

## INTRODUCTION

Specialized processing of faces begins early in life, yet we are just beginning to understand the neural underpinnings of the development of face expertise in infancy. Adults exhibit differential neural responses to faces as opposed to other classes of objects, evidenced by a larger N170 amplitude for faces than for objects. The N170 is a negative event-related potential (ERP) component occurring about 170ms post-stimulus onset, and research with infants has found two components that may be precursors to the adult N170. One of these components, the N290, is a negative deflection over posterior regions peaking at 290ms that is greater in amplitude for faces than visual noise (Halit, Csibra, Volein, & Johnson, 2004). In the first year of life, as infants acquire extensive exposure to faces, the N290 begins to differ in response to upright (as opposed to inverted) faces and to human (as opposed to monkey) faces (de Haan, Pascalis, & Johnson, 2002). However, few studies have examined whether changes occur in the morphology of the N290 that correspond to emerging expertise with faces as opposed to other objects. In the current study, infants' ERPs were recorded while infants of three different ages (4.5, 6, and 7.5 months) passively viewed faces and objects (toys). We also tested 9- and 12-month-olds (N = 8, 20, respectively).



Pictures were taken of the infant's mother and infant's favorite toy when they arrived for the study.



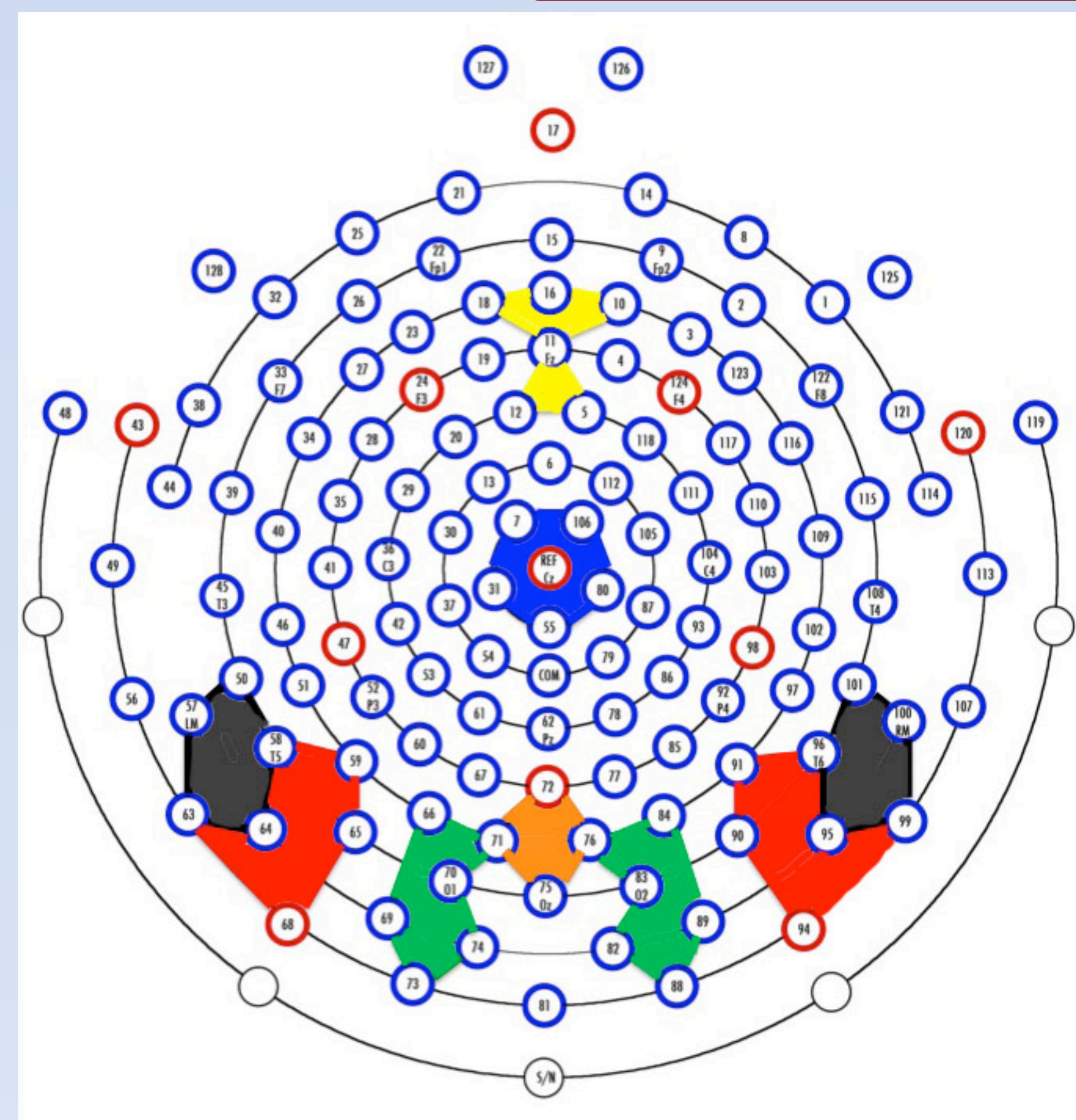
### Participants:

