

Infants of Depressed Mothers

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Depression is the most frequent psychiatric disorder and has long-term, compromising effects on the mother-infant relationship and the child's development. The infant continuously faces a climate of negative affect that disrupts the interactive experience of the infant and the mother. This article presents findings on the impact of maternal depression on the infant affective state and the specific interactive patterns associated with infant affect regulation. Mother-infant interactions were studied using microanalytic, second-by-second methods in the laboratory and also by using naturalistic home observations. The empirical findings highlight the impact of maternal depression on the infant affective state and on the capacity for repairing states of miscoordination. The impact is seen not only in severely and acutely depressed mothers, but in mothers who have only high levels of depressive symptoms. These infants develop negative affective states that bias their interactions with others and exacerbate their affective problems. Further findings with regard to gender-specific effects show that male infants are more vulnerable than female infants to maternal depression. The findings point out the need for therapeutic interventions that focus on the mother-infant dyad and infant affective state in the treatment of maternal depression. (HARV REV PSYCHIATRY 2009;17:147–156.)

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Maternal depression and mood disorders during the postpartum period are common. Not only do they cause suf-

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fering for the mothers, but they also have effects on their infants' social and emotional development. This article focuses on our work on the effects of maternal depression on infants. Maternal depression is a communicable disorder. In particular, maternal depression—by compromising mothers' emotions—distorts the communication of emotions between infants and mothers, and the distortion of their communication derails the infants' emotional and social development. In our studies of the effects of maternal depression on infant development, we have developed video techniques for studying the micro-analytic, second-by-second organization of the emotional communication between infants and mothers during face-to-face interactions in our laboratory. These microanalytic techniques function as a temporal microscope that reveals the distortions of the infant-mother communication system and their effects on infants. In later studies we have taken our techniques into the homes of depressed mothers and their infants to observe naturalistic interactions.

Postpartum depression is the most frequent maternal psychiatric disorder. It occurs in 10%–15% of women and is significantly higher in at-risk populations.^{1–3} Prevalence rates of postpartum depression, which vary for women from different cultures, depend on the assessment

method used to obtain diagnoses and the length of postpartum period under evaluation. Socially disadvantaged populations tend to have notably higher postpartum depression prevalence rates than wealthy, Western industrial nations.^{4,5} In comparison to early thinking that postpartum depression was isolated to the postpartum period, the occurrence of depressive episodes and anxiety disorders before and during pregnancy can be seen as important risk factors related to depression in the postpartum.^{2,3} About 60% of those women who showed depressive symptoms during pregnancy suffer from depressive symptoms during the postpartum period, suggesting that postpartum depression might be better named perinatal depression.^{5,6}

Postpartum depression is known to have effects on the development of offspring at every developmental stage from infancy through young adulthood—including depression, behavior problems, and psychopathology.^{7,8} During infancy, maternal depression has negative effects on early maternal-bonding processes,^{9,10} mother-infant interaction,^{7,8,11,12} and cognitive and motor development.^{13–16} It is our view that these effects occur because the emotional communication between infants and mothers is distorted by maternal depression.

Distortions of the communication regulatory system in the mother-infant dyad lead to an intergenerational transfer of both depression and a negative affective state from mothers to their infants. In this view, depressive and negative affective states emerge in infants and young children out of distorted interactive processes rather than being solely generated intrapsychically. This article will focus on some of the work in our laboratory and on the underlying thinking about the effects of maternal depression on infants.^{7,17–19}

PROCESSES OF MUTUAL REGULATION

The emotional communication system between infants and mothers functions to regulate infants' states of arousal and emotions. Ineffective regulation generates extreme states of arousal and affect that disrupt infants' engagement with people and with inanimate objects. It is important to understand, however, that the communication process between nonclinical samples of mothers and infants is not smooth, synchronous, or highly attuned.¹⁴ Our research has demonstrated that the interactions between clinically normal mothers and infants is synchronous only a small proportion of the time and that, though there is positive affect, it also makes up only a small proportion of the interaction. A more accurate characterization of mother-infant interaction is that periods of mismatching of emotions (the infant expressing a positive affect and the mother expressing a negative affect) or intentions (the infant intending to look

away toward an object and the mother soliciting the infant to look at her) are followed by periods of emotion and intention matching. This "messiness" in normal interactions is typically quickly repaired from mismatching to matching states such that mismatching states are of short duration. Mismatches generate an experience of negative affect and stress, whereas reparation to a matching state is associated with the experience of positive affect and the effective regulation of stress. Infants and mothers do not dance like Fred Astaire and Ginger Rogers but, instead, the way that most of us dance—with frequent stepping on toes, apologies, and the pleasure of then dancing a few coordinated steps together.

