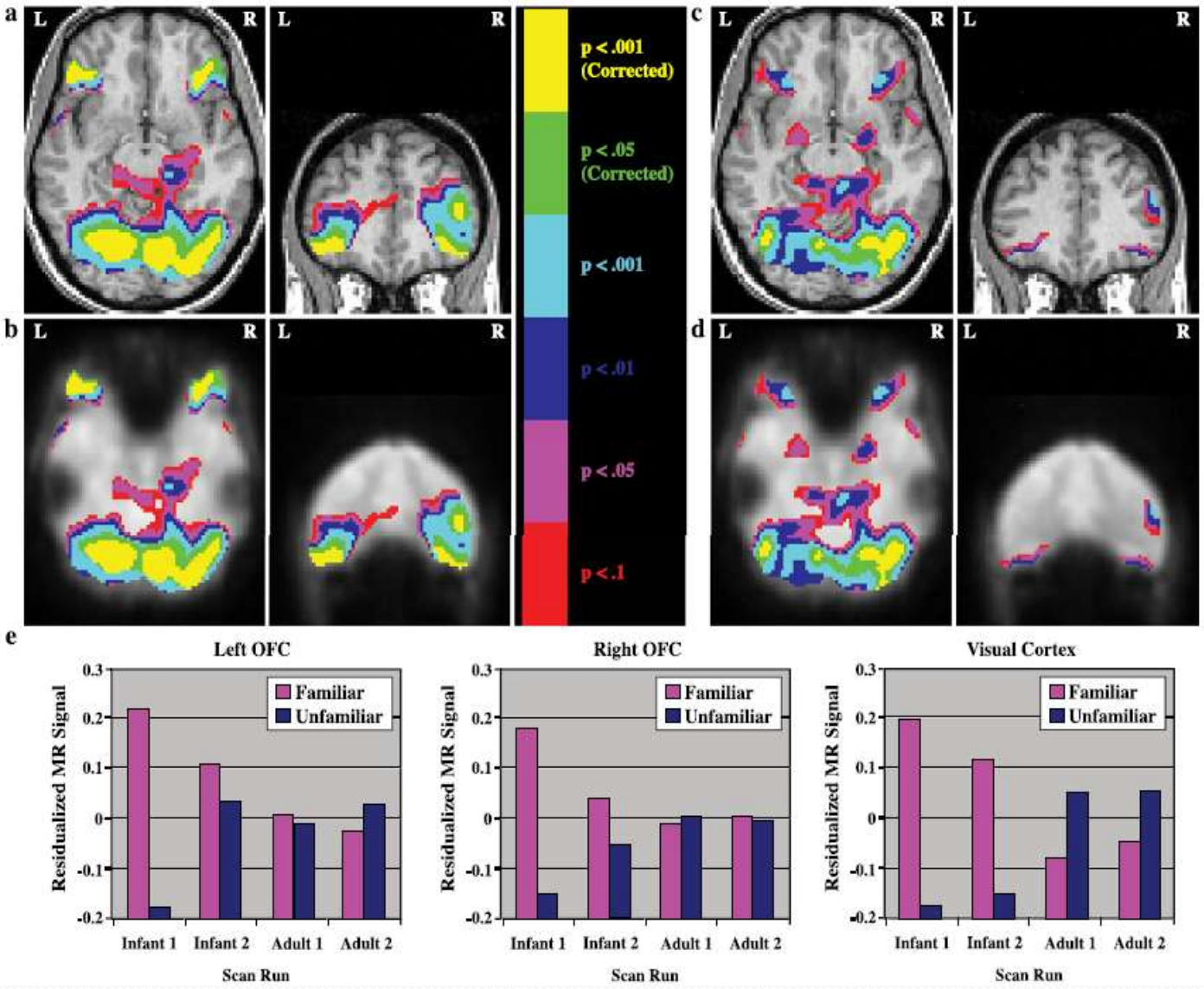


Own Baby Images Activate Orbitofrontal Cortex (OFC)