14 4.5-month-olds, 17 6-month-olds, 13 7.5-month-olds; additional groups, 8 9-month-olds, 20 12-month-olds.

**Stimuli:** Images of: infant's own mother, another infant's mother, infant's own toy, another infant's toy

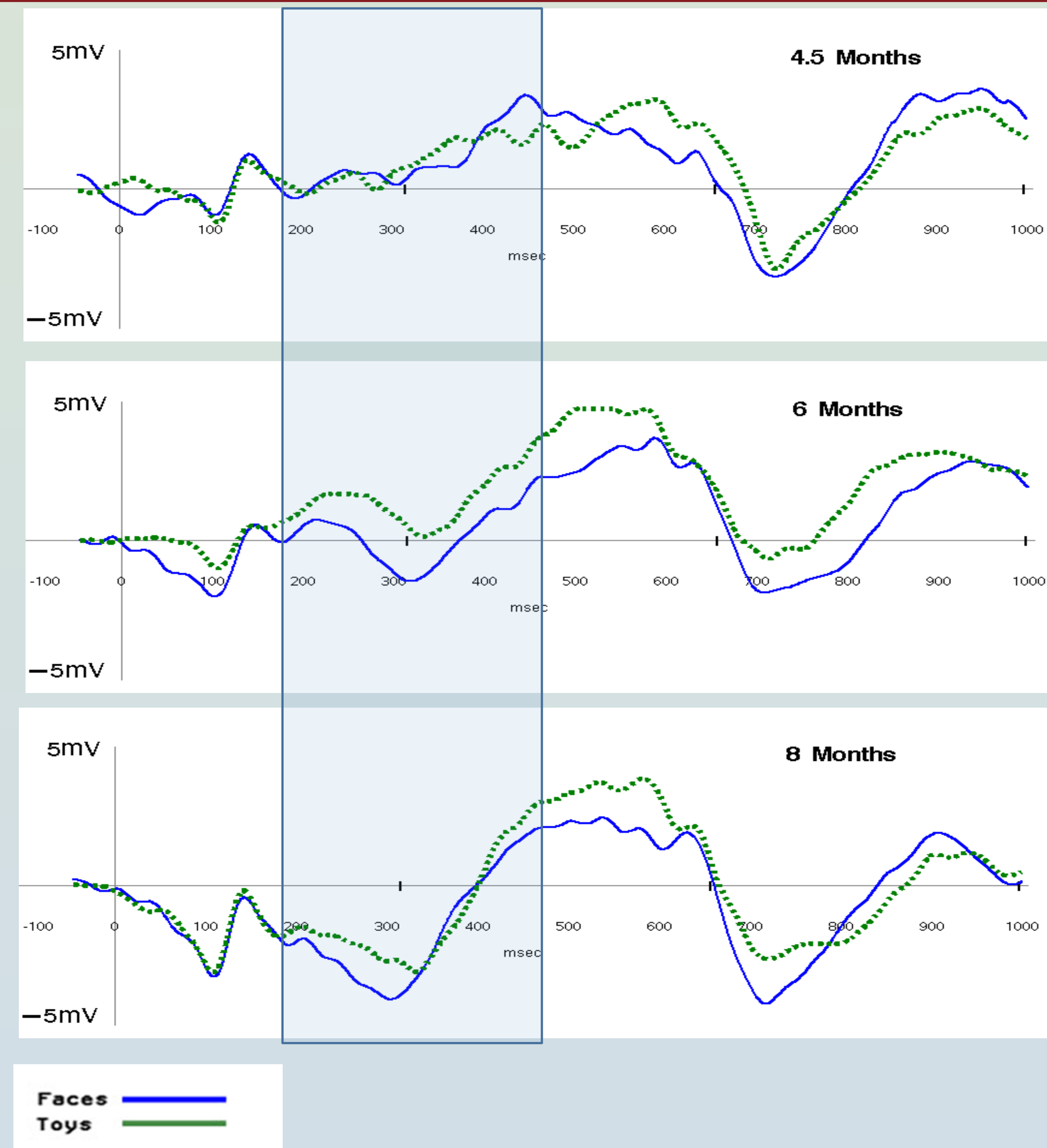
### Procedure:

