Published in final edited form as:
Infant Behav Dev. 2007 August ; 30(3): 431–435.

Depressed Mothers' Newborns Show Less Discrimination of Other Newborns' Cry Sounds

Tiffany Field[1,2], **Miguel Diego**[1], **Maria Hernandez-Reif**[1], and **Mercedes Fernandez**[1]

1 *Touch Research Institutes, University of Miami School of Medicine*

2 *Fielding Graduate University*

Abstract

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 showed the same 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. In contrast, the newborns of depressed mothers did not show a change in their sucking or heart rate to the cry sound of other infants. This lesser attentiveness/responsiveness to other infants' cry sounds may predict their later lack of empathy.

Keywords

Newborns of depressed mothers; Discrimination Cry sounds

Depressed Mothers' Newborns Show Less Discrimination of Other Newborns' Cry Sounds

Newborns' crying in response to the cry of another newborn has been reported by several investigators (Martin & Clark, 1982;Sagi & Hoffman, 1976;Simner, 1971), who have interpreted this behavior as an empathetic response to others' cry sounds that are similar to one's own crying (Thompson, 1987). In the Martin and Clark (1982) study, newborns cried in response to the cry of another newborn, but they did not cry to the sound of their own cry. These data suggested that the neonate was able to discriminate the infant's own cry from the cry of other infants. Similarly, Dondi et al (Dondi, Simion, & Caltran, 1999) reported differential responses by newborns to their own cry versus cries of other newborns. In that study facial behavior and nonnutritive sucking were recorded when the cry stimuli were presented in an awake state and in a sleep state. Those newborns who were presented with other infants' versus their own cry sounds showed more facial expressions of distress, and the expressions lasted for longer durations. In addition, their nonnutritive sucking rate decreased between the pretest phase and the presentation of the other infants' cry, although it did not for the newborns who heard other infants' cry sounds. Thus, the newborns' responses to the others' cry sounds were more distressed and lasted for a longer period of time, and the nonnutritive sucking rate decreased during the others' cry sounds, suggesting that the newborn recognized that the other infants' cry sounds belonged to other infants. This discrimination between the

two types of cries was also noted during the sleep state by Dondi et al (1999), although the infants' responses were more delayed and less intense during sleep.

Newborns' responses to the cry sounds of other infants may be early signs of empathy (Thompson, 1987) and, in turn, the lack of differentiated responding may predict the absence of empathy in later development. Preschoolers of depressed mothers have shown non-empathetic responses to their mothers' feigned distress (Jones, Field, & Davalos, 2000). These data highlight the importance of newborns' discrimination of cry sounds; although very few cry studies have been conducted in the past several years.

The present study was an extension of the Dondi et al (1999) study. It differed by assessing this empathy phenomenon in newborns of depressed mothers and by measuring sucking and heart rate. Newborns of depressed mothers versus those of non-depressed mothers have been noted to take longer to discriminate stimuli in various modalities and to explore those stimuli less actively. These stimuli include aroma (Fernandez, Hernandez-Reif, Field, Sanders, Diego, Roca, Beutler, & Largie, 2001), temperature (Hernandez-Reif, Field, Diego, & Largie, 2003) and texture stimuli (Hernandez-Reif, Field, Del Pino, & Diego, 2000) as well as the mother's face and voice (Hernandez-Reif, Field, Diego, Vera, & Pickens, 2006). Based on those data, the newborns of depressed mothers as compared to those of non-depressed mothers might be expected to show less differential responding to the cry of another infant. Thus, the objectives of this study were to determine 1) if newborns also show discrimination of other infants' cries based on their sucking and heart rate responses; and 2) if newborns of depressed mothers show less attentiveness/responsiveness to other newborns' cry sounds.

Method

Participants

Forty newborn infants (20 infants of depressed mothers) were recruited from the delivery unit. Based on a SCID diagnosis of depression and high CES-D scores (>16 for depression), they were assigned to a depressed or non-depressed group. The infants were born full-term (M GA = 38.2 weeks; M BWT=3325.3 grams) to lower-to-middle socioeconomic status mothers (M= 4 on the Hollingshead) who were distributed approximately 72% Hispanic, 21% African-American, and 7% Caucasian. The infants at the time of testing were two-weeks-old (M= 14 days). The depressed and non-depressed groups did not differ on any of the above variables. The groups, of course, differed on their CES-D (Center for Epidemiological Studies-Depression) scores (M=19.9 for the depressed group and 9.3 for the non-depressed group, p<. 0001).