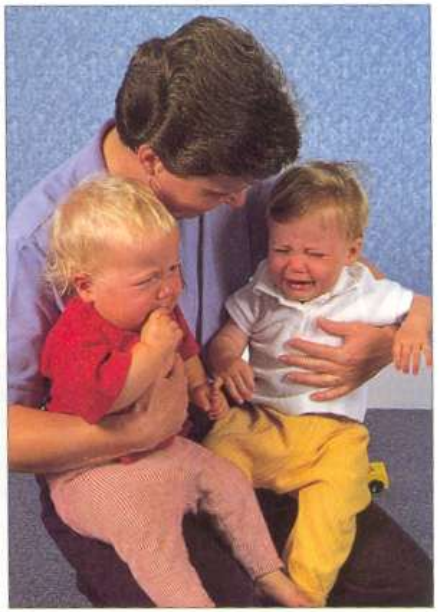
OFC appraisal of positive/

negative emotions

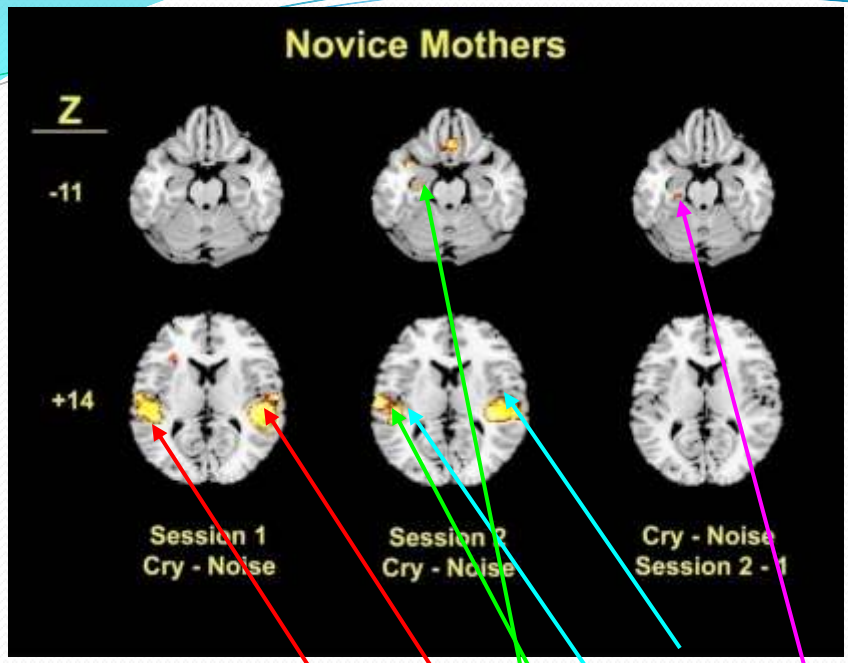
Nitschke, 2004, Neuroimage

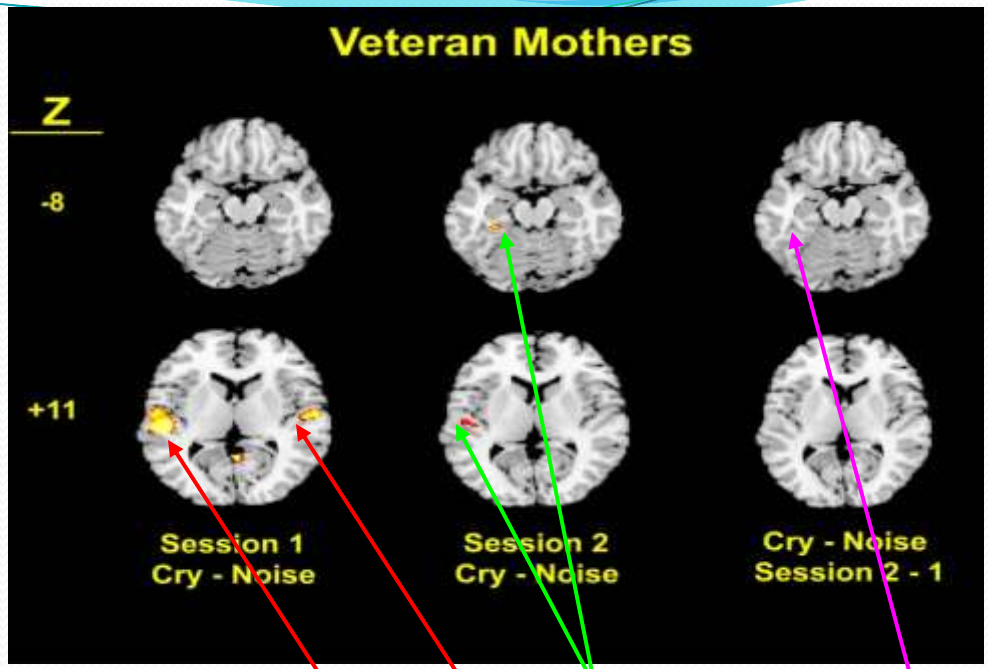


CRY AS SALIENT SIGNAL FOR ACTIVATING ATTACHMENT/REWARD SYSTEMS IN HUMANS



Maternal Response to Infant Cries





Point 1: Both novice and experienced mothers active superior temporal regions

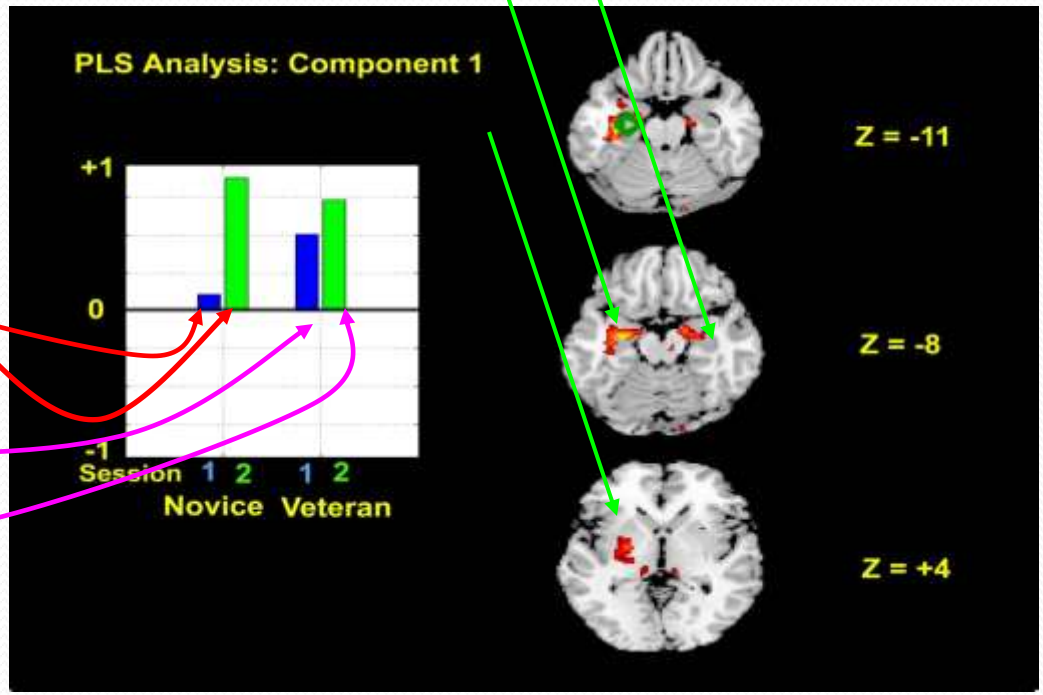
Point 2: By 3-4 months, for both, increased R medial temporal lobe activation

Point 3: For novices, increase in R hippocampal activation by 3 mos; for veterans present at 2 weeks already & no change by 3 mos

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

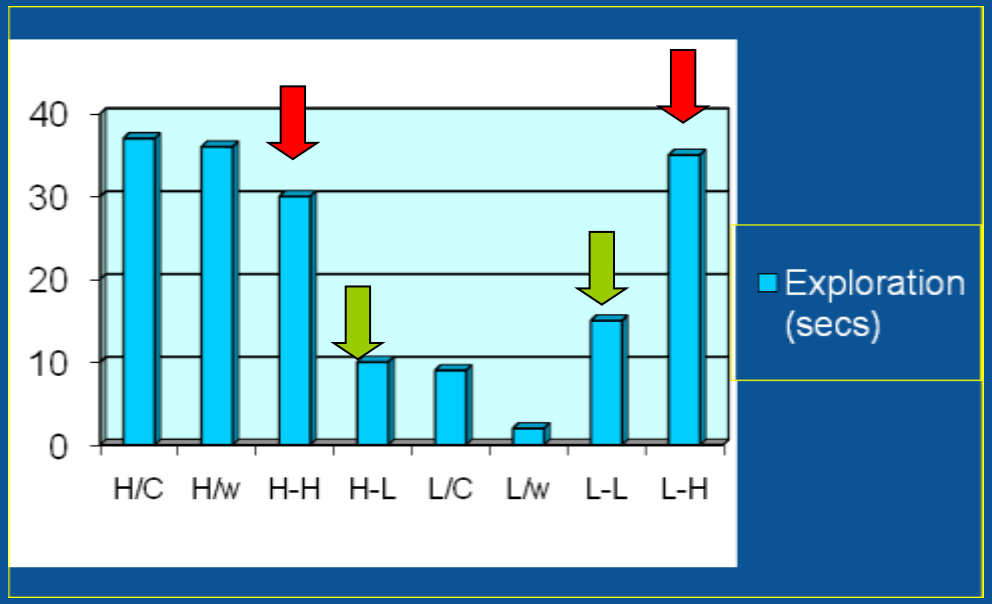


Analyses conducted by Leslie Jacobsen; Data from Swain, Leckman, Mayes, 2008

Early Life Experiences Are Built Into Our Bodies (For Better or For Worse)

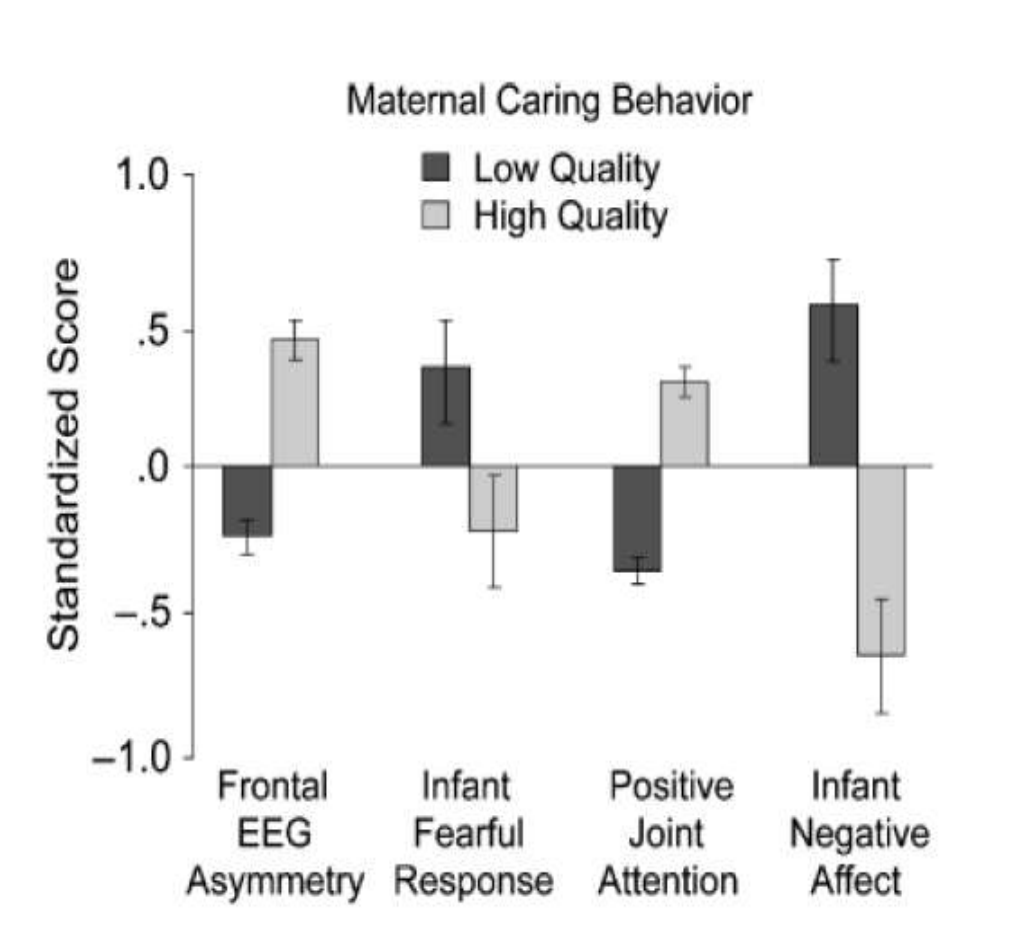
Early Parenting Experience and Adult Stress Response Systems

