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Three-Month-Old Infants' Reaction to Simulated Maternal Depression

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Cohn, Jeffrey F., and Tronick, Edward Z. *Three-Month-Old Infants' Reaction to Simulated Maternal Depression.* Child Development, 1983, **54**, 185–193. To investigate the nature of the young infant's social competence, the effect of depressed maternal expression during face-to-face interaction was examined using an experimental analogue of maternal depression. Subjects were 12 female and 12 male infants, ages 96–110 days, and their mothers. 2 counterbalanced experimental treatments consisted of 3 min of normal maternal interaction and 3 min of simulated depressed interaction. A control treatment consisted of 2 3-min epochs of normal maternal interaction. Interactions were videotaped and infant behavior described on a 5-sec time base that maintained order of occurrence. Infants in the depressed condition structured their behavior differently and were more negative than infants in the normal condition. Infants in the depressed condition produced higher proportions of protest, wary, and brief positive. Infants in the depressed condition cycled among protest, wary, and look away. Infants in the normal condition cycled among monitor, brief positive, and play. In addition, differences in negativity were likely to continue briefly after mothers switched from depressed to normal interaction. The data indicate that infants have a specific, appropriate, negative reaction to simulated depression in their mothers. These results question formulations based on alternate hypotheses and suggest that the infant has communicative intent in its interactions.

There is increasing evidence to suggest that during face-to-face interaction the frequency and duration of selected infant behaviors is clearly related to the quality of maternal expression (Brazelton, Koslowski, & Main 1974; Field 1980; Stern 1974, 1977; Tronick 1982). The most striking evidence for this relationship comes from studies in which maternal expression is experimentally manipulated. Carpenter, Tecce, Stechler, and Friedman (1970) were among the first to observe that infants aged 1–8 weeks would respond with increased proportions of both gaze aversion and negative affect in response to their mothers appearing motionless before them. Subsequently, several studies (Fogel, Diamond, Langhorst, & Demos 1982; Trevarthen 1977; Tronick, Als, Adamson, Wise, & Brazelton 1978; Ricks, Note 1) have found that infants aged 2 months and older also respond with increased proportions of gaze aversion and negative affect in response to their still-faced mother.

Although none of these still-face studies presented sequential analyses, each referred to modifications in the sequential ordering of infant behavior. Tronick et al. and also Ricks observed a pattern in which the infant would first become briefly positive and then avert its gaze and show distress. Tronick et al. interpreted this pattern as signifying the infant's capacity to modify its own behavior in response to that of the adult partner. The infant attempts to reinstate the normal interaction (Tronick 1982); unsuccessful, the infant becomes disengaged and negative in affect.

Few other manipulations of maternal expression have been reported. Dodd (1979) presented infants aged 10–16 weeks with nursery rhymes recorded in and out of synchrony with lip movements and found that the infants decreased the proportion of time spent gazing at the mother during the out-of-synchrony condition. In a less extreme manipulation, Field (1977) found that when mothers of 3½-month-old infants slowed their interactive behavior by imitating their infants' behavior, the result was increased infant gaze and positive affect. When mothers speeded up their behavior and became overly intrusive the consequence was increased infant gaze aversion and negative affect. Arco and McCluskey (1981) found a somewhat different relationship between what they refer to

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as the temporal pacing of maternal expression and infant affect, but procedural differences between their study and that of Field make substantive differences difficult to resolve.

To date, no study has used appropriate sequential techniques to describe the contingency structure of infant behavior in response to either the still face or any other manipulation of maternal expression. Moreover, there are few studies (e.g., Kaye & Fogel 1980) that have adequately described the contingency structure of infant behavior in response to normal maternal expression. The relationship between the quality of maternal expression and the sequential ordering of infant behavior, therefore, is not well understood. In addition, there is developmental and clinical reason to consider infant response to distortions of maternal behavior that an infant might experience outside of the laboratory. In the present study, appropriate sequential techniques are used in order to investigate infant response to normal and to simulated depressed maternal expression.

Mothers of 24 3-month-old infants were instructed to interact with depressed and/or normal maternal expression during face-to-face exchanges. During depressed interactions, maternal speech was slowed, maternal facial expression was reduced, and body movement and touch contact with the infant were limited. This manipulation was not intended as a true analogue of clinical maternal depression. It was, however, intended to inform future clinical investigations. A number of sources (Brazelton et al. 1974; Stern 1977; Tronick, Ricks, & Cohn 1982; Weissman & Paykel 1974) suggest that infant social development is strongly related to the quality of the caregiver's affect.

