The Cortical Sources of Face Sensitive ERP Components in Infancy

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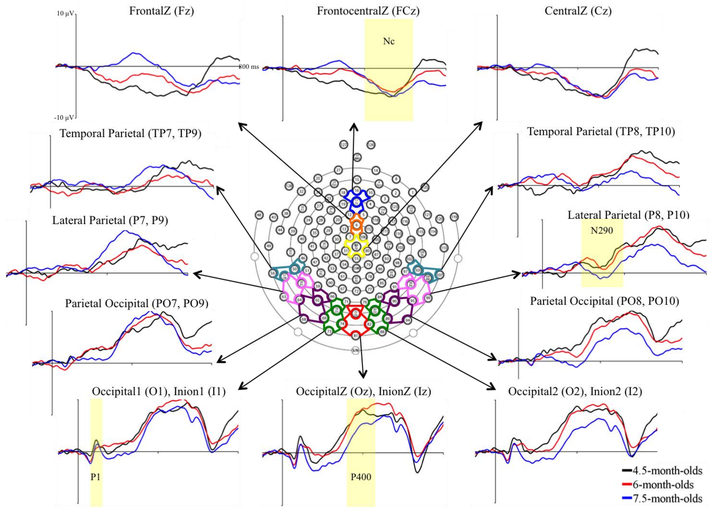
http://jerlab.psych.sc.edu/jerpdf/icis2016corticalsources.pdf

Introduction

The aim of the current study was to examine the neural development of face processing in infancy by recording event-related potentials (ERPs) and to determine the cortical sources of these neural signals. Developmental changes in the amplitude and latency of infant ERP components (i.e., N290, P400, Nc) were examined in response to faces and toys at 4.5, 6, and 7.5 months of age. ERP responses were greater in amplitude during heart rate (HR)-defined phases of attention than inattention at all components examined. The N290 was greater in amplitude to faces during attention than toys during attention. The P400 was greater in amplitude to toys than faces. The neural regions responsible for the ERP components' activation were investigated through the application of current density reconstruction (CDR), realistic head models derived from individual infant MRIs, and age-appropriate infant head templates. Source analyses were restricted to specific cortical regions of interest (ROIs) theoretically expected to be sensitive to faces.



Methods

Participants

14 4.5-month-old, 19 6-month-old, & 15 7.5-month-old infants

Stimuli

Images of the infant's mother's face, a stranger's face, the infant's own toy, and a novel toy

Procedure

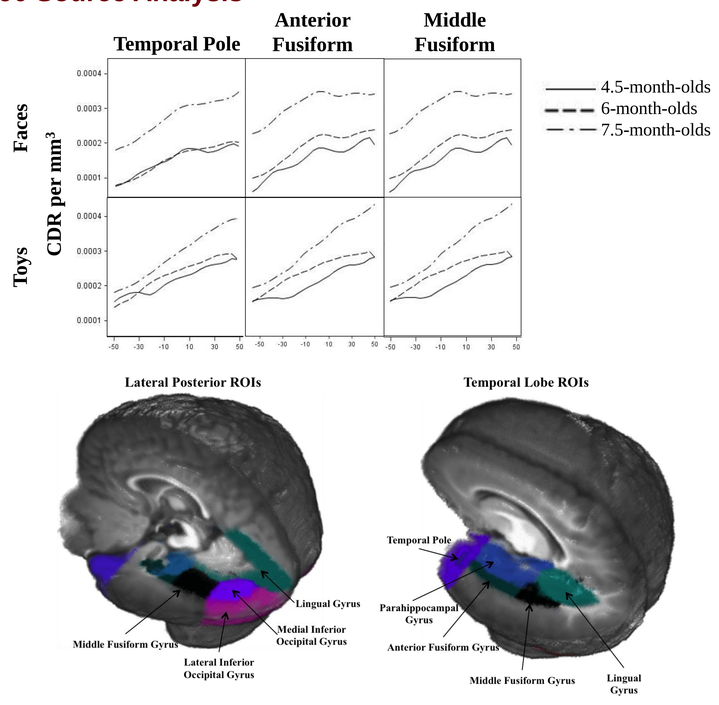
- The infant passively viewed brief stimulus presentations (500 ms) & paired comparison trials (4 s) while seated on a parent's lap in a dark room
- Recorded EEG from 124-channel EGI HGSN/GSN nets, EOG, & ECG
- Collected structural MRIs from during a separate visit to the MCBI