- Offspring of, or those cross-fostered to "low care" mothers show, as adults, increased response to acute stress and decreased exploration in novel environments



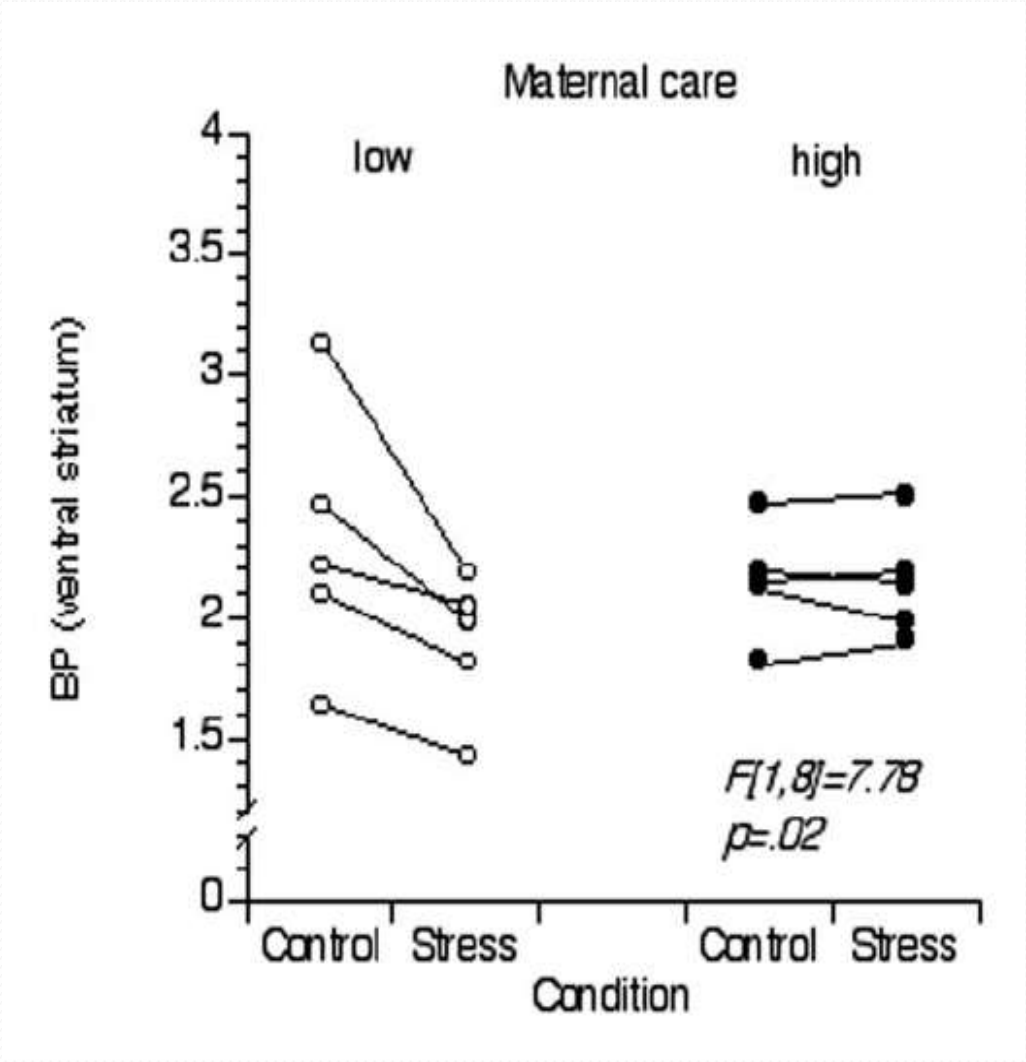
Francis *et al*., '99

Individual Differences in Maternal Care



Hane and Fox, 2006

Low Maternal Care in Humans Associated with Greater Striatal Dopamine Response* to Stressor as Adult

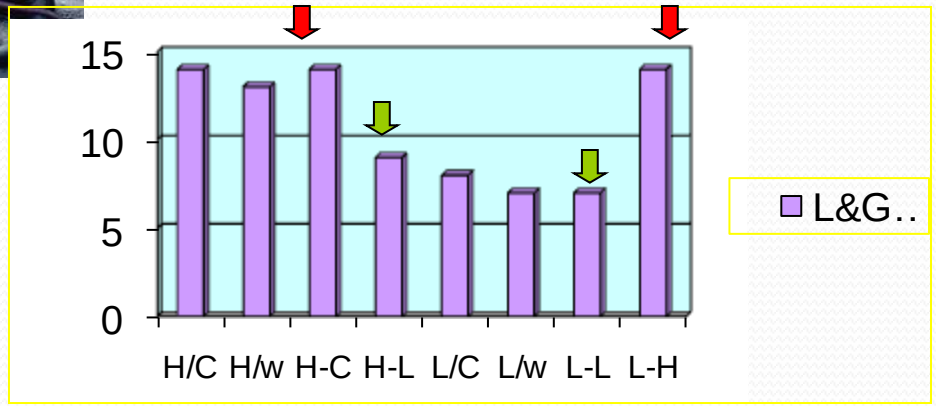


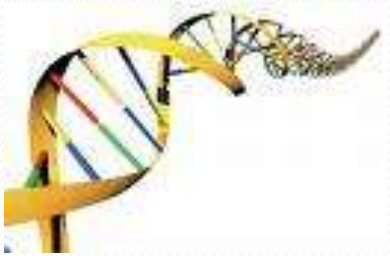
** reduction in [11C]raclopride binding potential

Pruessner, et al, 2004

Intergenerational Transmission of Parental Care

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





Francis, et al, 1999

"Parent as we were parented…."

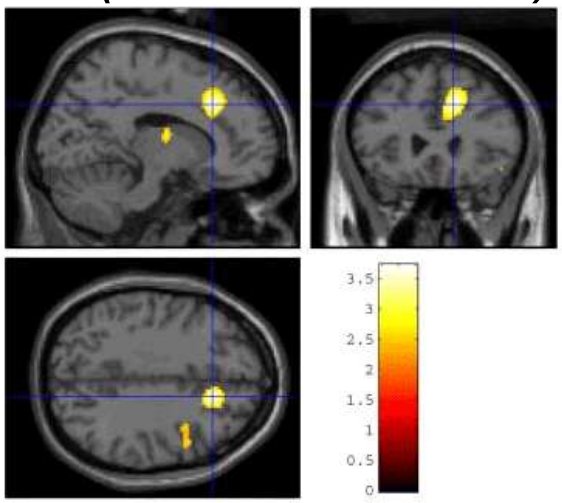
Care changes gene regulation

Interim Summary

- Adaptive parenting requires constellation of behaviors/capacities reflective of effective stress regulation, self-control, and effective decision making
- Salient infant cues activate circuits involved with reward, motivation, stress response, and emotional appraisal
- Individual differences in parenting behavior convey individual differences in stress-reward systems in offspring enduring into adulthood

How Parental Care Gets into Body, Brain, and Mind

Thinking about own and others' minds ("mentalization")



Children learn about their own feelings and about caring for others through interactions in which their parents acknowledge their child's "mind"-- feelings, needs, and wishes.