- Infants passively viewed a series of brief stimulus presentations (500 ms) of the images randomly interspersed across trials.
- High-density EEGs were recorded using an EGI 128-channel Geodesic Sensor Net.
- EEG data was analyzed for groups of electrodes over occipito-temporal regions (e.g., around T5, T6, O1, O2, Oz) based upon previous infant studies (de Haan et al., 2002).
- For each participant, ERP grand averages were computed for the time of the target onset, and the peak amplitude was derived using individualized time windows to capture each subject's N290; done with 1 Hz high-pass filter.
- The Nc was calculated from 350 to 700 ms post-stimulus onset



## RESULTS: N290 to Faces and Toys

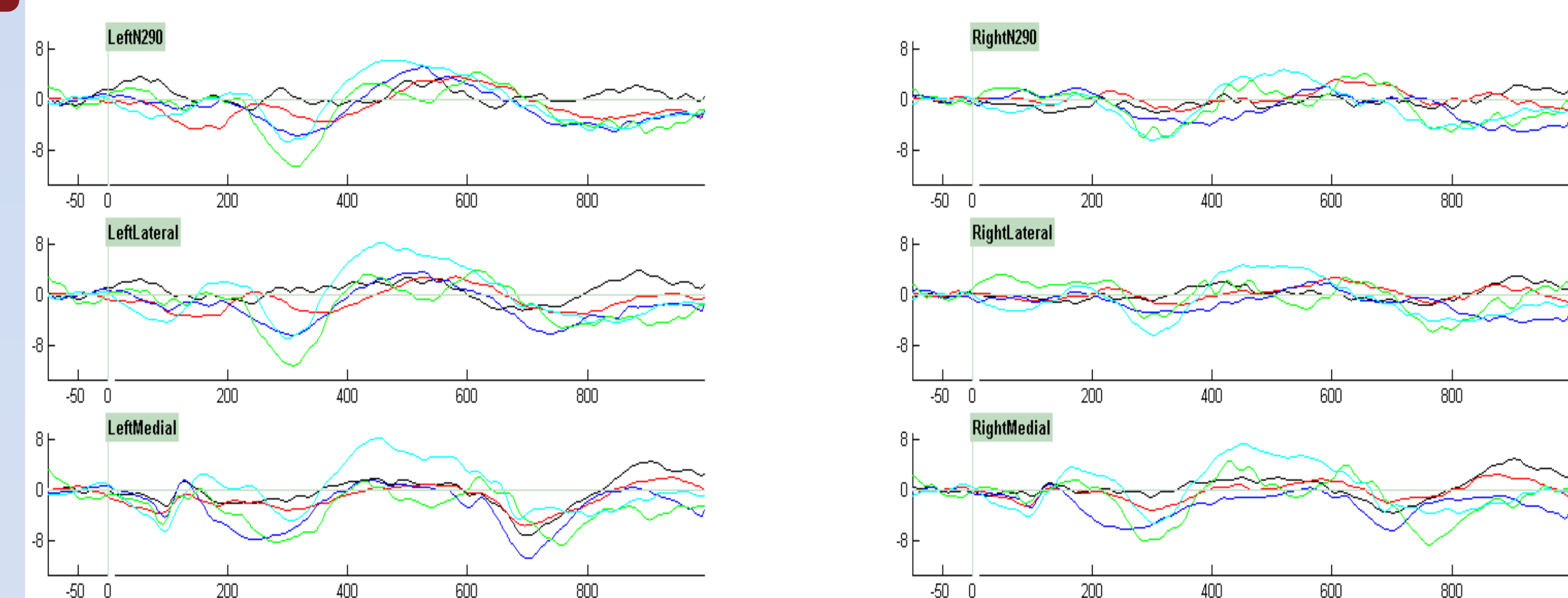
The dependent measure was the mean amplitude of the N290 component. A main effect of age was found for the three youngest ages [ $F(2, 88) = 5.81; p < .005^*$ ], and the increase in the amplitude of the N290 from 4.5 to 7.5 months can be clearly seen in the Figure below. There was also a marginally significant effect of trial type [ $F(1,88) = 3.26; p < .07$ ], as the amplitude was larger for faces than for toys (but the interaction was not significant). Thus, the N290 amplitude was larger for faces than for toys (see Fig. 1), and increased in amplitude across the age groups.