Procedure

Center for Epidemiological Studies Depression Scale (CES-D) (Radloff, 1977)— This 20-item scale was included to assess symptoms of depression. The participants are asked to report on their feelings during the preceding week. The scale has adequate test/retest reliability (.60 over several weeks), internal consistency (.80–.90) and concurrent validity (Wells, Klerman & Deykin, 1987). A score of 16 on the CES-D is considered the cutpoint for depression (Radloff, 1991).

Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-D)—All women in the study were given the SCID-I (Non-patient edition: research version) interview to determine depression and anxiety diagnoses and to screen out other disorders including bipolar disorder, schizophrenia and other psychotic disorders. Both depression types (Major Depression and Dysthymia) and those diagnosed with co-morbid anxiety disorder were eligible for the study.

The SCID was administered by research associates following training and with continuing supervision by a clinical psychologist.

Cry Procedure—The Dondi et al (1999) procedure was followed with the exception that the heelprick during the Brazelton Neonatal Behavior Assessment Scale was used in this study to elicit the cry sounds instead of a heelstick as used in the Dondi et al study. The newborns were divided into four independent groups. Two groups of 10 participants each experienced only the infant's own cry (5 boys, 5 girls in the depressed group and 5 boys, 5 girls in the nondepressed group), and the participants in the other two groups (5 boys, 5 girls in the depressed group and 5 boys and 5 girls in nondepressed group) listened only to the cry of another newborn. All of the infants were seen in an awake state.

The assessment was scheduled approximately half-way between the infant's scheduled feeding times and occurred in a small laboratory room. The infants were seated in an infant seat in front of a pressure transducer for recording their sucking activity. The infants wore small, padded mini headphones through which the stimuli were presented. Each trial of 6 minutes duration was divided into a pretest phase (1 minute), a test phase during which the stimuli were presented for 4 minutes, and a posttest phase (1 minute).

For the own cry group, the cries were recorded during the heel prick habituation item of the Brazelton Neonatal Behavioral Assessment Scale at the beginning of the session. As in the Dondi et al (1999) study, a complete bout of crying (M=40 seconds) from the first vocalization to the last rhythmic expiratory phase of crying was selected from each recording. Each of these cry segments had the same acoustic features. Each of the 10 cry segments was re-recorded to produce 10 stimuli composed of the smooth and continuing repetition of the same cry segment for a total of 4 minutes. Each of these 10 stimuli were in turn presented to only 2 participants, 1 in the own group and 1 in the other group where the newborn listened to the cry of another infant. This set of cries was also collected for the newborns of depressed infants such that a newborn of a nondepressed mother would be presented a cry of the newborn of a nondepressed mother, and the cry of a newborn of a depressed mother would be presented to the infant of a depressed mother. The test phase was marked by a light at the bottom right hand corner of the video screen. The cry stimuli ranged from 80 to 86 dB with a mean peak of 84 dB.

Non-Nutritive Sucking—The total number of sucks was obtained using a pressure transducer. The pressure transducer consisted of a spring wire electrode wrapped around an elastic plastic sheathing. A smooth rubber nipple was then used to cover the pressure transducer. The signal was amplified using a Biopac EMG100 amplifier with the following settings: 1) Low frequency filter: .05 Hz; 2) High frequency filter: 35 Hz; and 3) Amplification: 500. The data were sampled at a rate of 200 samples per second and streamed directly to a computer screen and saved to a hard disk using Biopac EMG100 acquisition system. Saved data were then analyzed offline for total number of sucks using AcqKnowledge software.

To minimize unwanted noise and improve the identification of sucks, the data were first smoothed using a floating average method utilizing 100 samples. Quantification of sucks was then conducted by identifying the number of amplitude variations exceeding a specified amplitude threshold value. Amplitude threshold values for each infant were defined as one standard deviation above the mean amplitude of the root-mean-square of the one-minute baseline signal. Number of sucks was then obtained by counting the number of positive amplitudes exceeding threshold.

Heart Rate—EKG was obtained by placing three disposable silver chloride electrodes on the infant's chest and back. The EKG signals were amplified using a Biopac EKG100B amplifier with filters set at 1Hz high pass and 100Hz low pass and a gain of 2,000. The signal was

streamed directly to a computer screen and saved to a hard disk using a Biopac MP100 acquisition system at a rate of 1000 samples per second. EKG data were then manually edited for artifact and beats-per-minute (BPM) were computed off-line using AcqKnowledge software.

Results

Group (depressed/non-depressed) by trial (pre-test to during test) repeated measures ANOVAs were conducted on the sucking and heart rate data, and Bonferroni t-tests were applied to test interaction effects (Rosenthal & Rubin, 1984). These analyses were conducted separately for the self-cry and the other infant cry data.