What is Mentalization

- Psychological ability that allow us to make sense of the actions of others as well as our own actions by reference to desires, thoughts, memories, feelings
- Difference between a physical/observable explanation versus a mental/non-observable one (“She’s crying versus “she’s crying because she is frightened, disappointed, sad….)
- Ability that is variable and often compromised under stress

“Understanding” Behavior (Own and Baby’s)

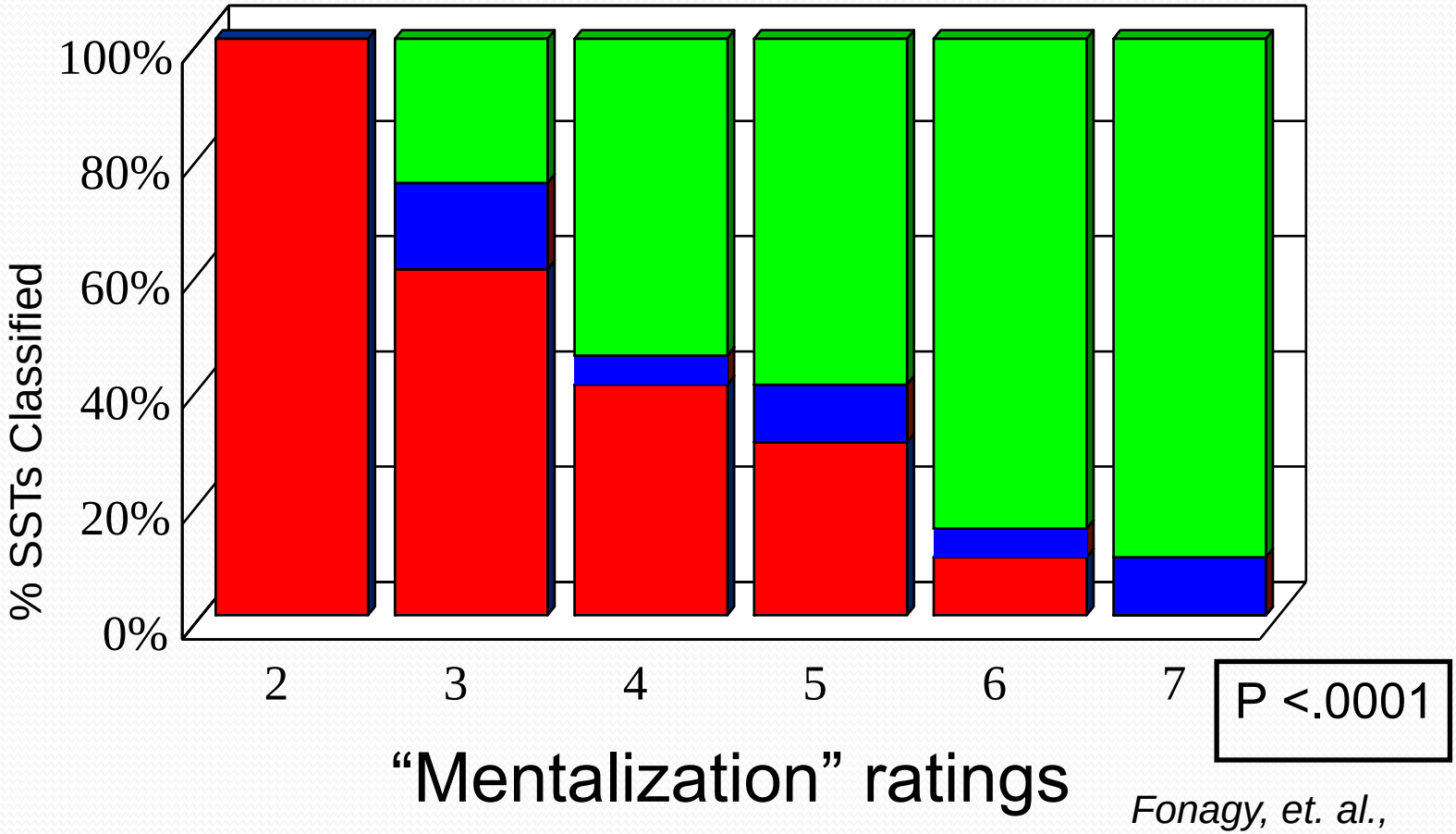
- Attributing intentions and feelings to self and the baby (e.g., “He feels sad and he misses me, and so he clings to me and begs me to stay. That makes me want to hold him forever.” vs. “He’s so bad, he just cries to irritate me. I don’t know what to do with him”)

Developing Mentalizing Abilities

- Mentalization abilities develop over childhood, increasingly complex and only gradually achieved fully

- Mentalization is a part of social attachment
  - Sharing internal experiences with others makes them meaningful
  - Central to understanding and regulating own emotions (“why am I so worried…..)
  - Also central to regulating emotions in interactions with others (e.g., empathy…)

Mother's “Mentalization” Predicts Infant-Mother Secure Attachment 1 year

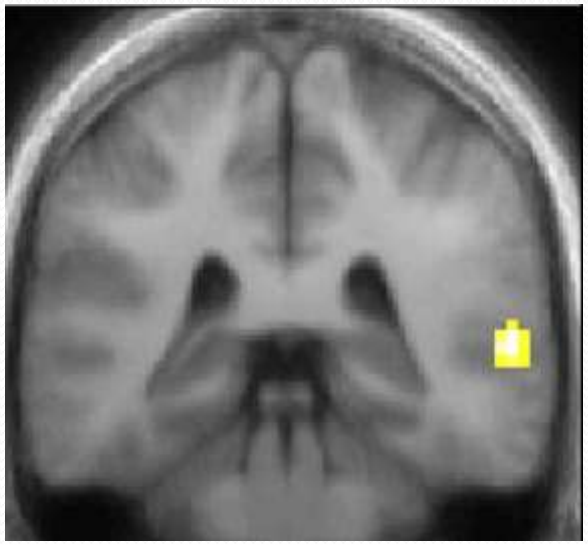


Fonagy, et. al., 2007

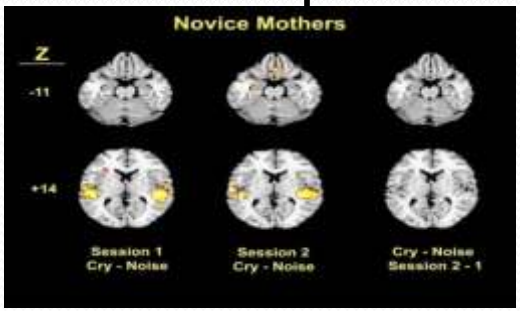
"Signal detection" and "top down" mentalization processes

? OVERLAP IN "PARENTAL CIRCUITRY" AND "MENTALIZATION CIRCUITRY"

- Superior Temporal sulcus, R temporal active across different types of mentalizing events *(Spiers, Maguire, Neuropsychologia, 2006)*

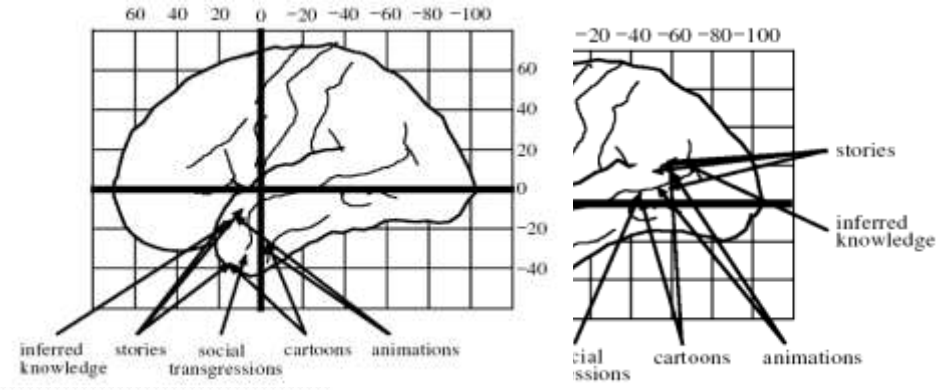


- Could response to cry (with similar regions activated) reflect parental reflection on infant's state of need—using a specialized circuit in service of parenting?



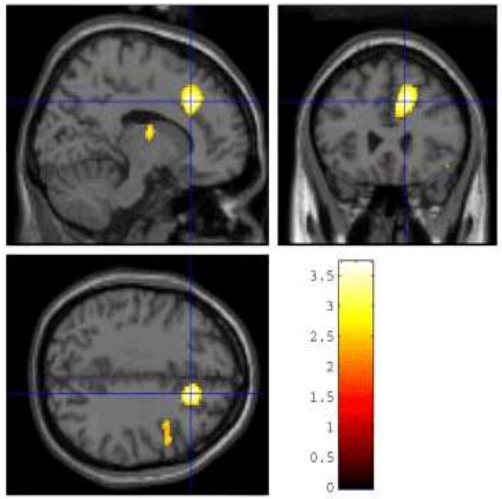
"MENTALIZATION CIRCUITRY"

- Mentalizing functions of superior temporal sulcus and temporal pole *(Frith and Frith, 2003)* especially in response to sensory signals that provide clues to mental states --"Signal detection"