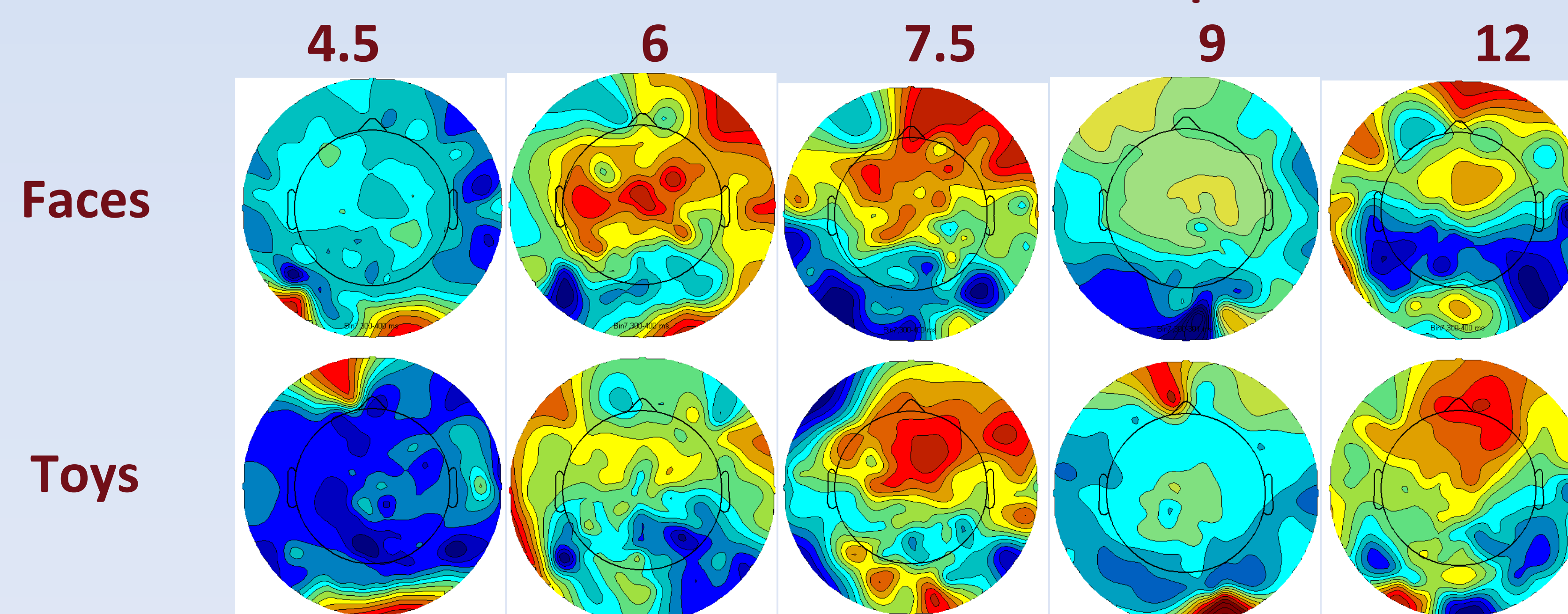
N290 peaks (see highlighted areas) for 4.5-, 6-, and 8-month-olds while viewing faces or toys.

