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Infants of Depressed Mothers Are Less Responsive To Faces and Voices: A Review

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Abstract

A review of our recent research suggests that infants of depressed mothers appeared to be less responsive to faces and voices as early as the neonatal period. At that time they have shown less orienting to the live face/voice stimulus of the Brazelton scale examiner and to their own and other infants' cry sounds. This lesser responsiveness has been attributed to higher arousal, less attentiveness and less "empathy." Their delayed heart rate decelerations to instrumental and vocal music sounds have also been ascribed to their delayed attention and/or slower processing. Later at 3–6 months they showed less negative responding to their mothers' non-contingent and still-face behavior, suggesting that they were more accustomed to this behavior in their mothers. The less responsive behavior of the depressed mothers was further compounded by their comorbid mood states of anger and anxiety and their difficult interaction styles including withdrawn or intrusive interaction styles and their later authoritarian parenting style. Pregnancy massage was effectively used to reduce prenatal depression and facilitate more optimal neonatal behavior. Interaction coaching was used during the postnatal period to help these dyads with their interactions and ultimately facilitate the infants' development

Prenatal depression has been noted to have physiological and biochemical effects on the fetus and neonate (Field, Diego & Hernandez-Reif, 2006). Infant perception and behavior have also been affected. Given the dysregulated physiological (right frontal EEG and low vagal activity) and biochemical profile (elevated cortisol and lower levels of serotonin and dopamine) of newborns of prenatally depressed mothers, infants of depressed mothers might be expected to have higher arousal levels and show less discrimination of different stimuli. In this paper we have focused on studies demonstrating less optimal perceptual performance in neonates and infants of prenatally depressed mothers. The review is limited to studies conducted during the last several years and in our lab only because we could not find other studies on prenatal depression effects on infants' responses to faces and voices.

Newborns' Responses to Faces and Voices

In a study on newborns' responses to a live face/voice, neonates born to prenatally depressed mothers were compared to neonates of non-depressed mothers on individual items of the Brazelton Neonatal Behavioral Assessment Scale (NBAS) (Hernandez-Reif, Field, Diego &

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Ruddock, 2006b). The neonates of depressed mothers received lower scores on orienting to the live face/voice stimulus and on the alertness items, suggesting that they were less attentive. They also scored less optimally on the cuddliness and hand-to-mouth activity items, suggesting that they were more aroused. These data lend support to the model that newborns of depressed mothers are more aroused and less attentive.

Newborns' Responses to Cry Sounds

In a similar study but on newborns' responses to cry sounds, prenatally depressed mothers' newborns showed less discrimination of other newborns' cry sounds (Field, Diego, Hernandez-Reif, & Fernandez, 2007a). Newborns' crying in response to the cry of another newborn has been called an "empathetic" response. The purpose of this study was to determine whether newborns of depressed mothers would also show this response. Newborns of depressed and non-depressed mothers were presented with cry sounds of themselves or other infants, and their sucking and heart rate were recorded. The newborns of non-depressed mothers responded to the cry sounds of other infants with reduced sucking and decreased heart rate suggesting an attentive response. In contrast, the newborns of depressed mothers did not show a change in their sucking or heart rate to the cry sounds of other infants. This lesser attentiveness/responsiveness to other infants' cry sounds may be a precursor to the non-empathetic behavior noted in preschool children of prenatally depressed mothers (Jones, Field & Davalos, 2000).

Newborns' EEG Responses to Instrumental and Vocal Music

In the space of two decades, research on frontal EEG responses has moved from reporting associations between frontal EEG asymmetry profiles and positive/negative affect, to later reinterpreting these as approach/withdrawal behavior patterns, to identifying individual differences in relationships between EEG and temperament and inhibition/uninhibition (see Field & Diego, 2008 for a review). Some studies have also associated greater relative right frontal EEG activation with depression in adults and most frequently in depressed women and their infants. Stability of these EEG profiles has been noted from the neonatal stage to early infancy to the preschool years (Jones et al., 2000).

