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BRIEF REPORT

Vocal Timing in Face-to-Face Interaction of Clinically Depressed and Nondepressed Mothers and Their 4-Month-Old Infants

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The timing of switching pauses is critical to mother–infant synchrony. The relation between switching-pause duration and maternal depression was studied in 15 depressed and 20 nondepressed mother–infant dyads. Switching pauses of depressed mothers were longer, more variable, and less consistent with scalar timing.

mother–infant interaction vocal timing postpartum depression switching pause

Mother–infant interaction has a dialogic or conversational structure that depends on the mother's ability to respond quickly and consistently to infant vocalizations (Beebe, Jaffe, Feldstein, Mays, & Alson, 1985). The timing of maternal responses to infant vocalizations may be impaired in depression. Depression typically results in psychomotor retardation or agitation and reduced responsiveness to other people. In a study of mothers with mild depressive symptoms, Bettes (1988) found that switching pauses were longer and more variable in symptomatic mothers. Switching pauses refer to the duration of silence after the infant stops vocalizing and the mother begins.

To evaluate switching pauses in relation to maternal depression, we studied (unipolar) depressed and comparison nondepressed mother–infant pairs in a play interaction at 4 months of age. We tested the hypotheses that depression results in longer and more variable switching pauses. In addition, we evaluated Stern and Gibbon's (1979) proposal that maternal vocal behavior follows a process they refer to as scalar timing. In scalar timing, mean duration and variability of response duration covary in direct proportion to one another, which increases the predictability of mother's behavior for the infant and facilitates infant turn-taking and mother–infant reciprocity. We tested this hypothesis in nondepressed mothers and asked whether switching pauses of depressed mothers would fail to follow scalar timing.

The mothers were participants in an ongoing study of postpartum depression (Campbell, Cohn, & Meyers, 1995) who met criteria for inclusion in this substudy. All participants were Caucasian, high school-educated, middle-class, married women between the ages of 18 and 35. The infants were born at term and were products of uncomplicated pregnancies and deliveries. A low-risk population was sampled to minimize the effects of negative environmental influences, with the exception of depression, on the mother–infant interaction.

For this substudy, participants were included in the depressed group if they were diagnosed with probable or definite major depression according to Research Diagnostic Criteria (RDC; Spitzer, Endicott, & Robins, 1978) through the time of the 4-month observation. Interviews were conducted by graduate students in clinical psychology and a psychiatric social worker, all of whom achieved 100% reliability for diagnosis. Participants were included in the control group if they were symptom free throughout the postpartum period. Thirty-five Caucasian mother–infant pairs (15 depressed mothers, 20 nondepressed mothers) met these criteria. Depressed and nondepressed partici-

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pants did not differ on infant gender or other demographic criteria.

Participants were videotaped in a split-screen paradigm in their homes during the day at a time when the infants were alert. During the 3-min interaction, mothers were instructed to play with their infants without toys.

Audio signals were digitally acquired from the analog tape sources using a Computerized Speech Lab (CSL) from Kay Elemetrics. The CSL is a high-resolution digitizing apparatus for acoustic signals which permits high-fidelity speech acquisition and analysis. After generating an oscillograph (intensity) display, the coder listened to successive 5-s segments of the digitized speech sample for occurrence of vocalization exclusive of infant cries, complaints, and vegetative noises (e.g., coughs, hiccups, burps). Periods of infant fussiness and mother singing were also excluded because mother's behavior may be altered during this time (Stern & Gibbon, 1979).

If the infant vocalized during a segment, the coder generated a narrow-band spectrogram to trace the fundamental frequency of the speech signal. Both the spectrogram and oscillograph were used to locate precisely the onset and offset of each switching pause and replay the speech signal to hear nonvoiced speech components, which are represented in the oscillograph but not the spectrogram. This method simulates the Automated Vocal Transaction Analyzer system (Jaffe & Feldstein, 1970) but is not completely comparable. Following Bettes (1988), switching pauses were not calculated when the mother or infant responded between two vocalizations of the partner that were separated by less than 300 ms of silence. Pauses less than 300 ms are defined as intraindividual pauses, and a vocalization by the partner is an interruption.

The switching-pause measures were aggregated to yield two dependent variables: (a) switching-pause mean duration and (b) coefficient of variation (CV). The CV (σ/μ) reflects the variability of switching pauses when the effect of mean differences in length of switching pause is removed. Ten percent of the interactions were coded independently by a reliability coder who was blind to participants' diagnosis. The intraclass correlations for mean switching-pause duration and coefficient of variation were .75 and .78, respectively.