Reparation or its failure has important developmental consequences. In normal interactions, reparation leads to a feeling in the infant (and also the mother) of trust in the partner, a sense that "we can overcome problems." Importantly, reparation leads to the learning of a critical, lifelong lesson that negative affect (arising from a mismatch) can be transformed into positive affect (achieving a match)—that one does not have to get stuck in a negative feeling state. Over time these positive consequences accumulate. Infants develop a sense of mastery and control over the world, a positive affective core that has them approach new situations with a hopeful feeling; they develop increasingly deep relationships with their mothers.

By contrast, in interactions between mothers and their infants when interactive mismatches are not repaired, the infant has repeated, moment-by-moment negative experiences that lead to the accumulation of negative affect and to the development of depression and a negative affective state or mood. Infants who have repeatedly failed reparatory experiences carry this negative affective state into new situations and are more likely to experience and react to new situations negatively. These affective states function to bias the infant's ongoing experience in the moment of an event that in and of itself is not negative. The infants' negative mood, something generated in the past, now functions to bias and likely compromise their current experience.

In our work on understanding the establishment of affective states in infants, we have examined the interactions of infants and depressed mothers. Our hypothesis is that reparatory problems underlie the "transfer" of depression between mothers and their infants, as well as the negative affect seen in infants of depressed mothers.^{8,20–23} Our view is that depressed mothers are likely to have problems in reading their infants' affective communications and in responding appropriately, thereby making for larger and longer mismatches and few reparations (see Figure 1). As a consequence the infant (and the mother) chronically experience negative affect because of a failure to repair negative affective mismatches. Over time the infant develops a depressed negative mood. Further, once

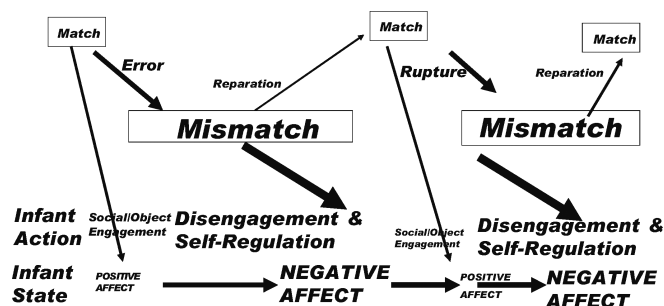


FIGURE 1. The effects of maternal depression on mutual regulation and infant affect. Matching states are of short duration, whereas mismatching states are of long duration and associated with negative affect.

the negative affective state is established, infants become poorer interactive partners and further compromise their own and their mothers' experience of each other. That is, there will be a mutual amplification through a downward spiral of their negative affective states and their interactive problems.

EFFECTS OF MATERNAL DEPRESSION ON MOTHER-INFANT INTERACTION

In our initial work we established that maternal depression in the postpartum period is a chronic state associated with compromised maternal psychosocial functioning. In one study²⁴ (among several we conducted with similar findings),^{25,26} we evaluated stability and change in the level of maternal depressive symptomatology over the course of the first postpartum year. The sample was a community cohort of 106 first-time mothers of full-term, healthy infants. The mothers were otherwise healthy and at low social risk except for depression. Our goal in choosing a low-risk sample was to minimize the effects of factors such as prematurity or poverty that are known to compromise the infant's and mother's functioning. Since mothers can have high levels of symptoms but not actually meet diagnostic criteria for depression, we also determined whether the mothers met diagnostic criteria for depression. This evaluation allowed us to determine, in turn, whether a diagnosed depression influenced the stability of the mothers' depressions and whether it had a differential impact on their infants. We hypothesized that high levels of depression, with or without a diagnosed depression per se, would have similarly negative effects on infants. Further, because we have found that the gender of infants had consequences for their affective states in nonclinical samples, we investigated the consequences of the infant's gender on the stability and change of maternal symptoms.