Instrumental and vocal/music effects on EEG and EKG were recently explored in neonates of depressed and non-depressed mothers (Hernandez-Reif, Diego & Field, 2006a). Neonates born to depressed and non-depressed mothers were randomly assigned to hear an audiotaped lullaby of instrumental music with vocals or without vocals. Neonatal EEG and EKG were recorded for 2 minutes of silence (baseline) and for 2 minutes of one or the other music presentation. The neonates of non-depressed mothers showed greater relative right frontal EEG asymmetry to both types of music, suggesting a withdrawal response. The neonates of depressed mothers, on the other hand, showed greater relative left frontal EEG asymmetry to the instrumental without vocal music segment, suggesting an approach response. But their greater relative right frontal EEG asymmetry to the instrumental with vocal music segment suggested a withdrawal response. Heart rate decelerations occurred following the music onset for both groups of infants. However, compared to the infants of non-depressed mothers, the infants of depressed mothers showed a delayed heart rate deceleration, suggesting delayed attention and slower processing in those infants.

Responses to Happy and Sad Faces and Voices by 3-month-old Infants

As infants develop over the first few months, they become very responsive to adult faces and voices, as is most evident in their interactions with their parents. But infants of depressed mothers are typically less responsive. In a study on 3-month-old infants, happy faces were habituated more slowly by infants of depressed mothers (Hernandez-Reif, Field, Diego, Vera, & Pickens, 2006c). In this study, three-month-old infants of depressed and non-depressed

mothers were habituated to video clips of a female model reciting phrases while posing happy or sad facial/vocal expressions and dishabituated to the alternate expressions. Overall, infants of depressed mothers took longer to habituate the video clips compared to infants of non-depressed mothers, and those assigned to habituate the sad video clips displayed a novelty response or dishabituated the happy expressions. These findings suggest that 3-month-old infants of depressed mothers discriminated sad from happy expressions. However, they did not seem to perceive sad expressions as novel, most likely because they had frequently experienced their mothers' sad facial expressions.

Young Infants Facing a Mirror versus Their Mother

To determine the differences between infants looking at themselves in a mirror and looking at their mother, behavioral responses were assessed in 3–6-month-old infants of depressed mothers placed face-to-face in front of a mirror versus in front of their mother (Field, Hernandez-Reif, Vera, Gil, Diego & Sanders, 2005c). Infants showed more positive behavior (smiling) with their mothers versus the mirror, but they also showed more negative behavior (gaze aversion, distress brow and crying) during the mother condition. These differences highlight the infants' greater affective responses (both positive and negative) to their mother versus the mirror. Equivalent amounts of vocalizing to the mother and mirror suggested that the mirror did elicit social behavior, with the infants perhaps enjoying watching themselves talk. Group differences suggested that the infants of depressed mothers showed less gaze aversion with their mothers, perhaps because their mothers were less interactive. And the infants, therefore, had less need for looking away to process the information (Field, 1981). When in front of the mirror, they vocalized more and gaze averted less than the infants of nondepressed mothers, suggesting that the mirror was particularly effective in eliciting social behavior in the infants of depressed mothers, possibly because their own mirror reflections were less aversive than their mother's sad faces.

Young Infants' Responses to Animate and Inanimate Faces

In a study on infants' responses to animate and inanimate faces, infants (mean age= 5 months) of depressed mothers and non-depressed mothers were seated in an infant seat and were exposed to four different degrees of animation, including a still-face Raggedy Ann doll (about two-feet tall suspended in front of the infant), the same doll in an animated state talking and head-nodding, an imitative mother and a spontaneously interacting mother (the more animate mother condition) (Field, Hernandez-Reif, Diego, Feijo, Vera, Gil & Sanders, 2007c). The infants spent more time looking at the doll, but they smiled and laughed more at the mother. The infants of depressed versus non-depressed mothers showed less laughing and more fussing when their mothers were spontaneously interacting, but showed more laughing and less fussing during the mother imitation condition, suggesting that they may have preferred their mothers being more contingently responsive during the imitation condition.