## Spatial distribution of ERP to faces and toys over age

The response to faces over age showed two trends. First, there was an increase in the size and distinctness of the N290 component from 4.5 through 12 months. Second, there was an increasing laterality effect in two ways. There was an increase in the left-lateralized N290 in the three electrode sites ("N290", "Lateral", "Medial"), and the difference between the N290 to faces and toys increased in the left sites but not in the right. The figures below show the responses to faces for the ERP tracings on left and right sides and at the different sites. (4.5, 6, 7.5, 9, and 12 months are black, red, blue, aqua, and green, respectively)



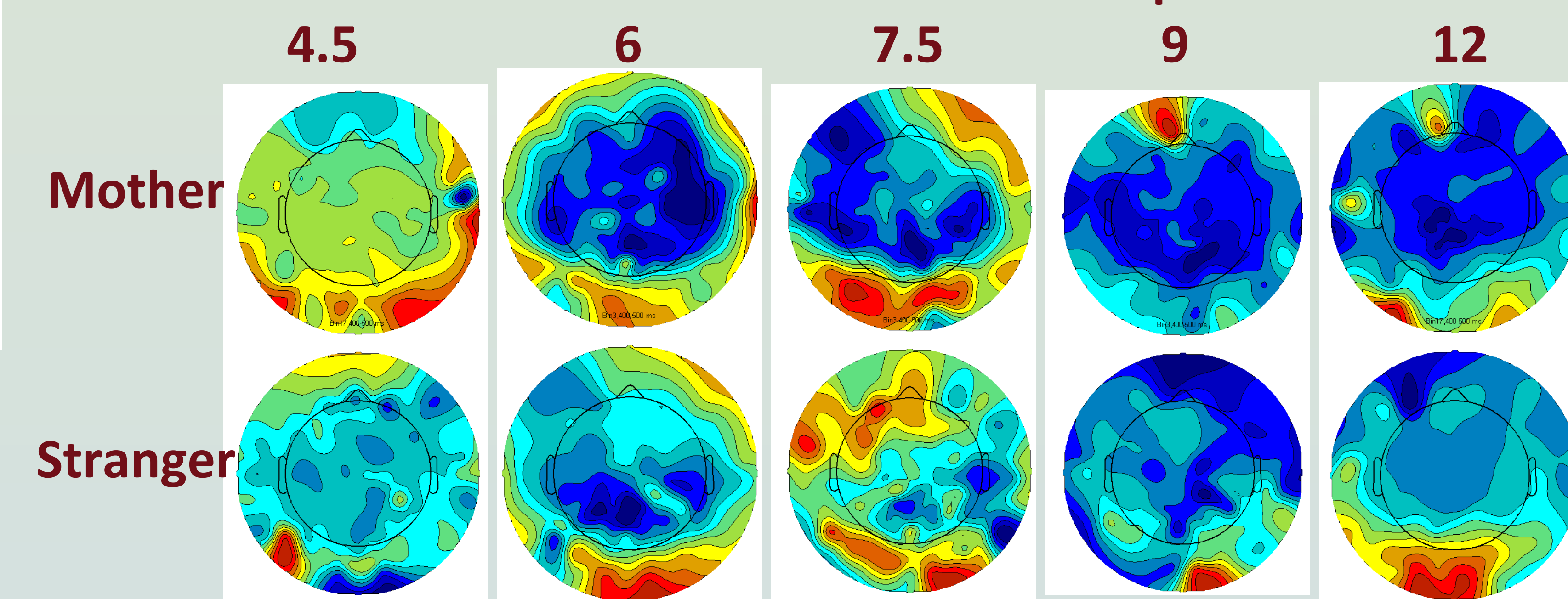
### Mean ERP from 300 to 400 ms post-onset



## RESULTS: Nc Component

The Nc component is a negative ERP component occurring over the frontal-central scalp regions (e.g., "Negative Central"). It is related to infant attention and is likely the first component reflecting the arousal mechanisms in the brain. The response to faces and toys were similar for the Nc, but there was a clear increase in the Nc component response to the mother's face compared to the stranger face.