At two months postpartum (intake), mothers were classified into one of two symptom groups on the basis of their

total scores on the Center for Epidemiological Studies–Depression Scale (CES-D): high (CES-D score ≤ 16) or normative (CES-D score = 2–12). Mothers with scores of 13 to 15 were not included, thereby allowing a clear separation between the non-clinical and depressed groups. Mothers completed the CES-D again at 3, 6, and 12 months postpartum. At 12 months, maternal diagnostic status for major depression and related disorders was evaluated using the Diagnostic Interview Schedule–III, Revised for the postpartum year and for lifetime history.

We found that mothers in the high symptom group at intake continued to have significantly higher CES-D scores at 3, 6, and 12 months than mothers in the normative symptom group at intake. In addition, more than a third of the mothers in the high symptom group at intake in subsequent assessments had CES-D scores that were at or above the clinical cutoff point of 16. Most importantly, there was a striking stability of maternal CES-D scores over the first year. Maternal CES-D scores were significantly correlated across all visits. The average of the correlations was $r = .52$: from intake at 2 months to 3 months, $r = .61$; intake to 6 months, $r = .46$; intake to 12 months, $r = .38$; 3 to 6 months, $r = .65$; 3 to 12 months, $r = .48$; and 6 to 12 months, $r = .46$ (all p 's $< .0001$). These correlations indicate that individual mothers retained their relative rank ordering in level of depressive symptoms over the course of the first postpartum year; that is, mothers with high levels of symptoms postpartum continued to have high levels of symptoms compared to mothers who had low levels of symptoms. Using regression analyses to evaluate diagnostic status and gender effects on maternal CES-D scores at 3, 6, and 12 months, we found that the most recent prior assessment contributed significant unique variance to mothers' CES-D scores at each subsequent assessment. For example, the 6-month CES-D score was more strongly related to the 12-month CES-D score than was the 3-month CES-D score.

Interestingly, CES-D scores were higher at 3 months if mothers had a diagnosed depression and were parenting a son. Our hypothesis is that, as we saw in our studies of normal interactions, infant sons are more reactive to maternal emotions, are less able to control their own emotions, and require more regulatory scaffolding from their mothers than daughters—characteristics that make them more difficult interactive partners. However, whatever the underlying reason for this gender-related finding on symptom levels, the result corroborates findings from prior studies that depressed mothers exhibit poorer psychosocial adaptation if they are parenting sons.^{27,28}

Taken together, these findings indicate that high levels of depressive symptoms experienced by some first-time mothers early in the postpartum period are not transient. Rather, these mothers are likely to continue to experience high levels of distress and depressed mood throughout the

first postpartum year. Importantly, this result appears to hold even when the mothers' scores are below the standard cutoff to label the mothers as depressed. The stability of depression symptoms suggests that "postpartum blues" may not be simply a transient, "normal" problem of mood, though the data do not indicate whether or not the "blues" are then transformed into a diagnosable depression.²⁹ We speculate that while postpartum blues and later-emerging high levels of symptoms or a diagnosed depression may seem closely related, they are actually two different phenomena such that the occurrence of the blues, which may affect 80% of women postpartum, may mask an underlying depression that is seen with the passing of the blues. How to unmask the postpartum depression from the blues is not yet known.

These findings clearly demonstrate that the infant of a mother with high depression symptom score compared to a mother with a low symptom score will be *chronically* exposed to a more depressive affective climate than an infant whose mother has low symptom levels. This chronic exposure may occur over the entire range of symptoms. Further, the findings suggest that even when a mother's symptoms are no longer at or above the cutoff point (i.e., she moves into the clinically normal range), she likely is not yet "well," because she will continue to experience a level of symptoms that is higher than that of mothers whose scores are within the normal range.

Exacerbating the effects of the depression are our findings—from another study with a similar sample of mothers—that many aspects of maternal psychosocial functioning are also compromised. Mothers with high depression symptom scores, when compared to controls, reported more anxiety, had a greater total number of psychiatric symptoms, experienced more negative affect and less positive affect, and had poorer maternal self-esteem and less confidence in their role as mothers. When we compared mothers with high depression symptom scores to a group of mothers with high depression symptom scores *plus* a diagnosed major depression pre- or post-birth, the psychosocial functioning of the two groups was similar in all domains of functioning except that the total number of psychiatric symptoms was higher in the group with major depression.²⁶ Thus, high symptom levels (subclinical depressions) may be as compromising of psychosocial functioning as in mothers whose depressions do reach the diagnostic threshold.

