

VISUAL RECOGNITION MEMORY AND BRAIN ELECTRICAL ACTIVITY IN 5- & 10-MONTH OLD INFANTS



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INTRODUCTION

Children who demonstrate preferences for novel objects relative to familiar objects during infancy tend to have higher IQ scores during childhood. As a result of this consistent research finding, there has been a great deal of attention given to infant attentional and memory processes. Much of this infant work has focused on memory processes and associated neural networks, such as hippocampal and temporal areas. Individual differences in visual attention during the familiarization phase of infant memory paradigms are highly correlated with the amount of time spent looking at a novel object during the testing phase when infants can choose to look at the familiarized or novel object. Posner (Posner & Raichle, 1995) has suggested that the vigilance attentional network of the brain is involved in effortful sustained processing of continuous visual stimuli. It may be that it is individual differences in the functioning of the vigilance attention network yield individual differences in infant novelty scores.

In this study, we examined infant brain electrical activity (EEG) during the familiarization phase of the infant recognition memory paradigm. We hypothesized that infants with a novelty preference would have different EEG patterns in frontal scalp locations (corresponding to areas implicated in Posner's vigilance system) as compared to infants who do not demonstrate a novelty preference. In addition, we investigated brain electrical activity patterns at temporal scalp sites, and hypothesized that infants with novelty preference (thus successful recognition memory) would have greater temporal activity during the retrieval test phase.

METHOD

Participants

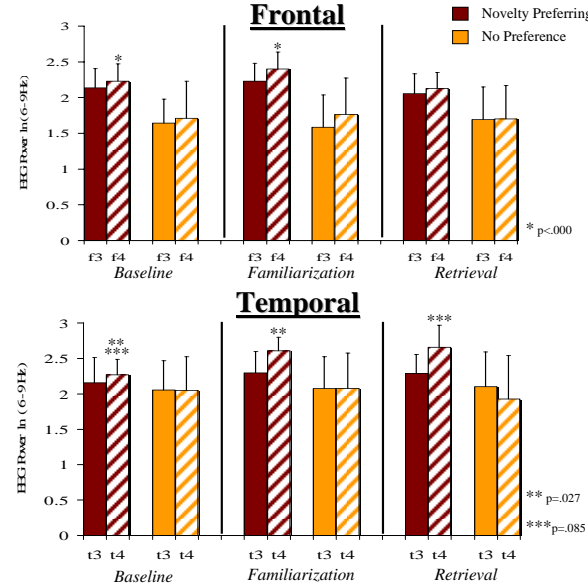
Twenty-three 5-month-old infants were recruited from the New River Valley area of southwest Virginia to participate in this study. Infants were recruited if they were born within 2 weeks of their expected due dates and experienced no prenatal or birth complications. All infants weighed at least 2,500 grams at birth, required no oxygen at birth, and had no neurological diagnoses.

These data are drawn from a subset of participants from an ongoing longitudinal study following the cognitive and socio-emotional development of 100 infants into early childhood. Preliminary analyses of these data will be discussed.

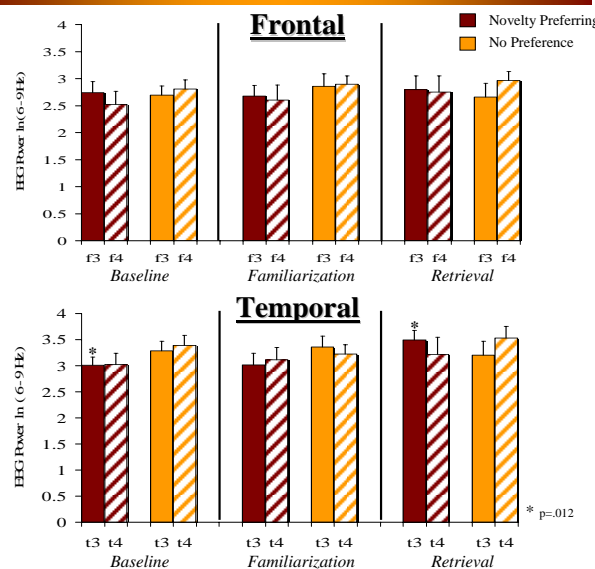
Procedures

	Electrode Application	With the infant seated on the caregiver's lap, the experimenter applied EEG and ECG electrodes as an assistant entertained the infant.
	Baseline Recording	Baseline physiology was collected as the experimenter manipulated an infant toy and tapped her fingernails for 60 seconds.
	Familiarization	Infants encoded the familiarization puppet by accruing 4 looks, each separated by a 3-second look away from the puppet (Diamond, et al., 1997).
	Retrieval	Approximately 20 minutes after familiarization, infants were allowed to look at both the novel and familiar puppets for 30 seconds to establish a visual preference.

5-MONTH-OLDS



10-MONTH-OLDS



RESULTS

Visual Preference

Visual preference was calculated according to Fagan's criteria (1971). During the retrieval phase, infants who spent more than 53% of the time looking at the novel puppet were labeled as Novelty Preferring (n=9). Infants who spent less than 53% of the retrieval phase looking at the novel puppet were categorized as having No Preference (n=14). After the 10-month visit, infants were regrouped according to the visual preference displayed at 10-months (6 novelty-preferring, 11 non-preferring).

5-month-olds

Infants who demonstrated a novelty preference at 5 months of age showed increased EEG power from baseline to task, specifically increased right frontal (F4) activity during familiarization (p<.000), as well as increased right temporal activity (T4) during familiarization (p=.027) and retrieval (p=.085). In previous work from our lab (Bell, 2001, 2002), infants who were high-performers on a test of infant working memory demonstrated EEG power increases from baseline to task. The current study replicates this trend with a recognition memory task. Non-preferring infants displayed a lack of task-related changes in brain electrical activity from any frontal or temporal scalp sites.

10-month-olds

Infants who demonstrated a novelty preference at 10 months of age showed increased EEG power from baseline to task only at left temporal site T3 (p=.012). As with 5-month-olds, 10-month-old infants without a novelty preference displayed no task-related changes in brain electrical activity from any frontal or temporal scalp sites.

DISCUSSION

Five-month-old infants displaying a novelty preference showed a different pattern of brain electrical activity than infants without a novelty preference. This pattern of EEG activity may suggest that differences in executive attention during encoding impact novelty preference. In addition, novelty-preferring infants had greater task-related right temporal activity when compared to infants without novelty preference during both familiarization and test. This temporal area has been associated with recognition memory (Nelson, 1995), specifically facial recognition (Barr, 1997), which is appropriate as the glove puppets contain several facial features. However, 10-month-olds preferring novelty showed an altered pattern of EEG in that novelty-preferring infants showed task-related changes only at left temporal site T3 during the retrieval phase.

Across the ages tested, 22% of the sample maintained a stable novelty preference. This is consistent with recent work by Colombo, Shaddy, Richman, Maikranz, & Blaga (2004) who indicated that although novelty preferences are intact for young infants (using a facial stimuli), these preferences degrade and eventually are absent by 9 months, as faces are categorized into a single class. Our lack of overall novelty preference at 10 months, and instability in novelty preference across age, reflect Colombo et al.'s (2004) findings.

Perhaps infants who display a novelty preference at 10 months are developmentally different than those who do not. Indeed, the associated pattern of EEG would suggest that the expression of a novelty preference at 5 months is qualitatively different than at 10 months. It may be that although facial stimuli, as used in the current study and Colombo's work, are sufficient to produce a novelty preference in 5-month-olds, more developmentally appropriate stimuli should be employed when studying recognition memory in older infants.