Method

Subjects

Subjects were 12 female and 12 male infants and their mothers. Infants ranged in age from 96 to 110 days (mean age, 103 days). Fifteen infants were firstborn and 9 infants were laterborn. The average educational level of mothers was 3 years of college (standard deviation = 2.4 years). Each mother was her infant's primary caretaker. Ten additional subjects participated in at least some of the experimental procedure, but their data were not included in the analyses on one of four a priori grounds: equipment failure during filming (5 infants); mother in violation of procedure (inclusion of toy in play sequence, 1 infant); infant found to be physically ill or facially deformed (2 infants); and infant cried when first placed in infant seat (2 infants). Appropriate-aged infants were identified from published birth announcements and their mothers were contacted by telephone.

Setting and Materials

The laboratory was equipped with an infant seat mounted on a table, facing adjustable stool for the mother, two videocameras, and a microphone. One camera was focused on the mother and one on the infant. Both pictures were transmitted through a digital timer and split-screen generator into a videorecorder.

Procedure

Infants, by sex, were assigned randomly to one of three treatment orders. Treatment orders consisted of two contiguous 3-min epochs of mother-infant interaction. Two experimental treatments were counterbalanced for order of presentation; they each consisted of one epoch during which mothers were instructed to interact with normal expression and one epoch during which they were instructed to interact with simulated depressed expression. A control treatment called for mothers to interact with normal expression for both 3-min epochs. Mothers were instructed to change (or continue) mode of expression on signal at the end of the first 3 min. They were also told that should their infant begin to cry, the procedure would be interrupted after 25 sec of hard, steady crying.

Mothers were told that their infants would be assigned to one of the three treatment orders. Orders and conditions (normal and depressed) were described verbally in an informal, semistandardized format. Mothers were asked to imagine how they felt on days when they felt tired or depressed and felt unable to play effectively with their infant. They were instructed to direct gaze toward their infant; speak in a flat uninteresting monotone; keep their faces relatively expressionless; and minimize body movement and touch contact with their infant. In addition to the verbal instructions, the mothers observed a videotape demonstration of the style of behavior requested. Specific assignments were made after the infant was placed in the infant seat and the procedure was ready to begin.

As a manipulation check, maternal behavior as a function of experimental instructions was examined using Ricks's (Note 1) modification of Ainsworth, Bell, and Stayton's (1974) sensitivity/insensitivity scales. Ricks's instrument includes three dimensions, each on a seven-point scale: elaboration, undercontrol, and overcontrol. Maternal behavior during the first 3-min epoch was rated on the dimensions of elaboration and of undercontrol. Elaboration scales the extent to which mothers appropriately respond to infant bids for attention. Undercontrol (cf. Stern 1977) reflects hesitancy and withdrawal during the interaction.

Behavior Codes and Scoring System

The coding system was comprised of five mutually exclusive states: look away, protest, wary, monitor, and positive. Positive was subdivided into brief positive and play. Look away, wary, and monitor included two to three substates each. Table 1 contains infant states and substates with descriptors. States and descriptors were developed from the Monadic Phases system of Tronick and associates (Als, Tronick, & Brazelton 1979; Tronick, Als, & Brazelton 1980).

Each 3-min epoch was divided into 36 5-sec intervals. The method of scoring provided for the recording of modified frequencies such that the original ordering of codes was preserved.

Reliability

Interobserver reliability was defined as the number of agreements divided by the number of agreements plus disagreements. Coders began working with experimental data only after training to 80% agreement on pilot tapes and tapes from related studies of mother-infant interactions. Reliability was checked continuously and was consistently above 80% for each of the five codes and above 90% for the distinction between brief positive and play.

Results

Manipulation Check

Maternal behavior was significantly more undercontrolling, $t_{(23)} = 7.75$, $p < .001$, in the depressed condition. The mean rating in the depressed condition was 6.5. The mean rating in the normal condition was 2.875. Maternal behavior was also characterized by significantly less elaboration, $t_{(23)} = -4.19$, $p < .001$. The mean rating in the depressed condition was 2.25. The mean rating in the normal condition was 5.06.

Condition Effects in the Proportion of Infant Time Spent in Affect States

Condition effects were tested by comparing depressed and normal conditions of the first 36 5-sec intervals. There was a significant main effect of condition for wary, $F(1,20) = 17.27$, $p < .001$; protest, $F(1,20) = 9.75$, $p < .01$; and brief positive, $F(1,20) = 7.18$, $p < .025$. Cell means were 15.25 versus 3.38 for wary, 11.88 versus 3.00 for protest, and 3.25 versus 1.38 for brief positive.