These findings of persistent depressive symptoms and the related compromise of psychosocial functioning indicate that these mothers' infants are chronically exposed to a negative affective climate. Our expectation was that this affective climate would compromise the mother-infant relationship—in particular, through a failure of reparation that, over time, would generate a negative affective state in the infant and compromise other aspects of the infant's functioning.

MATERNAL DEPRESSION AND INFANT DEVELOPMENT

In order to evaluate the question of how maternal depression might compromise infant development, we created an experimental model of depression—the simulated depression paradigm.³⁰ We asked mothers to interact with their infants but in an affectively flat manner. The mothers kept their facial expressions neutral and even sad, and spoke to their infants with a flat voice. They slowed down their movements. Thus, while there was contingent responsiveness by the mothers, their affect was "depressed," and reparation to positive, affect-matching states was not possible. It is interesting to note that although we had developed elaborate instructions and a videotape of a research assistant simulating the depression, most of the mothers found the instructions unnecessary. They *knew* what we were asking them to do.

The infants reacted very strongly to this simulation of depression. Compared to the normal interaction, the infants who were confronted with simulated depression cycled their affective reactions through protest: they were wary and looked away. They rarely either looked at their mothers or were affectively positive. The results strongly supported the hypothesis that depression would have a negative effect on the affective states of the infants.

Armed with the findings from the simulated depression paradigm, we looked at the interactions of mothers and their infants who had high levels of depressive symptoms but were otherwise healthy and at low social risk.^{8,22,23} As we anticipated, depressed mothers were less emotionally positive with their infants than nondepressed mothers (see Figure 2). They looked away from their infants and were generally less responsive. The infants of the depressed mothers also looked away from their mothers more than infants of nondepressed mothers, and they expressed more anger and negative affect.

We concluded that these infants could be seen as developing a persistently depressed, sad, and angry affective mood because of their chronic exposure to reparatory failure with the mother. This negative affective state explains the intriguing finding by Field³¹ that infants of depressed mothers have more negative interactions with unfamiliar (but sensitive) adults. Thus, infants of depressed mothers bring their negative affective state into their interactions with new persons, and their affective state makes them more difficult interactive partners and negatively biases their interactions. In our laboratory we have observed the same phenomenon. We found that the infant of a depressed mother has a powerful effect on the unfamiliar, but experienced, research assistant partner. In particular, we found that our research assistants, blind to the status of the infant, touched, smiled less, and stayed more distant from the infants of

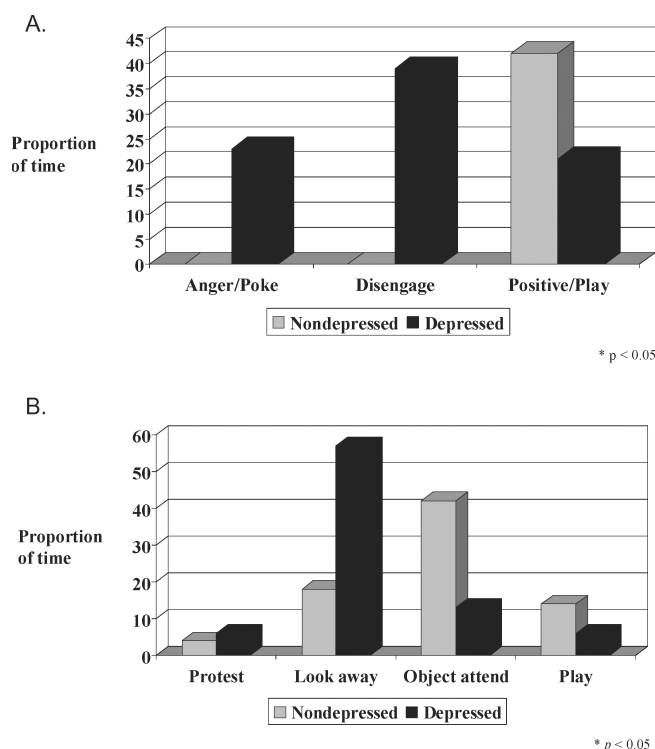


FIGURE 2. Depressed mothers and controls, and their infants. A. Proportion of time that depressed and nondepressed mothers engage in affective-social behaviors. B. Proportion of time that infants of depressed and nondepressed mothers engage in affective-social behaviors.

depressed mothers. Our interpretation is that for the infants, a history of interaction with depressed mothers generated a depressed, negative, and detached affective state that compromised their interactions with others. It can be seen as a kind of problematic proto-defense, a reaction to the other person even before the infant knows what the other person will be like. Unfortunately, the effect is to further compromise the infant's experience with others—experiences that might otherwise have a palliative effect.