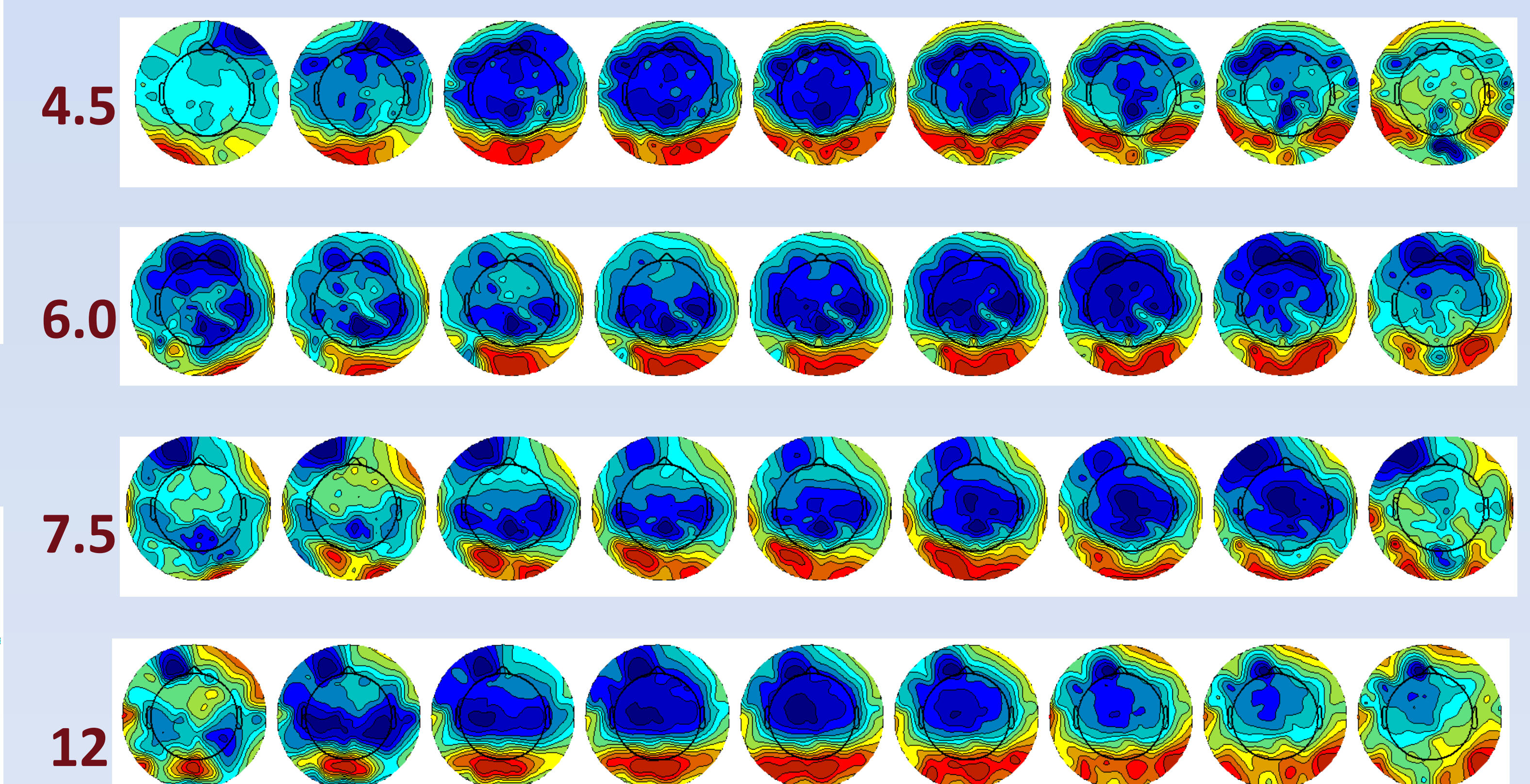
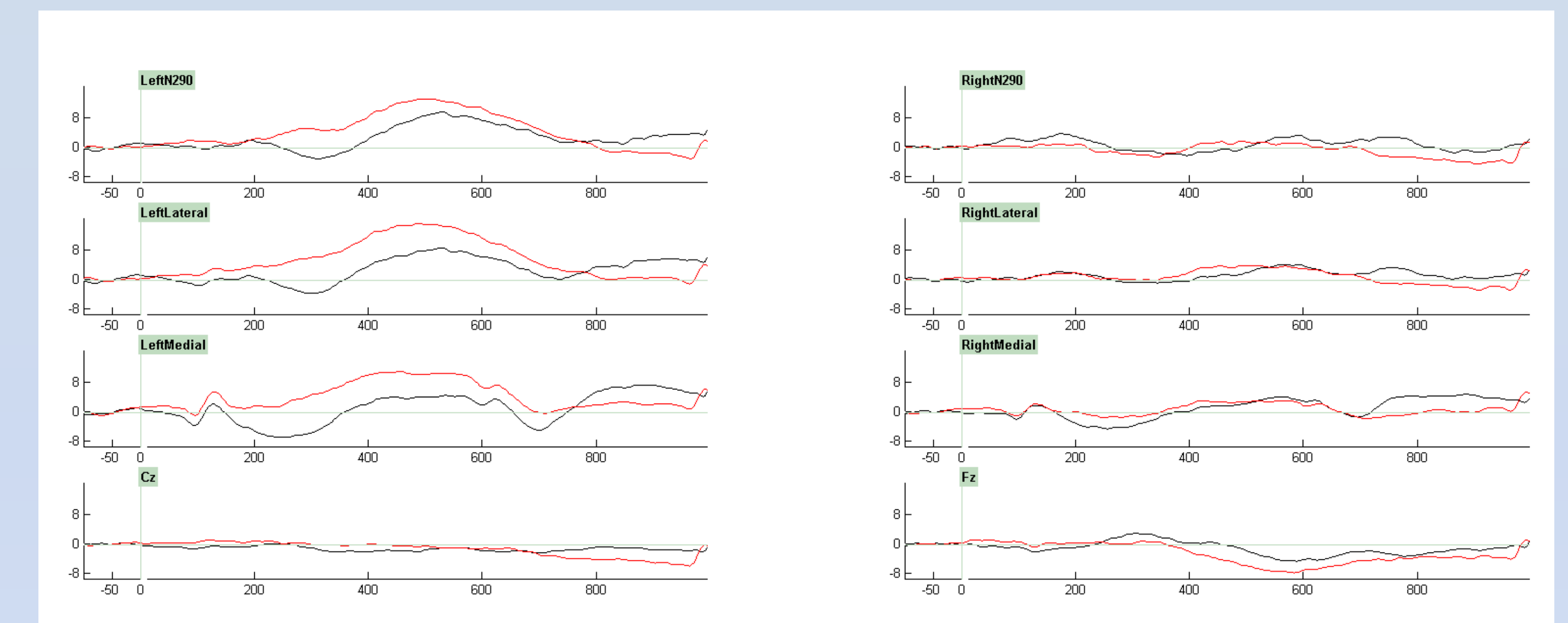
### Mean ERP from 300 to 700 ms post-onset