Additionally, the variability of play was substantially greater in the normal condition. Scores ranged from 0 to 32 intervals of play (mean = 11.00) versus 0–6 (mean = 2.13) in the depressed condition. This difference in variability was significant beyond the .001 level,

TABLE 1

INFANT STATES

State	Description
1. Protest	Negative facial expressions of cry face or grimace along with crying, fussing, or arching back or writhing movements; gaze may be toward mother or away
2-1. Wary	Gaze is toward mother; facial expression is serious-sober, with eyebrows somewhat narrowed; head may be positioned down or part-side
2-2. Glance away	From wary infant makes brief glance to look away; duration is less than 1.25 sec; return may be to either wary or monitor
2-3. Flash	Infant remains in wary; eyebrows are briefly raised and then lowered; duration of a single flash is less than 2.5 sec
3-1. Look away	Gaze is away from mother; facial expression is slightly negative to bright
3-2. Sweep	Face is to the side (level, down, or up) and then makes a continuous sweep toward mother and on to complete other side without clearly glancing at mother
3-3. Glance toward	Brief glance from look away toward mother and then away; duration less than 1.25 sec
4-1. Monitor	Gaze is toward mother; head position is level or up and en face; eyebrows and cheeks may be slightly raised; absence of smile
4-2. Glance away	From monitor, brief glance to look away; duration is less than 1.25 sec; gaze return may be to either monitor or wary
4-3. Flash	Infant remains in monitor; eyebrows are briefly raised and then lowered; duration of a single flash is less than 1.25 sec
5-1. Brief positive	Facial expression brightens but duration is brief (less than 3.0 sec) and appears attenuated; gaze is toward mother
5-2. Play	Facial expression is bright with smile or play face; must begin with gaze toward mother

$F_{(\max)}(2,7) = 27.02$. The difference in means between conditions approached significance, $F(1,20) = 4.07$, $p = .06$.

There was one significant sex of subject effect. Girls had higher rates of brief positive than did boys, $F(1,20) = 6.26$, $p < .025$. There was no sex $\times$ condition interaction for brief positive or for any other affect states.

Condition Carry-Over

To test for the presence of condition carry-over, infants' reaction to the first 60 sec of the epoch 2 normal condition was examined. This provided a comparison of those infants whose preceding experience had been one of depressed maternal expression with those whose preceding experience had been one of normal maternal expression. The data for one subject whose extreme upset necessitated cessation of the depressed condition were excluded from the analysis.

Infants who had previously experienced depressed maternal expression were significantly more likely to respond to subsequent normal maternal expression with protest or wary, $t_{(13)} = 2.18$, $p < .05$. In the first 60 sec (12 intervals) of the normal condition following depressed the average number of intervals of protest or wary was 7.28. The corresponding figure was 2.38. There was also continued presence of heterogeneity of variance for play, $F_{(\max)}(2,7) = 5.37$, $p < .05$. The range of play in the experimental group (normal after depressed) was 0–5; in the control group it was 0–10. In addition, no experimental condition infants entered monitor, whereas the range of monitor in the control group was 0–6 ($M = 2$, SD $= 2.67$).

Sequential structure of infant behavior within each condition.—In order to determine the transition rules in effect within each condition, a lag analysis of contingency was performed on the lag 1 group transition matrix of epoch 1 depressed and normal conditions. Following Sackett (1979), criterion behaviors with frequencies greater than 25 and for which the expected probability was greater than .1 were tested with the normal approximation to the binomial. Otherwise exact binomial probabilities were calculated. Criterion behaviors were said to have an excitatory function for a particular transition when the conditional probability of that transition was greater than the expected probability and said to have an inhibitory function when the conditional probability was less than the expected probability.

In the depressed condition, the conditional probabilities among the three predominant states of protest, wary, and look away are of zero order. There are no significant differences between the conditional and expected probabilities. The infant cycling among protest, wary, and look away is poorly organized: it is a function of the high baseline probabilities of each of these states (see fig. 1*A*).

The one well-organized transition in the depressed condition is that from brief positive to look away. Brief positive had an excitatory function for look away, $z = 3.14$, $p < .005$. The conditional probability of look away/brief positive was .690. The expected probability was .389 (table 2). Brief positive also had an inhibitory function for two states, protest and wary, $z = -2.09$ and -2.0, respectively, $p < .05$. The conditional probability of protest/brief positive was .077, whereas the expected probability was .255. The conditional probability of wary/brief positive was .115. The expected probability of wary was .293. No other significant lag 1 contingencies were detected in the depressed condition.