DIFFERENT INTERACTION STYLES OF DEPRESSED MOTHERS AND THE IMPACT ON INFANT BEHAVIOR

In another set of studies, we found that depressed mothers with equivalent levels of depression were not a homogeneous group in the ways that they interacted with their infants. Rather, there were at least two groups: one intrusive and the other disengaged and withdrawn (see Figure 3).^{20,32} Importantly, each form of interaction had a different effect on the infant. We found that “intrusive” mothers engaged in rough handling, spoke in an angry tone of voice, poked at

their babies, and actively interfered with their infants' activities. Disengaged and withdrawn mothers, by contrast, were unresponsive and affectively flat, and did little to support their infants' activities. As a striking demonstration of the sensitivity of the infant to affective displays, we found that infants of intrusive mothers and those of withdrawn mothers (re)acted differently. Infants of intrusive mothers spent most of their time looking away from the mother and seldom looked at objects. They infrequently cried, though they did express anger. In contrast, infants of disengaged, withdrawn mothers were more likely to protest, and to be distressed and sad, than the infants of the intrusive mothers, suggesting that maternal withdrawal may be especially aversive to young infants.

These differential emotional reactions are expectable when one thinks of the infant as a “detector” of emotional meaning in conjunction with the idea that chronic exposure to interactive disruption influences the infant's affect and affective state in a specific manner. The infants of intrusive, compared to disengaged and withdrawn, mothers are reacting to, and acting on, different kinds of input; their affective reality is different. Infants of disengaged, withdrawn mothers are failing to achieve social connectedness because of the mothers' lack of affective responsiveness, which conveys that she is not available to interact. The regulatory effect of the mother's withdrawal is that the infant needs to self-regulate his affective states without any external regulatory scaffolding to help him. The infant's experience is that “I have to take care of myself.” Infants are unable, however, to chronically or unremittingly cope on their own or to self-regulate their affective states, and they become dysregulated, fuss, and cry. This failure of emotional self-regulation, not unlike failures to regulate homeostatic states (hunger, temperature), compels them to devote much of their coping resources to controlling their own affective organization. As a consequence of this chronic experience with the withdrawal of the depressed mother, they develop a disengaged, sad, and withdrawn affective state and a self-directed regulatory style characterized by self-comforting and self-regulatory behaviors, along with passivity.

Infants of the disengaged and withdrawn mothers thus look “depressed”—but not simply because the mother transferred her depression to them or because they imitated or mirrored her affect. Rather, the transfer comes out of a more active process. These infants simultaneously attempt to regulate both their interactions with their mothers and their own affective states, but they fail. As a consequence of the failure, they become sad and withdrawn, and utilize self-regulation to control their negative states; they turn away from the world. Moreover, this sad, withdrawn affective state is used in an effort to preclude anticipated negative emotions even in situations in which negative affect may or