Sucking Data (see Table 1)

For the sucking data, no group or trial main effects were noted (pre versus during the cry stimulus) for the self or the other infant cry stimuli. However, a group by trial interaction effect ($F_{(1,37)} = 4.88$, $p<.01$) suggested that the infants of non-depressed mothers reduced their sucking from the pre to during the other infant cry stimulus period ($t_{(39)} = 4.98$, $p<.001$).

Heart Rate Data (see Table 2)

For the heart rate data, again no group or trial main effects were noted (pre versus during the cry stimulus) for the self or the other infant cry stimuli. However, a group by trial interaction effect ($F_{(1,37)} = 3.47$, $p<.05$) suggested that the infants of non-depressed mothers showed a decreased heart rate from the pre to during the other infant cry stimulus period ($t_{(39)} = 2.58$, $p<.05$).

Discussion

These data suggest that the infants of non-depressed mothers were discriminating the cry sounds of the other infant, as evidenced by their reduced sucking and their decreased heart rate. This reduced sucking in response to a novel stimulus has been called the Bronshtein effect, as in “the infant stops sucking to pay attention”. The decrease in heart rate has been called an orienting response (Clifton, 1974). A reduction in sucking is usually associated with a heart rate decrease (Nelson, Clifton, Dowd, & Field, 1978), as activity typically drives heart rate. Thus, these results are lawful and theoretically sound. They would also be expected based on earlier data showing a decrease in non-nutritive sucking during other infant cry sounds (Dondi et al., 1999) and were interpreted by these authors as the newborns recognizing that the other infants’ cry sound belonged to other infants. This discrimination was even noted during sleep by these authors (Dondi et al., 1999), although infants were only tested during wakefulness in the present study. Others have referred to this newborn discrimination between self and others’ cry sounds as empathy (Martin & Clark, 1982). In that empathy study, newborns cried in response to the cry of another newborn, but they did not cry to the sound of their own cry.

The failure to show differential sucking or heart rate to the other newborns’ cry sounds by the newborns of depressed mothers is perhaps not surprising given the data showing slower habituation/discrimination of stimuli in other modalities including visual (Hernandez-Reif, Field, Diego, Vera, & Pickens, 2006), tactile (Hernandez-Reif et al., 2000;2003) and olfactory (Fernandez et al., 2004) modalities. Although less distress facial expressions and vocalizations to cry sounds have been previously noted in infants of depressed mothers (Jones, McFall & Zeas, 2006), the present study is the first to note the absence of a sucking and heart rate change to the cries of other infants. Various interpretations have been made for the slower discrimination by infants of depressed mothers including their lesser attentiveness (Hernandez-Reif et al., 2006), their lesser activation (lower dopamine levels) (Field, Diego, Dieter,

Hernandez-Reif, Schanberg, Kuhn, Yando & Bendell, 2004), their greater arousal levels (higher cortisol levels) (Field et al, 2004) as well as their higher stimulus thresholds. Other related physiological and behavioral differences have been noted in newborns of depressed mothers including differences in their sucking (Hernandez-Reif et al., 2000) and their lower vagal activity (usually associated with higher heart rate) (Jones, Field, Fox, Davalos, Lundy & Hart, 1998).

Although it is not clear whether these data indicate lesser "empathy" in newborns of depressed mothers, preschoolers of depressed mothers have less empathetic responses to their mothers' feigned distress (Jones, Field & Davalos, 2000), and infants of depressed mothers are less distressed by their mother's still-face (Field,1984; Field, Hernandez-Reif, Diego, Feijo, Vera, Gil, & Sanders, 2005). The less evident attentiveness or empathetic responses to other infants' cry sounds by these newborns of depressed mothers may predict their later lack of empathy (Jones et al, 2000). This lack of empathy may also relate to the later internalizing and externalizing behaviors noted in children of depressed mothers (Field, Lang, Martinez, Yando, Pickens, & Bendell, 1996). Longitudinal studies are needed to assess this trajectory in larger and perhaps less heterogeneous samples than this small ethnically mixed sample. In addition, other developmental and psycho-physiological effects of maternal depression would need to be considered in parallel with the effects on the newborns' response to cry sounds.

Acknowledgements

We would like to thank the mothers and infants who participated in this study which was supported by an NIH Senior Research Scientist Awards (# MH 00331 and # AT 01585) and an NIMH Merit award (MH # 46586) to Tiffany Field and funding from Johnson and Johnson Pediatric Institute. Correspondence and requests for reprints should be sent to Tiffany Field, Ph.D., Touch Research Institute, University of Miami School of Medicine, Department of Pediatrics (D-820), P.O. Box 016820, Miami, FL, 33101, tfield@med.miami.edu.