In the normal condition there was significant cycling among play, brief positive, and monitor (table 3 and fig. 1*B*). This cycling is evident from the lag 1 conditional probabilities and from the longer sequences of these behaviors that were observed. The most likely transition from monitor was to play, $z = 3.63$, $p < .0005$. The conditional probability of play/monitor was .432; the expected probability was .196. The conditional probability of brief positive/monitor was .270 versus an expected probability of brief positive of .141, $z = 2.26$, $p < .025$. Brief positive, in turn, had an excitatory function for monitor. The conditional probability of monitor/brief positive was .393; the expected probability was .228, $z = 2.09$, $p < .05$. From play, the most likely contingency was to monitor, $z = 2.17$, $p < .05$. The conditional probability of monitor/play was .378, the expected probability .228.

The absorbing characteristics of this possitive cycle are, in fact, underestimated by reference to the lag 1, or first-order, conditional probabilities alone. Combining the subcategories of brief positive and play, one would expect the four-step sequence, monitor-positive-monitor-positive-monitor, to have a probability of .07 given the lag 1 conditional probabilities. The conditional probability of positive-monitor-positive-monitor/monitor, however, is a much larger .31, $p < .001$. When normal condition infants first enter monitor, they are highly likely to begin positive cycling.

One implication of this cycling is that these states inhibit transitions to negative states. The data support this implication.

Monitor, brief positive, and play also inhibited transitions to wary and protest. The conditional probability of protest/monitor was zero versus an expected probability of .161, $z = -2.68$, $p < .01$. Brief positive inhibited transitions to protest. The conditional probability of protest/brief positive was zero versus an expected probability of .123, $z = -1.98$, $p < .05$.

Look away in the normal condition had an excitatory function for two negative codes, wary and protest. The conditional probability of wary/look away was .304 versus an expected probability of .201, $z = 2.15$, $p < .05$. The conditional probability of protest/look away was .217 versus an expected probability of .132, $z = 2.07$, $p < .05$. Look away also had an inhibitory function for play. The conditional probability of play/look away was .116 versus an expected probability of .245, $z = -2.48$, $p < .025$.

Wary had an inhibitory function for monitor. The conditional probability of monitor/wary was .031; the expected probability was

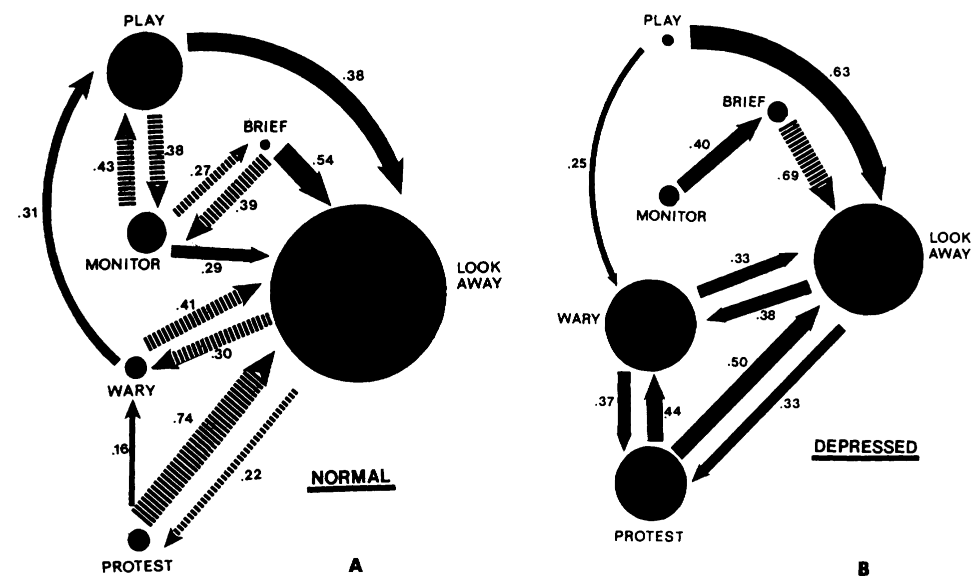

FIG. 1.—State transition diagrams for the depressed and normal conditions. The relative proportion of infant time spent in each state is indicated by size of the circle representing that state. The thickness of the arrows represents the relative size of the conditional probabilities of event sequence transitions. Striped arrows indicate those transitions for which conditional and unconditional probabilities do not significantly differ, $p < .05$. Only the highest conditional probabilities from each state are shown. The numbers next to the arrows indicate the exact size of conditional probabilities.