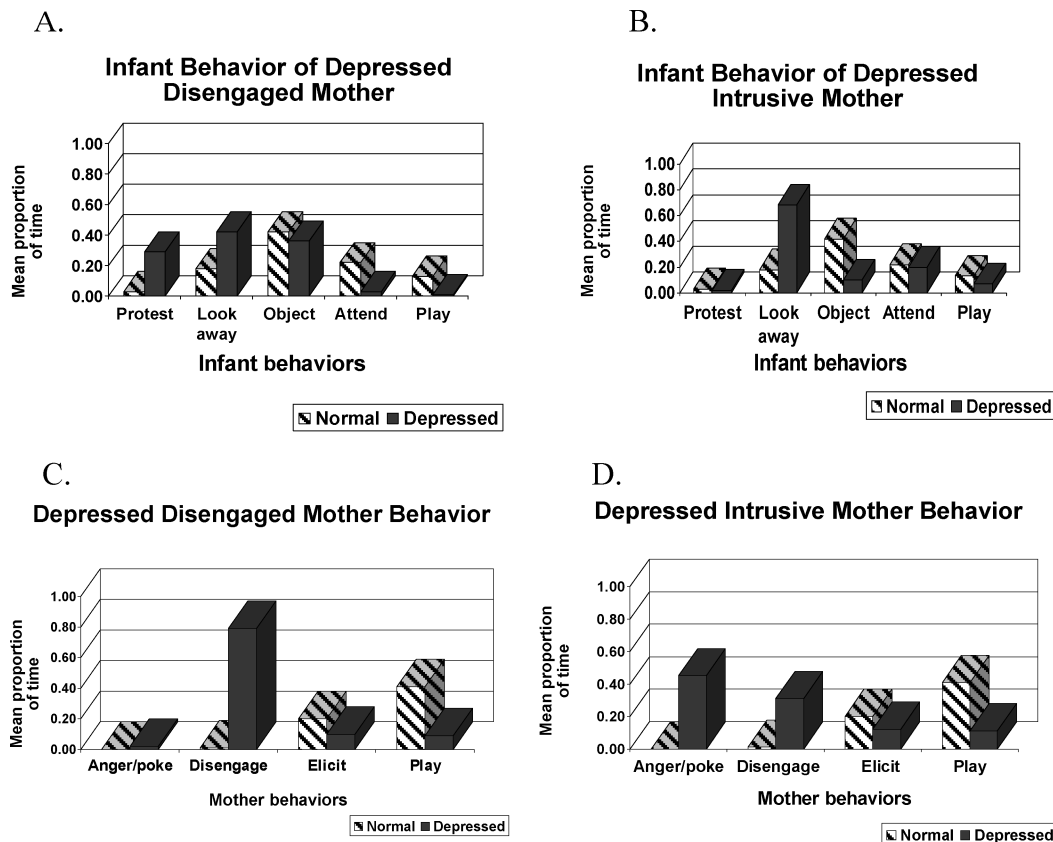


FIGURE 3. Behavioral and affective profiles of intrusive and disengaged depressed mothers and their infants.

may not occur. Eventually, with the reiteration and accumulation of failure, these infants develop an affective mood primarily characterized by sadness, as well as a representation of the mother as untrustworthy and unresponsive, and of themselves as ineffective and helpless. Perhaps this sad, withdrawn affective way of being could be considered an equivalent of depression in an infant.

The infants of hostile, intrusive mothers must cope with a different regulatory pattern and affective climate than the infants of the disengaged, withdrawn mothers. The intrusive mothers' behavior prevents reparation of the interaction because they consistently disrupt the infants' activities. These infants initially experience anger because of the mothers' thwarting of their intentions. They turn away from their mothers, push them away, or screen them out. However, unlike the failure experience of the infants of disengaged, withdrawn mothers, these coping behaviors are occasionally successful in limiting their mothers' intrusiveness. Thus, these infants erratically experience reparation—a transformation of anger into a more positive state, although it may only be brief. Nonetheless, given their experiences of reiterated anger, these infants eventually inter-

nalize an angry, protective style of coping that is deployed defensively in anticipation of the mothers' intrusiveness. We believe that infants are easily angered when interacting with their mothers and others, and more easily frustrated when acting on objects.

These differences in infant reactions to maternal withdrawal and intrusiveness suggest an interpretation of differential effects associated with parental neglect and abuse. Infants who experience neglect suffer the constant demand to self-regulate. Their withdrawal can be extreme, and they may even fail to grow, as occurs in children in some orphanages. The infants are continuously required to control their own physiologic and affective states without regulatory scaffolding from their mothers. This self-directed coping style compromises the infants' interchanges with the environment and even their motivation to engage with the world. By contrast, in the abusive situation, parental abuse leads to chronic physical defensiveness and anger, as well as heightened vigilance and also fear. However, because they have an affective and regulatory style that is active, these children do engage with others. Thus, we expect that the effects of chronic neglect may be differently, but equally

compromising, because it limits the capacity of the child to engage with others and to be an active participant in any relational (including therapeutic) process.¹⁴

OBSERVATIONS OF DEPRESSED MOTHERS AND THEIR INFANTS IN THEIR HOMES

We have now followed up these laboratory observations with observations of depressed mothers with their infants at home.³³ The sample consisted of 111 first-time, otherwise healthy mothers and their healthy infants. Mothers were contacted by phone by a female research assistant when the infants were two months of age. The CES-D³⁴ was administered to assess the mothers' current level of depressive symptoms. All eligible mothers who scored 16 or more on the CES-D were recruited for the study, and the next mother contacted whose score was below 12 was recruited for the comparison group. Participating mothers' mean age was 31.6 years, and most were Caucasian. These mothers were living with the infants' fathers and had at least a high school education. The infants were at low medical risk. The infants were full-term, and 48.6% were female.

