

Feeding Patterns Effect Brain Development in Infancy

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Introduction

- Previous research has linked the benefits of breastfeeding to infant health and to the maturation of the brain. Studies have found that feeding type influences the development of the central nervous system as well as behavioral development (Jing, Gilchrist, Badger, & Pivik, 2010).
- Greater frontal asymmetry patterns have been found for infants who are breast-fed over infants who are formula fed. (Jones, McFall, & Diego, 2004). This pattern is associated with enhanced neurodevelopmental functioning.
- Coherence, a measure of the connectivity between different regions of the brain, had yet to have been looked at in relation to infant feeding patterns.
- The purpose of the present study was to examine the effects of different infant feeding patterns on infant brain development. Specifically, the composition of breast versus formula milk and the method, breast versus bottle.
- Patterns of infant EEG coherence and asymmetry were examined across the left and right hemispheres and across anterior to posterior regions.
- It was hypothesized that infants who were breast-fed would have the fastest speed in connections between measured electrode sites (taking into account variable speeds due to long and short coherence bands), and that infants who were formula-fed would display slower speeds in connections between measured electrode sites.

Method

Participants

- 113 mothers and their infants participated in the one-month visit. Of these, 82 returned for the 3-month visit. 26 of which were bottle-fed and 56 of which were breast-fed.
- 59 participants had coherence data across all leads. Of the 59, 16 were bottle-fed and 43 were breast-fed.

Materials

EEG software and equipment manufactured by James Long, Inc.

Procedure

At both the 1- and 3-month visit mothers were asked to feed their infants following an initial play interaction. Feeding type included both breast-feeding and bottle-feeding. EEG data was collected during each session

Physiological Recordings

- Infant EEG was obtained from frontal, central, parietal, and occipital sites, specifically sites F3, F4, C3, C4, P3, P4, and O1, O2, respectively.
- EEG was analyzed using the frequency bands for infants, specifically 3-6 Hz and 6-9 Hz for both the 1 and 3 month olds.

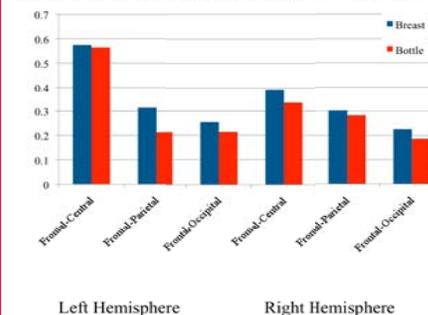
Data Reduction and Analysis

- EEG coherence scores, a measure of phase differences over a specific frequency band between two spatially different electrode sites (Cuevas & Bell, 2010), were computed for the relationship of the bands within each hemisphere.
- Measures of frontal hemispheric asymmetry, the cortical activation of the left and right hemispheres, were also computed.

Results

- Overall a series of repeated measures MANOVAS demonstrated significant effects for infant feeding type on infant brain maturation.
- No main effect was demonstrated for age.
- For measures of EEG coherence, a significant 4-way interaction was demonstrated for the 3-month old infants between region (anterior vs. posterior), length of communication (short, medium, and long), side (left hemisphere vs. right hemisphere), and feeding type (breast vs. bottle). Significant main effects were obtained across region, $F(1,57) = 50.28$, $p < .000$, indicating differential influence of the anterior and posterior leads. Thus further analyses were conducted separately for these regions.
- To assess our main hypothesis, a subsequent MANOVAS comparing communication from the frontal region to other regions showed a significant 3-way interaction for length, side, and feeding type, $F(1,57) = 4.44$, $p < .05$. As noted in the figure, the pattern of coherence differed, with breastfeeding infants exhibiting faster communication between the frontal region and all other sites than bottle-fed infants.
- In addition, analyses demonstrated differences in frontal EEG asymmetry, with breastfed infants showing greater relative left frontal EEG asymmetry and those that were formula fed showing greater right frontal and central EEG asymmetry, $ps < .05$.

Coherence Measures at 3-Months



Discussion

- Infant feeding type influences the maturation of the brain of infants during the first three months of life.
- As hypothesized, breast-fed infants displayed faster communication between all measured sites than did bottle-fed infants. This is consistent with findings from previous studies that emphasize breast-feeding promotes more optimal neurodevelopment.
- Similar to previous studies, infants who breastfed showed patterns of greater left frontal EEG asymmetry. The left hemisphere activation is associated with positive mood states whereas the right hemisphere activation is associated with negative mood states (Jones, McFall, & Diego). This indicates that breastfeeding plays a positive role in infant temperament.

References

- Cuevas, K., Bell, M.A. (2010). EEG and ECG from 5 to 10 months of age: Development, cognitive processing, and individual differences in performance on a spatial working memory task. *International Journal of Psychophysiology*, 80, 119-128.
- Jing, H., Gilchrist, J. M., Badger, T. M., & Pivik, R. T. (2010). A longitudinal study of differences in electroencephalographic activity among breastfed, milk formula-fed, and soy formula-fed infants during the first year of life. *Early human development*, 86(2), 119-25. Elsevier Ltd.
- Jones, N.A., McFall, B.A., & Diego, M.A. (2004). Patterns of brain electrical activity in infants of depressed mothers who breastfeed and bottle feed: the mediating role of infant temperament. *Biological Psychology*, 67, 103-124.