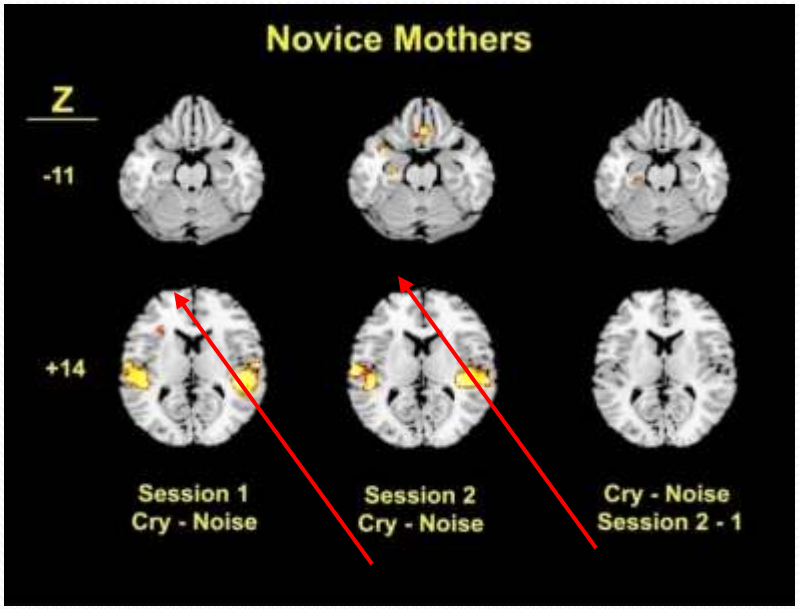
- These regions connected to medial prefrontal cortex which may be involved in processing the mental versus physical representations of these "mental state clues"

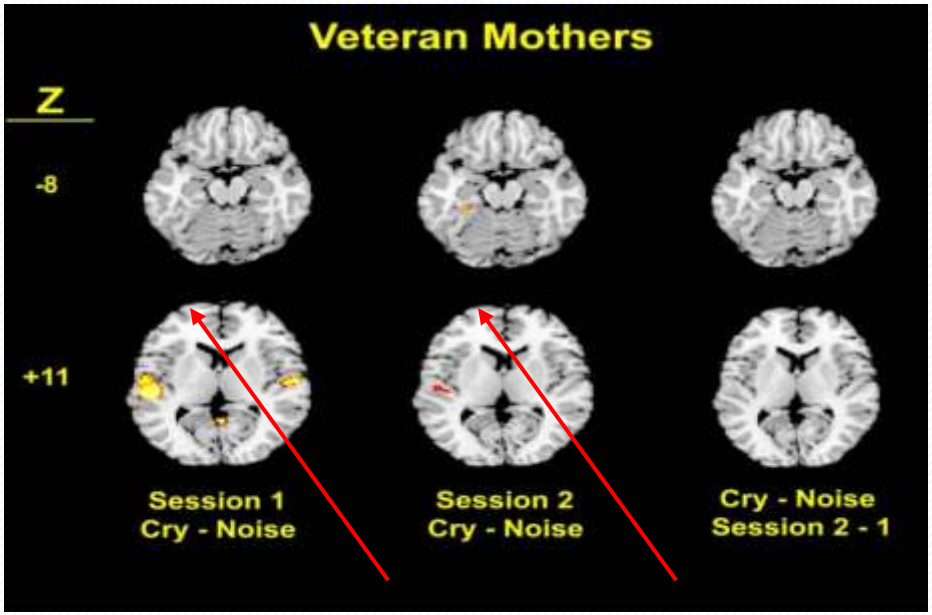
- "Top Down" component of mentalization circuit



Early Parenting and Mentalizing—Salience of Cues

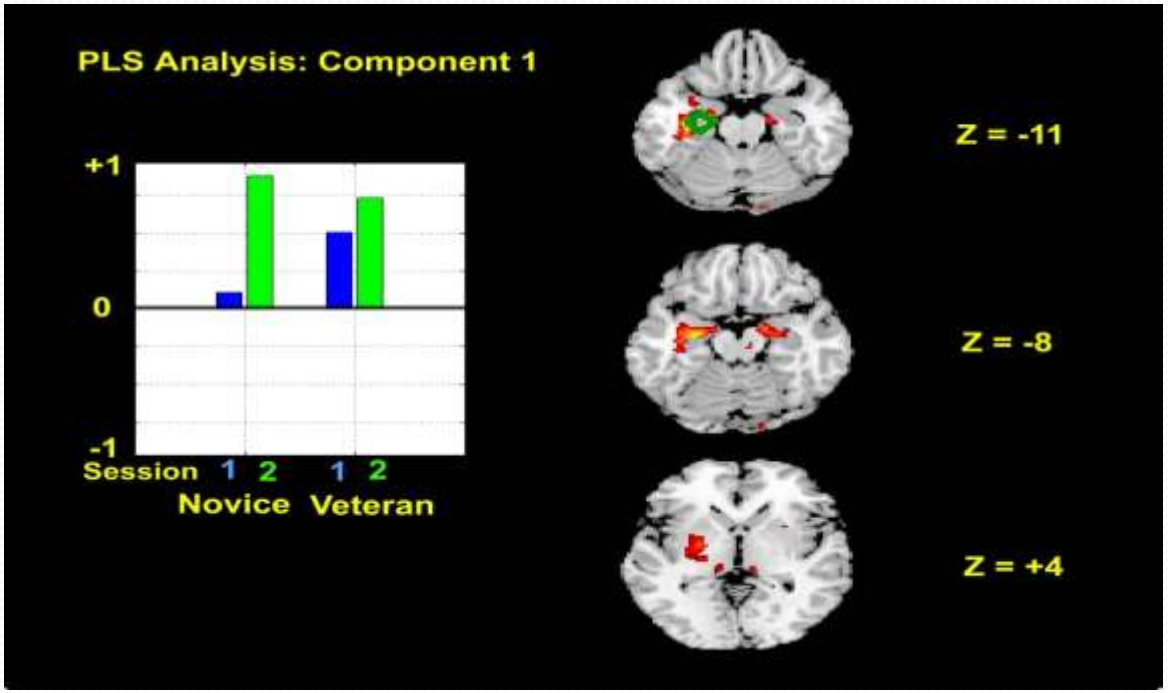
- Infant cues activate parts of “mentalizing circuitry” that give clues to infants’ mental states (“signal detection” component)
- Early “parental preoccupation” = enhanced signal detection (superior temporal regions)





Early Parenting and Mentalizing--Experience

- "Top down" aspects of mentalization circuitry come into play with experience with infant



