Neural Correlates of a Mother’s Bond to Her Newborn Infant

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Introduction

A mother’s relationship to her infant is a potent bond that extends across species. One aspect of this bond in human mothers is the positive anatomy of their OFC and hippocampus.

Building on the extensive research examining maternal behavior in nonhuman animals, recent neuroimaging work with nonhuman mothers has begun to elucidate the neural substrates that govern this form of positive emotion as well as other domains of maternal attachment.

Methods

Subjects

All subjects were free of any medical or neurological problems. Twenty-seven first time mothers (age 22-39) were recruited from the Madison, WI, community.

Stimuli

Stimuli for the fMRI experiment were selected from a video shoot in which mothers were shown pictures of their own infant, a stranger infant, and an unfamiliar adult. Each stimulus type was shown to mothers in a random order.

Design

Each of the two functional scan runs included 12 half-cycles, which lasted 20 seconds each. Each half-cycle consisted of five different pictures of the same infant or adult images per cycle.

Data Analysis

Talairach transformation and a 4-mm FWHM Gaussian spatial blur were applied to the data. An averaged hemodynamic response function was used and a least squares general linear model (GLM) was fit to an orthogonalized design matrix; 240 mm FOV; TR/TE/Flip = 2000 ms/30 ms/90°; 263-270 whole-brain slices collected per run).

Anatomical and functional data were collected on a GE 3.0 Tesla system (GE Medical Systems, Waukesha, WI) equipped with a quadrature head coil and a vacuum pillow to restrict head movement. Anatomical data consisted of high resolution T1-weighted images (3D SPGR; 256x192 matrix; 240 mm FOV; 124 axial slices, slice thickness 1 mm).

Functional data consisted of 10-mm sagittal 127-weighted gradient-echo EPI slices (2 mm inter-echo gap, 60° flip angle, 940 ms FOV, TR/TE/FI=500/30-35/90°; 263-270 whole-brain slices collected per run).

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Analyses

APN was used for all post-processing of the data. Data were motion corrected, and coordinates registered.

Results

The effect of own infant and unfamiliar infant was tested with a one-sample t-test analysis. An averaged hemodynamic response function was used and a least squares general linear model (GLM) was fit to an orthogonalized design matrix; 240 mm FOV; TR/TE/Flip = 2000 ms/30 ms/90°; 263-270 whole-brain slices collected per run).

Mood ratings were analyzed by performing a voxel-wise t-test regression, computing the ratings for living, excited, happy, warm, motherly, anxious, and sad. Each rating was made on a scale from 1 (low) to 9 (high).

In this study we found greater activation in the bilateral hippocampal regions to pictures of one’s own infant than pictures of an unfamiliar infant, as specified in a t test analysis. 

Association of IBI and Mood Rating Data

Mood Rating Data

Discussion

In this study we found greater activation in the amygdala, brainstem, and the hippocampus when mothers viewed pictures of their own infant than pictures of an unfamiliar infant.

One day demonstration of the importance was highly accurate positive stimuli, consistent with other work on the amygdala (Davis & Whalen, 2003). Mothers were asked to do the same task on the same day. For each stimulus type, we found that the picture was more positive than the neutral and negative stimuli for the other mother.

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Mood Rating Data