TABLE 2

LAG 1 CONDITIONAL PROBABILITIES AND SUMMARY STATISTICS FOR THE DEPRESSED CONDITION

	Look Away	Protest	Wary	Monitor
p_{L1}	.690	.077	.115	.115
p_e	.389	.255	.293	.064
SD_{p_e}	.096	.085	.089	.048
Z	3.14**	−2.09*	−2.00*	1.06

NOTE.—Criterion is brief positive. p_{L1} is the conditional probability at lag 1, p_e is the expected (unconditional) probability at lag 1, SD_{p_e} is the standard deviation of expected probability.

* $p < .05$.

** $p < .005$.

.189, $z = -2.29$, $p < .025$. If one combines brief positive and play, wary has an excitatory function for a transition to positive. The conditional probability of brief positive or play/wary was .531 versus an expected probability of .325, $z = 2.48$, $p < .025$.

Discussion

Infant behavior differed markedly depending on the quality of maternal affect. This difference was evident in both the proportion of time spent in affect states and in the sequencing of transitions among states. Depressed condition infants spent a full half of their time in protest or wary and had higher frequencies of brief positive. By contrast, normal condition infants were only rarely in protest or wary and seldom made brief positive displays. The variability of play was also far less in the normal condition.

Equally important is the finding that the sequencing of infant affect states is clearly related to the quality of maternal expression. During periods of engagement normal condition infants are most likely to cycle in a well-organized way among the three states of brief positive, monitor, and play. This positive cycling occurs within a larger on-off cycle of engagement-disengagement similar to that described by Brazelton et al. (1974) and Kaye and Fogel (1980). About 40% of the transi-

TABLE 3

Lag 1 Conditional Probabilities and Summary Statistics for the Normal Condition

Criterion and Probabilities	Protest	Wary	Monitor	Brief	Play
Look away:					
p_{L1}	.217	.304	.174	.188	.116
p_e	.132	.201	.245	.176	.245
SD_{p_e}	.041	.048	.052	.046	.052
Z	2.07*	2.15*	−1.37	.261	−2.48**

	Look Away	Protest	Monitor	Brief	Play	Positive
Wary:						
p_{L1}	.406	.031	.031	.219	.313	.532
p_e	.383	.102	.189	.136	.189	.325
SD_{p_e}	.086	.054	.069	.061	.069	.083
Z	.27	−1.31	−2.29*	1.36	1.80	2.49**

	Look Away	Protest	Wary	Brief	Play
Monitor:					
p_{L1}	.297	0	0	.270	.432
p_e	.396	.106	.161	.141	.196
SD_{p_e}	.080	.051	.060	.057	.065
Z	−1.23	−2.08*	−2.68***	2.26**	3.63****

	Look Away	Protest	Wary	Monitor
Brief positive:				
p_{L1}	.536	0	.071	.393
p_e	.461	.123	.187	.228
SD_{p_e}	.094	.062	.074	.079
Z	.780	−1.98*	−1.57	2.09*

	Look Away	Protest	Wary	Monitor
Play:				
p_{L1}	.378	.108	.135	.378
p_e	.462	.123	.187	.228
SD_{p_e}	.082	.054	.064	.069
Z	1.02	−.28	−.81	2.17

Note.—p_{L1} is the conditional probability at lag 1, p_e is the expected (unconditional) probability at lag 1, SD_{p_e} is the standard deviation of expected probability.

* $p < .05$.

** $p < .025$.

*** $p < .01$.

**** $p < .0005$.

tions from play and about half the transitions from brief positive lead to look away and a state of disengagement. From look away the infant then returns to the positive cycle. When normal condition infants occasionally become negative they then return to a positive state through transitions either to positive or through look away.

Depressed condition infants cycle in a poorly organized way among wary, protest, and look away as indicated by the absence of significant excitatory contingencies among these states. In addition, they also show what appears to be a difference in eliciting pattern. Whereas in the normal condition infants briefly become positive (brief positive) and then go to monitor, in the depressed condition, when infant affect is positive briefly, infants next avert gaze (look away) and enter the negative cycle. Although there are few longer, unattenuated positive displays (play), when they do occur they almost always effect a transition to the negative cycle. This negativity is then likely to carry over into subsequent interactions.