Non-Contingent Interaction Effects

Several different paradigms have been developed to determine infants' responses to atypical maternal behavior that is very much like depressed maternal behavior. One paradigm is the non-contingent maternal behavior paradigm (Nadel, Carchon, Kervella, Marcelli, & Reserbat-Plantey, 1999). In one of our studies, infants of depressed and non-depressed mothers were videotaped interacting with their mothers in this paradigm, which consists of three segments including: (1) a free play, contingent interaction, (2) a replay of the mothers' behavior that had been videotaped during the first segment such that the mother's behavior was now non-contingent, and (3) a return to a free play, contingent interaction (Field, Nadel, Hernandez-Reif, Diego, Vera, Gil, & Sanders, 2005d). As compared to infants of non-depressed mothers, infants of depressed mothers showed less negative change in their behavior during the non-

contingent replay segment, e.g. a lesser increase in frowning. This finding was interpreted as the infants of depressed mothers being more accustomed to non-contingent behavior in their mothers, thus experiencing less violation of expectancy in this situation.

Still-Face versus Separation Effects

An even more non-contingent maternal behavior paradigm is the still-face condition. In an earlier study, we had noted that maternal emotional and physical unavailability had differential effects on infant interaction behavior (Field, Vega-Lahr, Scafidi & Goldstein, 1986). In that study, four-month-old infants experienced their mother's still-face and a brief separation from the mother. Spontaneous interactions preceded and followed these to serve as baseline and reunion episodes. Although the infants became more negative and agitated during both conditions, the still-face elicited more stressful behaviors.

In a more recent study, we replicated our earlier study, but we also compared infants of depressed and infants of nondepressed mothers (Field, Hernandez-Reif, Diego, Feijo, Vera, Gil, Sanders, 2007b). The infants of depressed versus those of nondepressed mothers were less interactive during the spontaneous interactions, as were their mothers, and they showed less distress behavior during the still-face condition. During the "return to spontaneous interaction" following the still-face condition, they were also less interactive, as evidenced by fewer positive as well as fewer negative behaviors. Their mothers were also less active. The nondepressed mothers and infants were extremely active, as if trying to reinstate the initial spontaneous interaction. Minimal change occurred during the separation condition except that both groups of infants vocalized less than they had during the spontaneous interaction. During the reunion following the separation period, the infants of depressed versus nondepressed mothers were paradoxically more active, even though their mothers continued to be less interactive.

Anxiety and Anger Effects

Anger and anxiety mood states have been notably comorbid with maternal depression. Comorbid states have also been assessed for their effects on early interactions (Field, Hernandez-Reif, Vera, Gil, Diego, Bendell & Yando, 2005b). In that study depressed mothers (high CES-D scores and SCID diagnoses) were assessed for anxiety (STAI) and anger (STAXI). Based on median splits on scores on these scales, depressed mothers with high and low anxiety were compared and depressed mothers with high and low anger were compared on their spontaneous and imitative interactions with their 3-month-old infants. The high versus low anxiety mothers spent less time smiling, showing exaggerated faces, gameplaying and imitating and more time moving their infants' limbs, but equivalent amounts of time vocalizing and touching. The infants of high versus low anxiety mothers also spent less time smiling and more time in distress brow and crying, but equivalent amounts of time on other behaviors (vocalizing, motor activity, gaze aversion and imitation).

The high anger versus low anger mothers differed in the same ways that the high anxiety mothers differed from the low anxiety mothers. However, the infants of high versus low anger mothers differed on all behaviors including less time spent smiling, vocalizing, and showing motor activity and imitation and more time spent showing distress brow, gaze aversion and crying.

Withdrawn Versus Intrusive Maternal Interaction Styles

Depressed mothers have been noted to have different interaction styles including withdrawn and intrusive styles. The effects of maternal interaction styles (intrusive/withdrawn) on the development of brain electrical activity were studied in infants of depressed and non-depressed mothers shortly after birth and again at 3–6 months of age (Diego, Field, Jones & Hernandez-

Reif, 2006). Infants of depressed mothers in general exhibited significantly greater relative right frontal EEG activation than infants of non-depressed mothers, suggesting withdrawal behaviors. This was especially true for infants of depressed withdrawn mothers who exhibited greater relative right frontal EEG activation than infants of depressed intrusive mothers. Furthermore, while infants of depressed mothers with intrusive interaction styles showed a shift towards greater relative left frontal EEG activation from birth to 3–6 months, infants of depressed mothers with withdrawn interaction styles showed a shift towards greater relative right frontal EEG activation.

