

# FUNCTIONAL NEUROIMAGING & PSYCHOLOGY OF PARENT-INFANT BONDING

J. E. Swain<sup>1</sup>, J. F. Leckman<sup>1</sup>, L. C. Mayes<sup>1</sup>, R. Feldman<sup>2</sup>, P. Kim<sup>1</sup>, and R. T. Constable<sup>3</sup>

<sup>1</sup>Child Study Center, Yale University, New Haven, CT, United States, <sup>2</sup>Psychology, Bar Ilan University, Ramat Gan, Israel, <sup>3</sup>Diagnostic Radiology, Yale University, New Haven, CT, United States

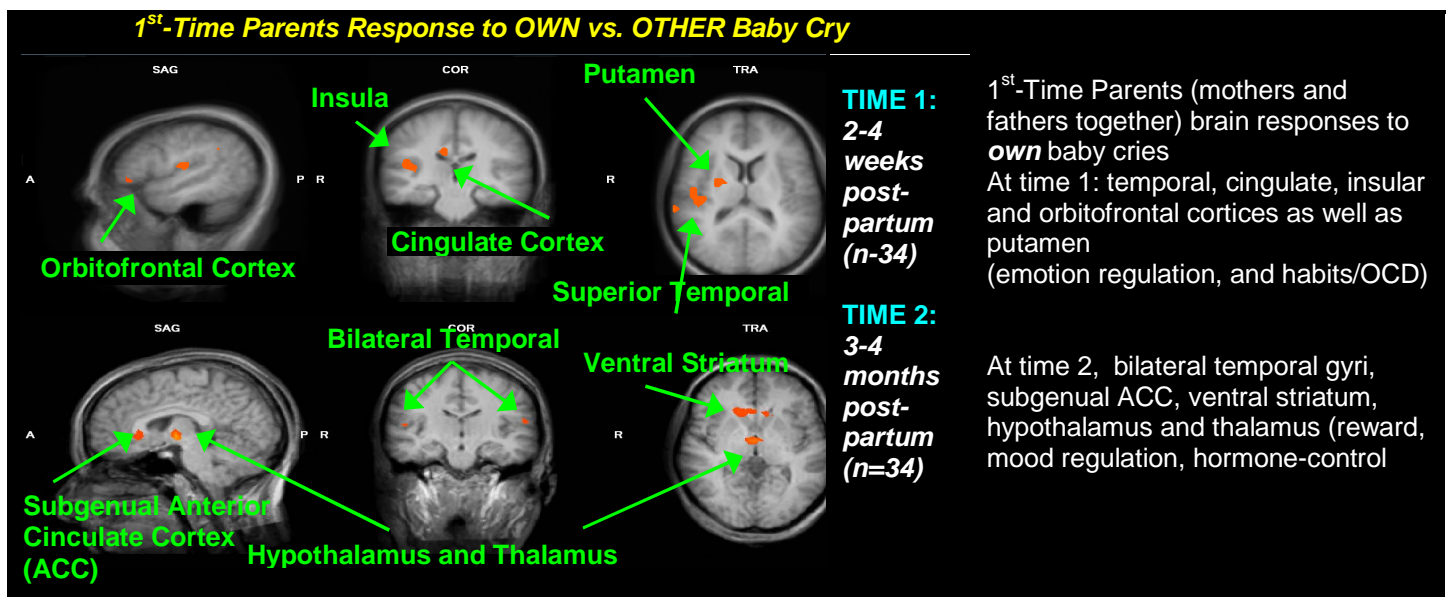
**Background:** We are attempting to delineate neural circuits and changes in thoughts and behaviors in new parents that respond to infant pictures and cries, particularly when those stimuli arise from their own infant. We hypothesize that the human capacity to form parental attachment lies within the same genetic and neurobiological substrates that are involved in experiencing empathy as well as some aspects of anxiety, obsessive-compulsive disorder and addiction

Specifically, we propose to test the hypotheses that:

- 1) baby cries activate cortical-subcortical circuits which correlate with levels of parental preoccupations involving anxious, intrusive, obsessive-compulsive-like thoughts, and these activations will be more for parents than non-parents
- 2) baby pictures activate patterns of sensory analysis and reward circuits which correlate with levels of parental preoccupations involving intrusive, but rewarding idealization
- 3) brain activations of parents to stimuli from their own infant's pictures and cries will be more robust than from control infants, and more for mothers than fathers;

**Methods:** We are studying parental attachment in several ways in 30+ sets of parents: we are administering interview and self-report versions of the Yale Inventory of Parental Thoughts and Actions, making brief videos of parent-infant interaction to assess attachment and interpersonal synchrony, we are performing functional magnetic resonance imaging (fMRI) of the brains of both mothers and fathers (using a Siemens 3T Trio scanner) while listening to baby stimuli, including own and other baby cries as well pictures. All data are acquired longitudinally at 2 weeks & 3 months postpartum. At 3-4 months postpartum, we are also acquiring brief free play videos involving mother plus infant, father plus infant, and mother plus father plus infant to assess attachment and interpersonal synchrony.

**Results:** Overall, mothers and fathers activate a stable circuit over the first four months postpartum, including regions that regulate anxiety and social cognitions. However, individual and group differences emerge according to parental status, gender, experience timing, and parenting measures. First-time parents activate more alarm centers than veteran parents, and mothers activate more than fathers. Over the first few months, alarm responses in mothers shift to hypothalamus (metabolic control), nucleus accumbens (reward), and frontal cortical (planning) activations as the parent-infant bond develops (please see figure below). Psychometric data indicate significantly higher preoccupations in moms compared to dads ( $p < 0.001$ ), and correlations of pre-occupations with depression ( $p < 0.001$ ), and brain activity in the amygdala and basal ganglia (fear, worry and OCD circuits) at 2 weeks; some correlations hold up at 3-4 months. Correlations of brain activity and parenting behavior appear in arousal and emotion control regions.



**Discussion:** Human parenting involves brain circuits of emotion, drive, salience, and habits, which are consistent with animal parenting work. Certain brain circuits are common across time and gender, while others vary with baby stimuli, gender, timing and relationship. This is the first longitudinal study to combine neuroimaging of brain regions in both mothers & fathers, with concurrent & psychometric measures. This suggests that we are now able to detail the brain basis of certain aspects of parental thoughts and behaviors, toward understanding and improving family bonding and optimizing risk and resilience health profiles.