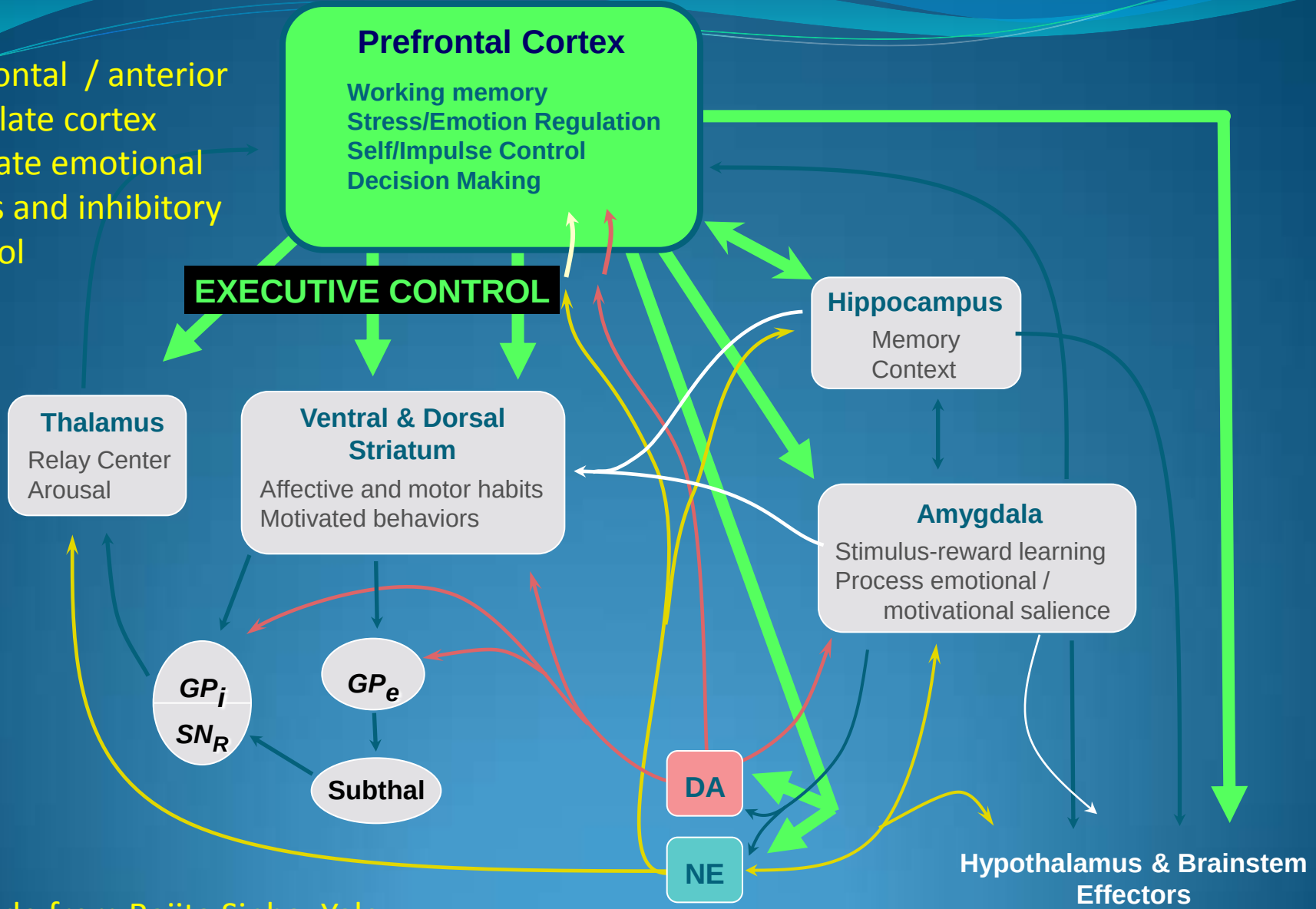
Mentalizing and Parenting capacities

- Capacity to maintain executive control under heightened arousal (or stress responsivity)
- Self-control (versus impulsivity)
- Emotional regulation or distress tolerance
- Decision making/Consequence appraisal

Intact Top-Down Appraisal Capacities (Prefrontal Cortical/Executive Control)

REWARD AND STRESS REGULATION

Prefrontal / anterior cingulate cortex regulate emotional stress and inhibitory control



Slide from Rajita Sinha, Yale Interdisciplinary Stress Consortium

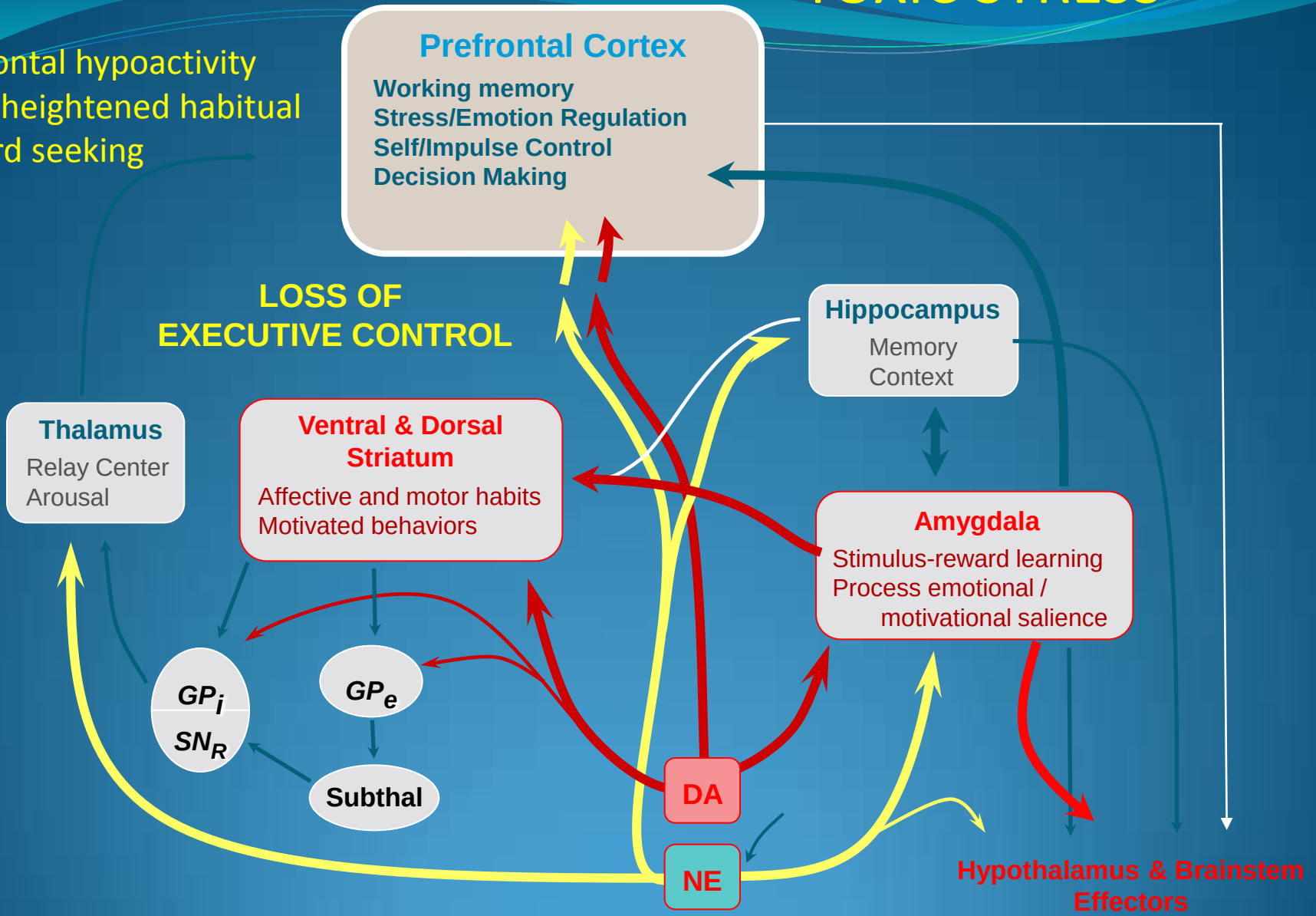
Threats to Mentalization

- Decreased or compromised signal detection
  - Depression
  - Effects of drugs
  - Addiction

- Compromised ability to interpret the signal
  - Adolescence with still developing prefrontal cortical fx
  - Acute stress (diminished prefrontal cortical fx)
  - Heightened stress sensitivity (e.g., long-term effects of early adversity) with compromised prefrontal cortical fx

TOXIC STRESS

Prefrontal hypoactivity with heightened habitual reward seeking



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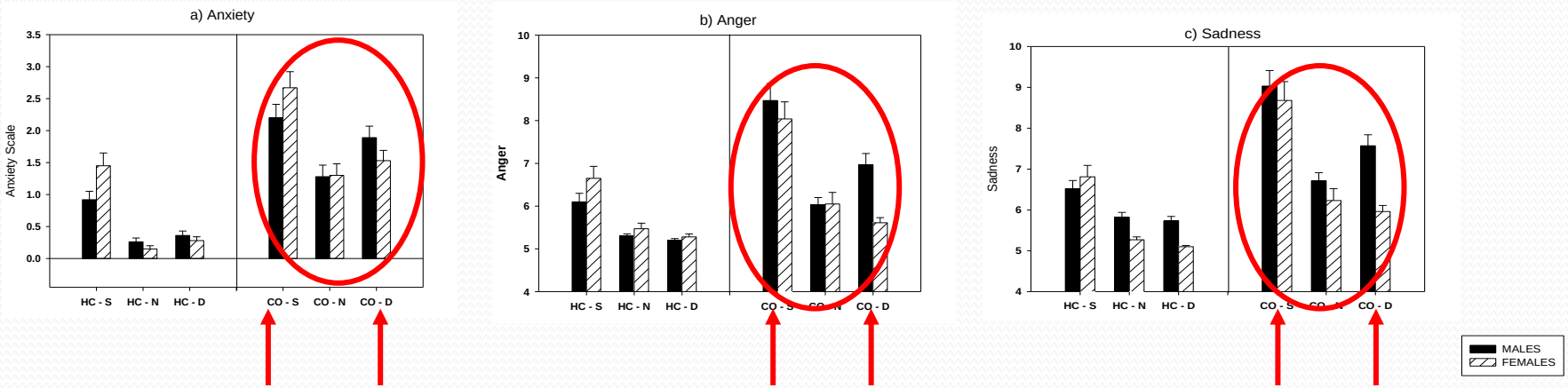
CLINICAL EXAMPLE
ADDICTION AND PARENTING

