

# Mother–Infant Face-to-Face Interaction: Influence is Bidirectional and Unrelated to Periodic Cycles in Either Partner's Behavior

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During mother–infant face-to-face interactions, bidirectional influence could be achieved through either the entraining of periodic cycles in the behavior of each partner or through the stochastic organization of behaviors. To determine whether and how bidirectional influence occurs, we used both time- and frequency-domain techniques to study the interactions of 54 mother–infant pairs, 18 each at 3, 6, and 9 months of age. Behavioral descriptors for each mother and infant were scaled to reflect levels of affective involvement during each second of the interaction. Periodic cycles were found in infants' expressive behavior only at 3 months and not in mothers' behavior. Nonperiodic cycles, which were found in some mothers' and infants' behavior at each age, were more common. At no age was the occurrence of cycles in mothers' or infants' behavior related to the achievement of bidirectional influence. Similar proportions of mothers and infants were responsive to moment-to-moment changes in the other's behavior, except at 6 months when the proportion of mothers was higher. Bidirectional influence was brought about by the stochastic organization of behaviors rather than through the mutual entraining of periodic cycles.

Early mother–infant face-to-face interactions have a conversation-like pattern in which each partner appears to be responsive to the other. The assumption that this pattern is actually achieved by bidirectional influence has been seriously questioned in a series of papers (Gottman & Ringland, 1981; Thomas & Malone, 1979; Thomas & Martin, 1976). Few studies have rigorously tested the null hypothesis that during face-to-face interactions moment-to-moment changes in the infant's behavior are independent of changes in the mother's behavior. Three studies that did test the null hypothesis (Gottman & Ringland, 1981; Hayes, 1984; Thomas & Malone, 1979) failed to reject it.

Two types of organization of the infants' behavior, periodic or stochastic, would permit the mother to create the semblance of bidirectional influence. *Periodic* events cycle on and off at regular, precise intervals, permitting highly accurate prediction of the timing of future events. A periodic cycle is deterministic in that the frequency, phase, and amplitude do not vary over time (Gottman, 1981). Alternatively, *stochastic* events are autocorrelated over short intervals; that is, sequences occur nonrandomly (e.g., smiles following the onset of visual regard; Kaye & Fogel, 1980). Depending on the type of autocorrelation, sequences may also be cyclic, but not periodic. Cohn and Tronick

(1983), for instance, reported that, during normal interactions, infants displayed cycles of neutral and positive expressions. Because these cycles were stochastic (i.e., nonperiodic and, hence, variable in frequency, phase, and amplitude), they would not accurately predict infants' expressions over the long term.

These two types of behavioral organization have different implications for how bidirectional influence could occur. One hypothesis is that periodic cycles occur in both the infant's and the mother's behavior and that these cycles become synchronized through a process of mutual entrainment (Lester, Hoffman, & Brazelton, 1985; Schaffer, 1977). A second hypothesis is that expressive behaviors are autocorrelated over short intervals but also cross-correlated with (i.e., contingent on) the preceding behavior of the partner (Cohn & Tronick, 1987; Kaye & Fogel, 1980). These hypotheses are not mutually exclusive; a third hypothesis, therefore, is that bidirectional influence occurs in both of these ways.

These hypotheses all posit active processing of social signals by the young infant and are consistent with the view that infants respond in specific and appropriate ways to their mother's communicative displays (Campos, Barrett, Lamb, Goldsmith, & Stenberg, 1983; Cohn & Tronick, 1983; Tronick, 1981). They differ in regard to how this responsiveness comes about.

Mutual entrainment hypotheses make greater demands on the infant's cognitive abilities because they assume that the infant can abstract relatively long periodicities from the mother's behavior. Lester, Hoffman, and Brazelton (1985) reported periodicities of 10 to 45 s. The accomplishment of this task would be all the more impressive in light of the fact that the mother's periodicity varies as she attempts to adjust to her infant's. Because face-to-face interactions seldom last more than several minutes, infants might have to accumulate experience over the course of many interactions before mutual entrainment could occur and bidirectional influence could be detected.

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Preparation of this article was supported in part by National Institute of Mental Health Grant 1R03MH39706-01A1 to the University of Pittsburgh.

Elizabeth Krafchuk, Margaret Ricks, and Steve Winn assisted with the collection of these data, and Reinaldo Matias and Shelley Ross assisted with data analysis. David Stoffer provided statistical consultation.

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