Cortical Source Analysis

- Structural MRIs were segmented into CSF, WM, GM, scalp, eyes, skull, nasal cavity to create finite element method (FEM) models
- Electrodes were registered to head models using fiducial locations in individual MRIs and average electrode placement maps
- Anatomical ROIs identified with stereotaxic atlases created for each MRI
- CDR estimates were calculated using EMSE software with sLORETA as the constraint and restricting sources to GM and eyes
- CDR was examined during time windows of relevant ERP components
  - N290: individualized time windows identified to capture each participant's peak at lateral parietal electrode sites
  - P400 & Nc: examined concurrently from 400-600 ms after stim onset

Results

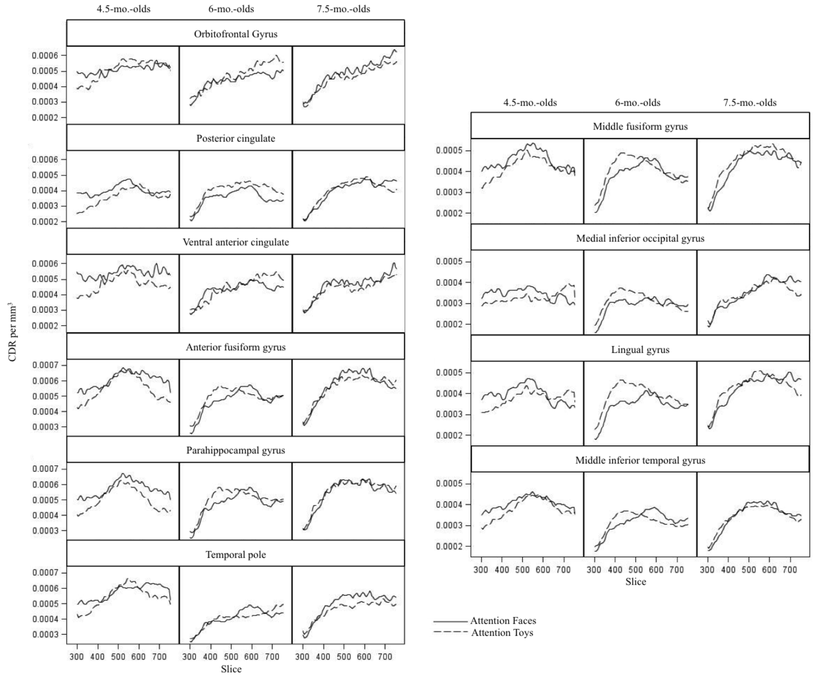
N290 Source Analysis



Activation increased with age in the middle and anterior fusiform gyri, lingual gyrus, parahippocampal gyrus, lateral inferior occipital lobe, and temporal pole. Mean activation was not significantly different across stimulus type, but linear and quadratic polynomial trends differed with age. The 4.5-month-olds showed linear slopes of activation in response to faces and toys. Six-month-olds showed linear slopes and an emerging negative quadratic trend. At 7.5 months of age, the response to toys was linear in nature, whereas the response to the faces showed a strong negative quadratic trend.

P400 and Nc Source Analysis

Results revealed significant increases in activation in the orbitofrontal gyrus, posterior cingulate, ventral anterior cingulate, anterior fusiform gyrus, parahippocampal gyrus, temporal pole, middle fusiform gyrus, lingual gyrus, medial inferior occipital gyrus, and the inferior middle temporal gyrus.



Discussion

The linear trend to both faces and toys during the time window of the N290 likely reflects the emerging P400 and Nc activity occurring after the N290 latency, whereas the quadratic trend to faces in the older participants reflects the cortical source of the N290 deflection in the ERP. Results indicate that brain areas associated with face specific processing show greater activation with age.

The results of this study are included in the manuscript, "The cortical development of specialized face processing in infancy," currently in press in *Child Development.* Additionally, the data are included in a broad analysis of the development of face processing across the first year of life (http://jerlab.psych.sc.edu/jerpdf/icis2016facesbrain.pdf).

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