ADDICTION AS A STRESS DISORDER

- Addiction = Loss of control over behavior that leads to adverse consequences but also extreme negative affective state if not engaged in behavior
- Common across many addictions (drugs, gambling, overeating) is increased stress reactivity, poor ability to regulate stress, impulsive behavior in face of stress, and increased “craving” for salient/habitual condition
- Similar to profile resulting from chronic/toxic stress
  - Higher rates of early abuse and neglect in addicted adults
  - Higher rates of attachment related violence (parent-child abuse and domestic violence) among addicted adults

RESPONSE TO STRESS AMONG ADDICTED ADULTS

- Increased craving for drug, heart rate, and feelings of anxiety among cocaine and/or alcohol dependent subjects in response to a stressful story (Sinha, 2003; Breese et al., 2005)



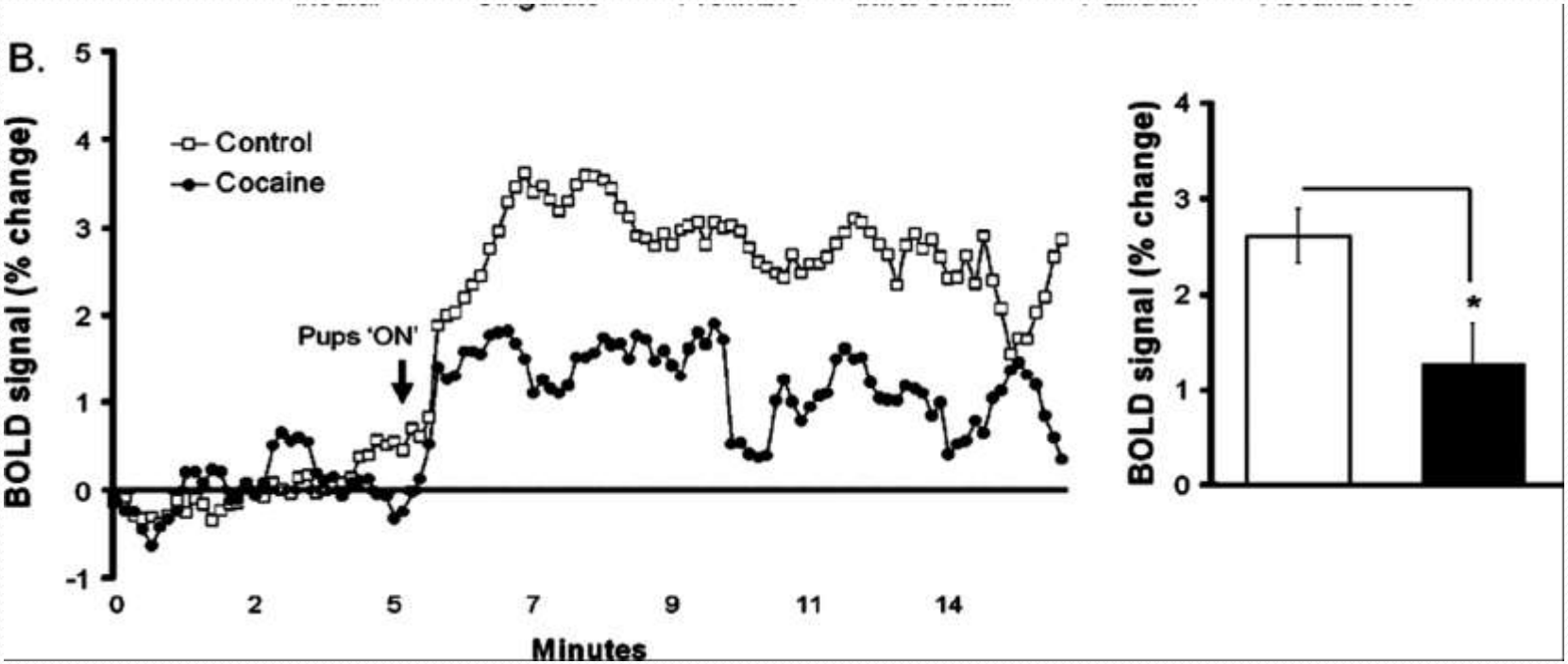
- Stress-induced craving predicts treatment outcome (Greater craving= increased risk for relapse) (Sinha, 2006)

- Addicted adults who experienced child maltreatment perceive greater stress and use more avoidant coping strategies (Hyman, et al, 2007)

PARENTING AMONG SUBSTANCE ABUSING ADULTS

Animal Models of Parenting and Drug Addiction

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



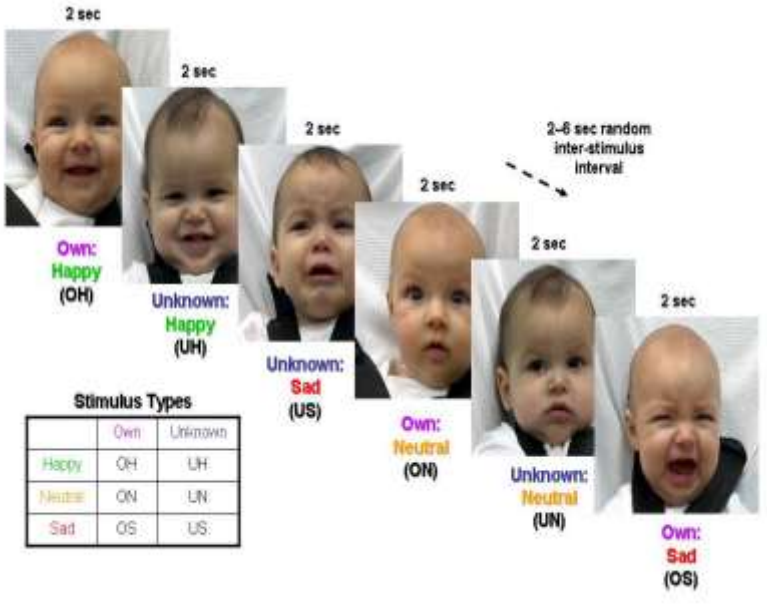
Animal models of Parenting and Drug Addiction

- 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

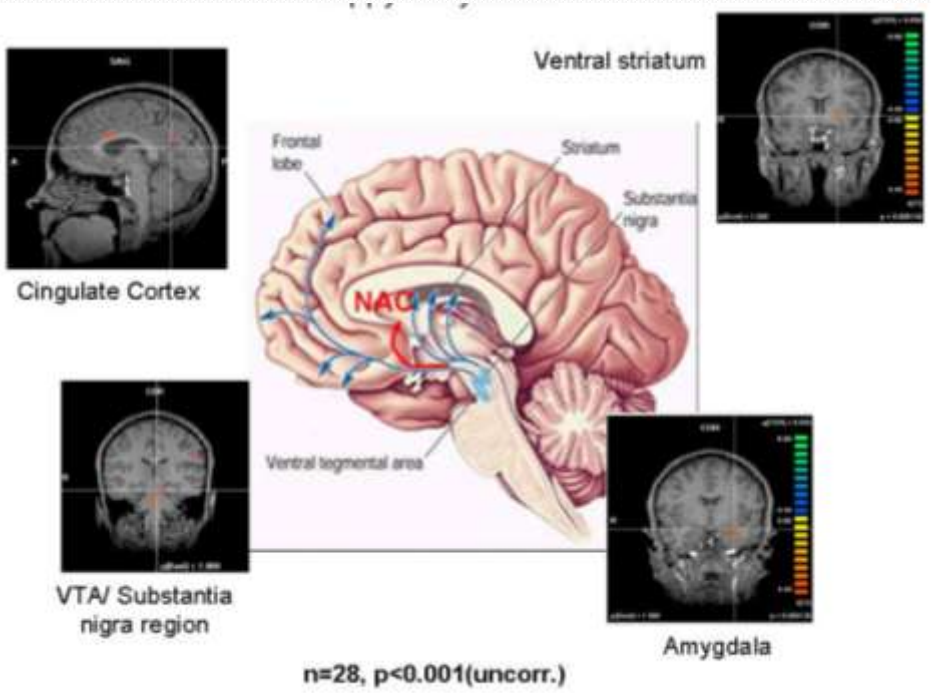
Parenting Behavior Among Substance Abusing Adults

