

Longitudinal Associations Between the Quality of Mother–Infant Interactions and Brain Development Across Infancy.

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Child Development (2016) 87, 1159-1174

The authors make the hypothesis that good nurturing of infants will have a positive effect on the synapses forming in the brain. They are looking for possible links between early care-giving experiences and children's brain development. They note that very little research has been done so far on normal mother-infant relationships. We have only seen evidence from worst case scenarios of neglect in orphans or in children of severely stressed mothers. The research in animals has indicated what we might find, but no-one has yet done the research in human mother-infant pairs.

In this research, pairs of mothers with their infant were tested at three time periods. The study was done in USA with mothers representing several ethnic groups. Their offspring were approx. 53% daughters to 47% sons. The study started with over 352 mothers, but by the third examination, there were only 215. 197 pairs attended all three tests. The infants were analysed at the age of 5, 10 and 24 months. As some families moved away with time, the number of families participating declined.

At each test, a cap with 16 electrodes, connected to an electroencephalograph (EEG), was positioned on the baby's head. A 1 minutes' base line on the EEG was obtained whilst the assistant kept the attention of the baby with a bright, colourful toy. This quietened the infant and reduced their eye and body movements. Then the infant was placed in a seat and the assistant left the room. The mother was filmed playing with her baby for 2 minutes with two specific toys. The mother's maternal behaviour was scored (as four traits) from the video recording at only the initial time point of 5 months. At each of the three time points, the alpha and theta signal from EEG were recorded and converted to "alpha power" and "theta power".

The theta signal is the lower wavelength of the two and this band has been associated by other authors with infant working memory and inhibitory control. The alpha signal is the higher wavelength and has been associated with infant attention and emotion. The "signal" reflects post-synaptic activity and the EEG "power" reflects the excitability of groups of neurons; the latter is believed to be a measure of brain development. More neural activity translates into higher EEG power. EEG power increases almost linearly with age across infancy and is therefore considered indicative of brain development.

The authors chose to use readings from the electrodes over the front of the brain, based on their previous papers which showed that the biggest differences were observed in the frontal areas. In this study the readings from the left and right side electrodes were averaged for each of the three frontal pairs of electrodes detecting brainwaves from the front cortex of the brain. The authors were not concerned with differences between the left and right side of the brain.

Mothers were scored according to a coding system developed by the second author and this can be further referred to in her previous papers. There were four measurements recorded by the experimenter (at 30, 60, 90 and 120 seconds) per maternal behaviour and a scale of

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1=none, 4= high was used for each dimension. These four measurements were averaged over the 2 minutes.

- 1) Maternal sensitivity: this was the extent to which the mother's interactions were correlated with the infants. It included appropriate levels of stimulation by the mother, soothing, picking up on the infant's interests,
- 2) Maternal intrusiveness: this was the extent to which the mother displayed over-controlling behaviour or was focused on her own agenda, ignoring the infant's cues. It included appearing to force toys or herself on the infant. High intrusiveness is a negative trait.
- 3) Maternal positive affect: the extent to which the mother expressed positive emotions to the infant, using tone of voice, facial expressions, ranging from brief or slight smiles up to smiling and laughter.
- 4) Maternal physical stimulation: the extent to which the mother directly stimulated the infant's body for the purpose of heightening the infant's arousal, including tickling, exercising the infant's limbs, rubbing the mother's face on the infant or touching a toy on the infant. High stimulation is a negative trait, if a mother can use her voice and smiles to communicate, she does not need to resort to physical stimulation.

The 4 measurements were reduced to two by combining the scores of 3) and 4) called maternal positive effect and the scores of 1) and 2) called maternal intrusiveness.

There was no positive correlation between maternal intrusiveness and EEG "frontal" power (detected in the front 3 pairs of electrodes). The authors were surprised that this was the case, but felt it may have been due to the methods used. It may take more than 2 minutes to see and score the subtle traits of sensitivity or intrusiveness.

In contrast, maternal positive effect (measured at 5 months) correlated significantly with EEG frontal power and correlated positively with EEG power at 10 months and 24 months. EEG power increases with age and is a measure of brain development. There were however larger increases in EEG power in infants from 5 to 10 months and from 10 to 24 months if the mother had higher scores in maternal positive effect. Although the magnitude was modest, the authors argued that finding reliable links between maternal behaviour assessed in a brief free play and infant EEG power several months later is remarkable, and could suggest that the underlying links between maternal parenting and children's brain development are especially robust. On the other hand, the small effect sizes they observed almost certainly suggest that many other biological and environmental factors could influence brain development. The authors felt that this was the first time that correlations like this had been shown. The design was nonexperimental so we cannot infer a cause and effect, only a correlation. If these results are taken in the context of other research, then they are important in being among the first to show that normative variation (i.e. in the normal range) in parenting quality may be sufficient to influence the normative course of early brain development in infants. In the future we may find out if these differences are responsible for the profound effects of parenting on child development.

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