Various authors have attempted to interpret infant affect responses in terms of discrepancy based hypotheses (e.g., Arco & McCluskey 1981; Carpenter et al. 1970; Hebb 1946; Kagan 1974; Stern 1974). As a test or illustration of discrepancy based hypotheses of affect, the present study shares serious limitations with much of this literature (for a critical review of discrepancy studies of affect, see McCall & McGhee [1977]). McCall and McGhee state, "Stimulus sets have not been as precisely defined, discrepancy is often used as an explanatory concept when only one level of discrepancy is sampled, familiarization is frequently naturalistic and not under experimental control, and procedures for separating the effects of discrepancy from the particular stimulus event are typically absent." Moreover, as McCall said of this study, "The discrepancy hypothesis has not been developed fully enough to apply to this context with the specificity these authors have demanded and attributed to it" (McCall, Note 2). Nevertheless, it is from just such studies that consensual support for discrepancy based hypotheses of affect has emerged. It therefore seems appropriate to consider the present data from this perspective, particularly inasmuch as they speak to the sequencing of affective responses.

Stern (1974) has hypothesized that a mother who understimulates her infant is presenting it with a minimal level of discrepancy. If simulated depression is experienced as understimulation and hence as a minimally discrepant event, one would expect the infant to respond with an increased proportion of looking away together with neutral affect. If the manipulation instead represents moderate discrepancy, one would expect somewhat higher proportions of negative affect and possibly of looking away followed by positive affect once the infant resolves the discrepancy. Without ascribing developmentally advanced capacities such as hypothesis activation (Kagan 1974), it is difficult to consider simulated depression as occasioning extreme levels of discrepancy in 3-month-old infants. But if indeed it does, one would expect very high proportions of negative affect and of looking away that would either be sustained or would be followed by positive affect (if the discrepancy is resolved) or would be followed by looking away together with neutral affect (if the infant stops trying). Only if the infant resolves the discrepancy, as indexed by sustained positive affect, would a carry-over effect necessarily be expected. In the case where discrepancy is resolved, it is conceivable that depressed maternal expression would then be the new standard against which normal maternal expression in the following condition would be compared.

These data do not conform to any of these discrepancy based expectations. Although protest may be masking the true proportion of infant gaze aversion (look away), the proportion of look away is not significantly different between conditions. More important, for the depressed condition, discrepancy based hypotheses are unable to account for the higher proportions of brief positive or for the significant transitions from brief positive to look away or for the alternating patterns of negative and positive affect that were observed. Additionally, the finding that the effect of the depressed condition carried over into the next period of normal interaction runs directly counter to discrepancy based hypotheses in which affect is said to be a function of current discrepancy–subjective uncertainty parameters. Contradiction of discrepancy predictions is particularly striking given that, post hoc, the model has been considered nearly irrefutable (Hinde 1974). These data would, therefore, strongly caution against the application of discrepancy based hypotheses of affect to the affect responses of infants in a quasi-naturalistic or nonlaboratory situation.

The results of this study do support the hypothesis that infants are able to participate in the regulation of dyadic behavior by 3 months of age. They modify their affect in response to their partners' affective change; they markedly alter the organization of their behavior; and these changes carry over into their subsequent interactions.

They further suggest that the infant is able to detect the affective quality of the mother's displays and appropriately modify his or her own affective displays in response to them. These capabilities, while highlighted in a manipulated situation such as the one reported here, are, more importantly, responsible for the infant's performance in normal interactions. Indeed, they suggest that the infant possesses complexes of affect and behavior guided by the meaning of the stimulus event in its context. Such meanings would include object or person (Brazelton et al. 1974), differences among people (Dixon, Yogman, Tronick, Adamson, Als, & Brazelton 1981; Parke 1979) and even style of interaction (Field 1980; Tronick et al. 1982). We cannot help but speculate than an infant's social development would be jeopardized were he continually confronted with depressed or distorted maternal behavior. In this investigation, 3 brief minutes of depressed maternal affect resulted in a pattern of negative cycling and distress that persisted well into the next period of normal interaction. These findings, together with those of Massie (1978), Seligman (1975), and Stern (1971), would suggest that infants would adapt to chronic distortions of maternal behavior with a pattern of adaptation reflecting both the quality and the chronicity of that experience—and that the experience is one of ineffectance and, indeed, helplessness. We expect that the resulting adaptation and sense of helplessness would continue even into new situations in which no distortion was experienced.

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