- 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

OWN BABY VISUAL CUES ACTIVATE DOPAMINE REGULATED REWARD CIRCUITS

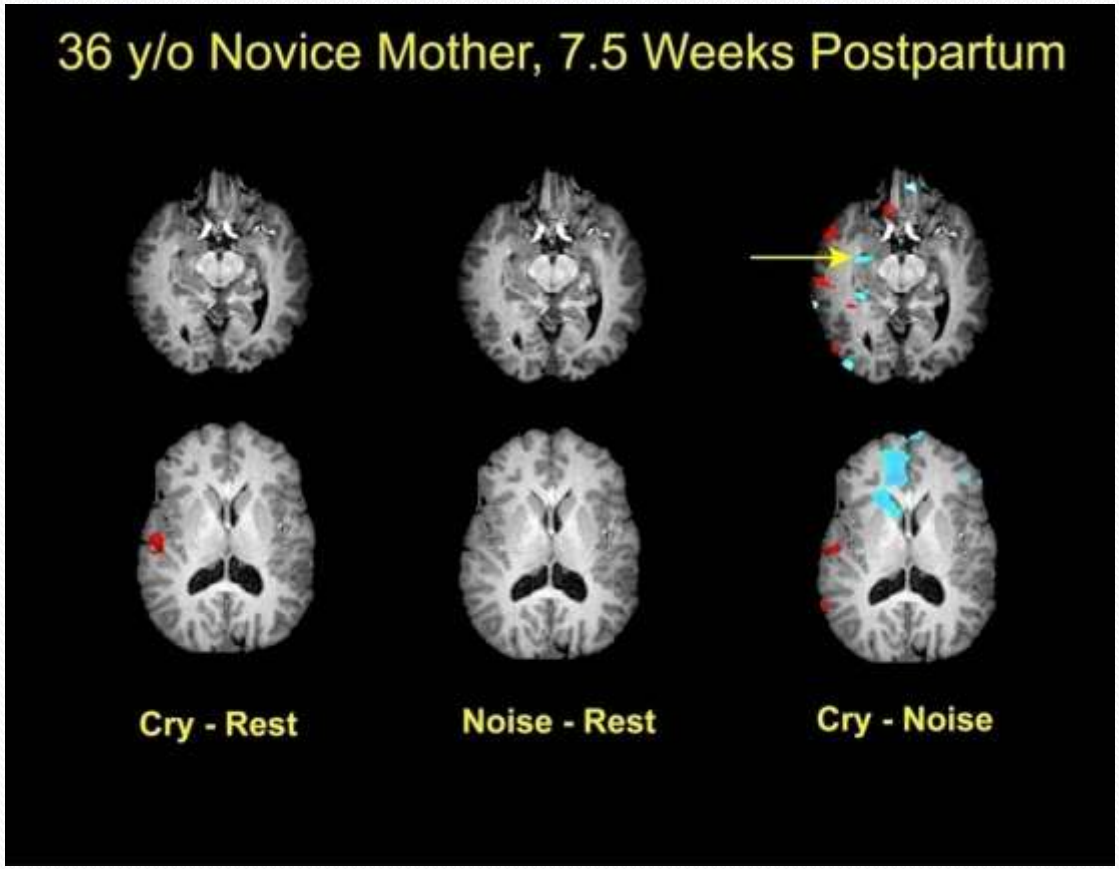


STRATHEARN, et al., 2007



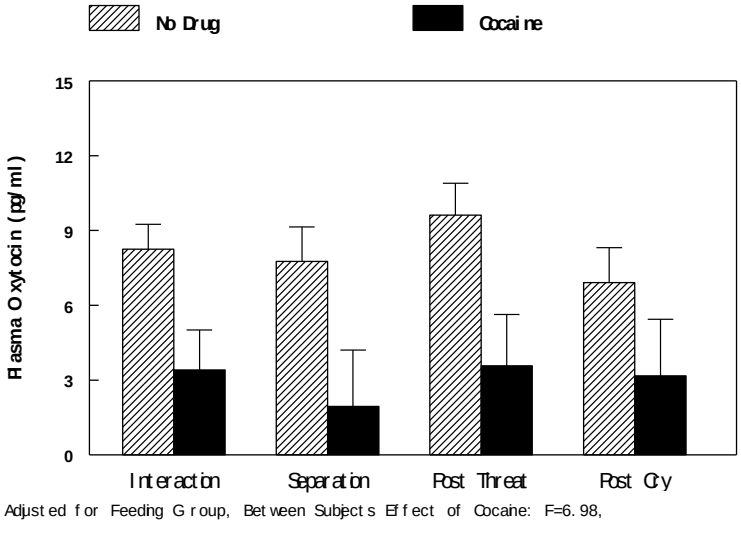
Preliminary findings in cocaine-abusing mothers: Relative decrease in activation in ventral striatum in response to infant positive affect

Substance Abuse and Parenting
Decrease in attachment related salience

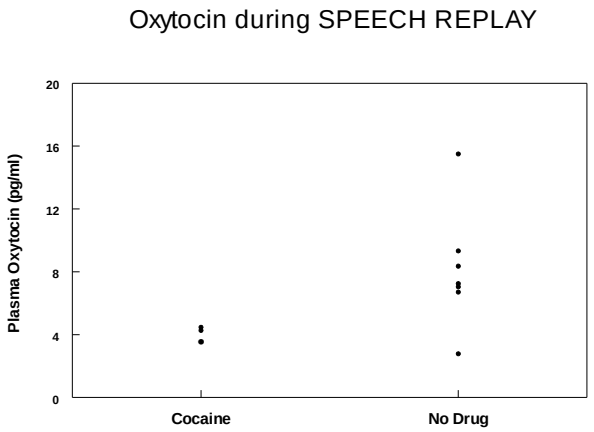


Decreased activation of right hippocampus (arrow), modest activation of right superior temporal gyrus (STG) in contrast to increased hippocampal and greater STG activation in non-drug using.

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

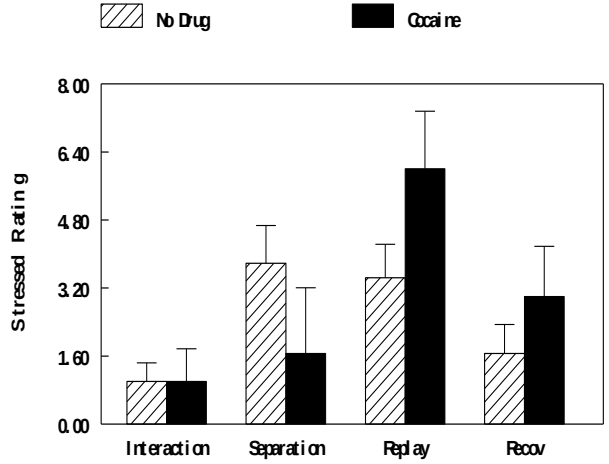


Adjusted for Feeding Group, Between Subjects Effect of Cocaine: F=6.98,



Perceived Stress

(Light, et al. 2007)



Interim Summary

- Addictive processes reflect dysregulation of stress reactivity and reward sensitivity
- Early adversity increases risk for addiction
- Profile linked to long-term effects of early adversity parallels the neural circuitry and behavioral pattern of addiction
- Addicted adults experience infant cues as both stressful and insufficiently rewarding secondary to dysregulation of stress/reward system in addiction
- Addiction is one example of a more general model for how early adversity compromises parenting

How Early Adversity/Addiction Impacts Parenting

- 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, salient infant cues are increasingly stressful and capacity to anticipate actions is diminished.

HOW INFANT CUES INCREASE STRESS AND CRAVING IN ADDICTED ADULTS

- Infant signals that are stressful, difficult to interpret, increase parental stress with withdrawal from infant
- Stress in turn increases craving for habitual behavior that downregulates acute stress
- Individual turns to drugs or other habitual behavior rather than infant (neglect…) or….
  - Needs to quieten infant to decrease own stress (poor distress tolerance) (abuse….)

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**

Intervention Implications

- Focus on adult as parent as much as on infant/child
- 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

SUMMARY

- Early adversity and impact on stress-reward systems may be a common mechanism across a range of adult disorders associated with poor parenting
- Addiction and impact on parenting is a specific model of a broader mechanism for how dysregulated stress/ reward systems compromise parenting
- With chronic parental dysfunction, poorer stress regulation in infant/child further increasing stress for parent
- May serve as a mechanism for understanding child abuse/neglect
- Interventions for at-risk children must also target parents

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