Switching-pause duration and coefficient of variation were analyzed in a MANOVA with depression status and infant gender as between-subject variables. The effect of depression status but not gender was significant (Wilks Lambda = .79, p = .03). In separate univariate ANOVAs, depressed mothers had longer and more variable switching pauses (see Table 1).

To test the hypothesis that the switching pauses of nondepressed—but not depressed—mothers are consistent with scalar timing, the log-transformed standard deviation of the duration of switching pauses was plotted against the log-transformed mean duration (Stern & Gibbon, 1979). On a double-log plot, scalar timing is represented as a line with a slope of 1.0; the standard deviation is proportional to the mean. This signifies that as the mean duration of the switching-pause increases, variability increases in direct proportion. If the regression slope is not equal to 1.0, the duration of the switching pauses vary randomly or conform to another timing mechanism (Stern & Gibbon, 1979).

Regression slopes were calculated separately for depressed and nondepressed mothers. The regression lines for the nondepressed and depressed groups were linear; therefore, t tests were conducted separately for the depressed

TABLE 1
Switching-Pause Duration in Depressed and Nondepressed Mother–Infant Dyads

	Depressed	Nondepressed		
Switching Pause	***M* (*SD*)**	***M* (*SD*)**	***F***	***p***
Duration	0.66 (0.47)	0.44 (0.18)	4.37	.04
CV[a]	1.11 (0.36)	0.79 (0.34)	6.71	.01

[a]CV = coefficient of variation.

and nondepressed groups to determine whether the slopes were significantly different than 1.0. The slope of regression line for nondepressed mothers ($\beta = 1.05$, $R^2 = .63$, $t = 0.26$, *ns*) but not depressed mothers ($\beta = 1.33$, $R^2 = .90$, $t = 2.65$, $p < .05$) conformed to scalar timing (i.e., slope significantly greater than 1.0).

A test for parallelism was conducted to determine whether the slope of the depressed group was significantly steeper than the slope of the nondepressed group. The slopes were not significantly different, $t = 1.20$, *ns*.

In a preliminary study, Bettes (1988) found that mothers with depressive symptoms had longer and more variable switching-pause durations. Because only about half of all women with elevated scores on symptom checklists are clinically depressed (Campbell & Cohn, 1991), we sought to confirm the relation between depression and vocal timing in a clinically depressed sample. Consistent with Bettes's preliminary findings, we found that mothers who met rigorous research diagnostic criteria for depression had longer and more variable switching pauses. In addition, their switching pauses failed to conform to the scalar process proposed by Stern and Gibbon (1979). Switching-pause durations in depressed mothers were not only longer and more variable, they were less predictable as well. These findings suggest that depression negatively affects the mother's ability to coordinate her vocal behavior, which may contribute to reduced synchrony in depressed mother–infant interactions (Field, Healy, Goldstein, & Gothertz, 1990). Furthermore, increased variability in vocal timing at 4 months has been associated with insecure attachment at 12 months (Feldstein, Crown, Beebe, & Jaffe, 1995).

The results of this study are notable because differences between middle-class depressed and nondepressed mother–infant dyads have emerged only when the depression lasts through 6 months postpartum (Campbell et al., 1995). Two differences between our study and previous research may account for these results: (a) analysis of vocal timing instead of facial expression, and (b) rapid sampling rate. Middle-class mothers may have more of an incentive to appear positive for the benefit of the experimenter, and previous research suggests that participants falsify their expressions (e.g., simulate positive expressions to conceal negative emotions) to conform to display rules (Ekman, Friesen, & O'Sullivan, 1988).

Unlike in facial expression, there are no display rules in vocal timing to appear responsive even when one feels disengaged from the interaction. It is even more difficult to monitor vocal timing than facial expression because in the "split-second" world of the mother–infant interaction, behaviors occur faster than 0.5 s (e.g., Beebe & Stern, 1977). Our methods allowed us to detect these fast-occurring behaviors and note differences between depressed and nondepressed dyads. Previous studies of kinesic behavior typically have used 1-s sampling intervals or longer to analyze dyadic timing, so the fast-occurring behaviors characteristic of the mother–infant interaction may have gone unnoted.

In conclusion, we found that clinically depressed mothers in a low-risk population were less responsive to their 4-month-old infants and used a timing mechanism that is less predictable. An implication of these results is that the infant may be less able to follow mother's behavior, resulting in reduced synchrony. The consistency of our findings with those of Bettes (1988) suggests that vocal timing provides a robust and sensitive measure of depression effects (e.g., difficult to falsify responsiveness) without bias from social desirability.

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