## One intermediate component, or separate P400 and Nc?

Researchers studying infant response to faces often analyze a P400 (P4) component. This component is a large positive component centered over the central and medial electrodes on the posterior scalp area. The Nc begins about the same time but is over the frontal electrodes. Is it possible that the P4 is the positive pole of the Nc? The time course of the P4 and Nc were very similar in this study; perhaps if they are functionally related to the same independent variables and have the same cortical sources, we might conclude they are from the same brain area. The 7.5 mo old ERP components show a large overlap in the time course between the posterior and Fz electrodes, and topographical scalp potential maps show a similar time course.

### ERP Components for electrode groups for 7.5 mo



## REFERENCES

1. Halit, H., Csibra, G., Volein, A., & Johnson, M. (2004). Face-sensitive cortical processing in early infancy. *Journal of Child Psychology and Psychiatry*, 45(7), 1228-1234.
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## CONCLUSIONS

The current study documents a developmental change in the face-sensitive N290 corresponding to a time period when infants are developing expertise with faces. These studies suggest that, like adults, infants demonstrate special processing of faces compared to other objects, and that the N290 is similar to the N170 in that its amplitude is greater to faces than other objects. The N290 is similar in its response to familiar and unfamiliar faces (e.g., mother, other mother), but the Nc component shows a difference for mother's and stranger's face. This could mean the early component (N290) is differentiating overall form or stimulus type, whereas the later component is response to processes of attention and cognitive processing.