References

Clifton RK. Heart rate conditioning in the newborn infant. Journal of Experimental Child Psychology 1974;18:9–21. [PubMed: 4459438]

Dondi M, Simion F, Caltran G. Can newborns discriminate between their own cry and the cry of another newborn infant? Developmental Psychology 1999;35:418–426. [PubMed: 10082012]

Field T. Early interactions between infants and their postpartum depressed mothers. Infant Behavior and Development 1984;7:517–522.

Field T, Diego M, Dieter J, Hernandez-Reif M, Schanberg S, Kuhn C, Yando R, Bendell D. Prenatal depression effects on the fetus and the newborn. Infant Behavior & Development 2004;27:216–229.

Field T, Hernandez-Reif M, Diego M, Feijo L, Vera Y, Gil K, Sanders C. Still-face and separation effects on depressed mother-infant interactions. Infant Mental Health Journal. 2006

Field T, Lang C, Martinez A, Yando R, Pickens J, Bendell D. Preschool follow-up of infants of dysphoric mothers. Journal of Clinical Child Psychology 1996;25:272–279.

Fernandez M, Hernandez-Reif M, Field T, Diego M, Sanders C, Roca A. EGG during lavender and rosemary exposure in infants of depressed and non-depressed mothers. Infant Behavior and Development 2004;27:91–100.

Hernandez-Reif M, Field T, Del Pino N, Diego M. Less exploring by mouth occurs in newborns of depressed mothers. Infant Mental Health Journal 2000;21:204–210.

Hernandez-Reif M, Field T, Diego M, Largie S. Haptic habituation to temperature is slower in newborns of depressed mothers. Infancy 2003;4:47–63.

Hernandez-Reif M, Field T, Diego M, Vera Y, Pickens J. Happy faces are habituated more slowly by infants of depressed mothers. Infant Behavior & Development 2006;29:131–35. [PubMed: 17138268]

Jones N, Field T, Davalos M. Right frontal EEG asymmetry and lack of empathy in preschool children of depressed mothers. Child Psychiatry and Human Development 2000;30:189–204. [PubMed: 10851793]

Jones NA, Field T, Fox NA, Davalos M, Lundy B, Hart S. Newborns of mothers with depressive symptoms are physiologically less developed. Infant Behavior and Development 1998;21:537–541.

Jones NA, McFall B, Zeas B. Reactive cries demonstrate individual variation in the development of empathy for newborns of depressed mothers. 2006In review

Martin GB, Clark RD. Distress crying in neonates: Species and peer specificity. Developmental Psychology 1982;18:3–9.

Nelson M, Clifton R, Dowd J, Field T. Cardiac responding to auditory stimuli in newborn infants: Why pacifiers should not be used when heart rate is the major dependent variable. Infant Behavior and Development 1978;1:277–290.

Radolff LS. The CES-D Scale: A self-report depression scale for research in the general population. Journal of Applied Psychological Measures 1977;1:385–401.

Rosenthal R, Rubin DB. Multiple contrasts and ordered Bonferroni procedures. Journal of Educational Psychology 1984;76:1028–34.

Sagi A, Hoffman ML. Empathic distress in the newborn. Developmental Psychology 1976;12:175–176.

Simner ML. Newborns' response to the cry of another infant. Developmental Psychology 1971;5:136–150.

Thompson, RA. Empathy and its development. Eisenberg, N.; Strayer, J., editors. 1987.

Table 1

Mean number of sucks prior to and during the infants' own cry sounds and the cry sounds of another infant (standard deviations in parentheses).

	Group			
	Depressed		Non-Depressed	
	Pre	During	Pre	During
Self	42.3 (18.1)	39.4 (12.2)	41.7 (14.2)	38.9 (9.5)
Other	41.3 (13.7)	37.3 (24.1)	44.7 (13.6)	23.6* (11.9)

* ($F_{(1,37)} = 4.88$, $p<.01$, $t_{(39)} = 4.98$, $p<.001$)

Table 2

Mean heart rate prior to and during the infants' own cry sounds and the cry sound of another infant (standard deviations in parentheses).

	Group			
	Depressed		Non-Depressed	
	Pre	During	Pre	During
Self	146.3 (6.2)	147.6 (6.3)	149.6 (8.4)	150.6 (8.3)
Other	148.9 (12.2)	144.0 (8.8)	149.5 (7.2)	141.7* (8.2)

* ($F_{(1,37)} = 3.47$, $p<.05$, $t_{(39)} = 2.58$, $p<.05$)