A review of the literature on these two different styles of depressed mother interactions (intrusive and withdrawn) showed that withdrawn versus intrusive mothers typically had an EEG pattern that was associated with negative affect (i.e., greater relative right frontal EEG activation) as well as lower levels of the activating neurotransmitter, dopamine (Field, Hernandez-Reif, & Diego, 2005a). These profiles also occurred in their newborn infants. These prenatal effects on newborn EEG together with the less stimulating interaction behavior of the withdrawn mothers might explain why the infants of withdrawn mothers were less exploratory and had lower scores than infants of intrusive mothers on the Bayley Mental scale at one year (Hart, Jones, Field & Lundy, 1999).

Interventions have been differentially tailored for intrusive and withdrawn mothers, such as interaction coaching which has been designed to decrease the behaviors of intrusive mothers (imitation) or increase the behaviors of withdrawn mothers (attention-getting) (Malphurs, Field, Larrain, Pickens, Pelaez-Nogueras, Yando, & Bendell, 1999). Similarly, different types of music have been tried as mood inductions for the different interaction style mothers (Tornek, Field, Hernandez-Reif, Diego, & Jones, 2003). Although immediate positive effects have been noted, more intensive, long-term interventions may be needed to alter these negative interaction behaviors. In addition, interventions are needed to reduce the mother's prenatal depression and thereby prevent its negative effects on fetal development and neonatal behavior. In one such intervention, pregnancy massage not only resulted in lower maternal depression scores but also in a lesser incidence of prematurity and low birthweight and more optimal scores on the Brazelton habituation, orientation, and motor scales (Field, Diego, Hernandez-Reif, Deeds & Figueiredo, 2009).

Disengaged and Authoritarian Parenting Behavior

Depressed mothers have also been noted to have different parenting styles as their infants become toddlers. In a study on parenting styles of depressed mothers, the mothers were classified by the "parenting styles" defined by Baumrind as authoritative, authoritarian, permissive, or disengaged based on their behavior during a structured play/compliance task with their toddlers (Pelaez, Field, Pickens & Hart, 2008). Based on depressed mothers' parenting styles with older children and the data just reviewed on depressive mothers of infants showing withdrawn and intrusive interaction styles, the depressed mothers were expected to show either more disengaged or more authoritarian behavior patterns than non-depressed mothers when interacting with their toddlers in the play/compliance session. As a way of encouraging a typical 'parenting behavior style' during mother-child interaction, we asked the mothers to try to engage their toddlers in a "clean up" task during which the toddler was encouraged by the mother to help pick up a series of toys and place them in a box. The depressed mothers showed more authoritarian and disengaged behaviors. Their toddlers, in turn, followed their mothers' instructions for a lesser percent of the time and displayed aggressive play behavior for a greater percentage of time. The toddlers of mothers with depressive symptoms also showed off-task behavior a greater percentage of the time.

Caveats and Future Directions

These data could be interpreted in many different ways, not just the interpretations we have offered. In addition, these data may not generalize to situations other than the laboratory settings used in these studies. Nonetheless the data are suggestive of the less optimal development of infants of prenatally depressed mothers and the need for interventions to prevent prenatal depression. Research using variations of these paradigms might also inform the process of designing interventions.

Summary

In summary, infants of depressed mothers appeared to be less responsive to faces and voices as early as the neonatal period. At that time they have shown less orienting to the live face/voice stimulus of the Brazelton scale examiner and less orienting to their own and other infants' cry sounds. This lesser responsiveness has been attributed to higher arousal, less attentiveness and less "empathy." Their delayed heart rate decelerations to instrumental and vocal music sounds have also been ascribed to their delayed attention and/or slower processing. Later at 3–6 months they showed less negative responses to their mothers' non-contingent and still-face behavior, suggesting that they were more accustomed to this behavior in their mothers. The less responsive behaviors of the depressed mothers was further compounded by their comorbid mood states of anger and anxiety and their difficult interaction styles including being withdrawn or intrusive and their later authoritarian parenting style.

These data highlight the need for early interventions during the prenatal period to attenuate these mothers' apparently chronic depression that may be contributing to the lesser responsiveness of their infants as early as the newborn period. Interaction coaching could then continue into the postnatal period to help these dyads with their interactions and ultimately facilitate their infants' development.

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