Two hours of naturalistic observations of the mothers and their infants at home were videotaped at 3, 6, and 12 months. At this time we can report only the 3-months-postpartum results. Using the "Home Affect Coding Scale," 30 minutes of the observations were coded in five-second intervals. The infant's affect was coded as positive, neutral, negative, cry, or unscorable. Mother's affect was coded as exaggerated positive, positive, neutral, withdrawn, hostile, or unscorable. Affective matching, a measure of the proportion of time that the infant and mother were in the same affective state (e.g., positive/positive) was also evaluated. There were no significant differences in the overall expression of positive or negative affect of the mothers by depression status, but the 3-month-old infants of depressed mothers expressed less positive affect than infants of nondepressed mothers. The infants of depressed mothers also cried significantly less than infants of nondepressed mothers. Importantly—and what is perhaps the underlying mechanism—the depressed dyads had less positive affective matching and also fewer reparations to positive matching than their nondepressed counterparts.

The findings from these home observations demonstrate that infants of depressed mothers live in a less positive social environment. The lower amount of crying in the infants of depressed mothers suggests that they have developed their self-regulatory capacities for controlling their own negative affect. The lower rate of positive affective matching is a sign of reparatory failure. These findings are similar to laboratory studies and support the validity of those observations.

More importantly, the findings suggest that infants of depressed mothers are chronically exposed to less positive and well-regulated interactions, which even at three months is observed to have an effect on infants' affective regulatory style. In particular, the 3-month-olds are developing an affective state that is characterized by less positive affect. Our expectation is that at 6 months they will have more fully established a negative affective state if their mothers' affective states do not change.

In a recent study we have more directly explored issues of reparation in depressed mothers (unpublished data, Reck et al.). The primary goal of the study was to evaluate specific patterns of dyadic coordination and the capacity for repairing states of miscoordination in a sample of postpartum, severely depressed mothers and their infants compared to a healthy control group as evaluated with the DSM-IV diagnostic interview. The study was conducted at the mother-infant inpatient treatment unit of the University of Heidelberg Psychiatric Clinic.³⁵ More than half of the mothers in the clinical sample had comorbid disorders (viz., anxiety or obsessive-compulsive disorder), and more than half received pharmacotherapy. The infants ranged in age from one to eight months. Mothers and infants were videotaped during face-to-face interactions.

Preliminary findings were striking. We found a higher degree of interactive coordination in the healthy group than in the depressed group for positive and social matches (e.g., infant and mother both looking at each other with neutral affect), and depressed dyads had a lower reparation rate of going from a mismatching state to positive matches. Considering that even when the depressed dyads established a positive match, it took them four times longer than healthy dyads to do so, our findings confirm that there is poorer interactive coordination in depressed, compared to healthy, dyads.

It is our view that these differences reflect poor mutual regulation, weaker coping mechanisms, and fragile self-regulatory competencies in the depressed mothers and their infants. Though the differences are moderate in size, these interactive phenomenon (failure to repair) typically occur quite quickly, so that the overall number of interactions, given the length of time that mothers and infants are in close contact, mounts rapidly. Infants can thus accumulate a very large number of experiences of being stuck in their own negative affective states and in mismatched interactions. They will repeatedly experience reparatory failure, with the likely consequences that the infants will come to see the mothers as unreliable and untrustworthy (making them an unlikely source of a secure attachment) and negative affect as incapable of being transformed into positive affect. One should expect these infants to be more vulnerable to depression.

GENDER DIFFERENCES IN INFANT REGULATION STYLE AND AFFECT

These observations on the interactions of depressed mothers and their infants need to take into account gender differences in infants' regulatory and affective styles.^{36,37} We have found that boys are more reactive affectively and are less able to self-regulate their affective states. We think that they may be particularly susceptible to the disengaged and withdrawn style associated with depression since maternal withdrawal denies them the regulatory support they need. In contrast, girls—who at six months are significantly more focused on objects than boys and who more effectively self-regulate—may be more vulnerable to the intrusive style of depression because it interferes with their own agency and regulation.

In our laboratory, in a study of mothers with a diagnosis of major depression, we found that the six-month-old male infants of these mothers were significantly less likely to express positive affect or to use self-comforting strategies to regulate affective states than the female infants.²⁸ The depressed mothers were also more affectively negative with their sons than with their daughters. Maternal depression thus appeared to have a differential impact on the early interactive behaviors of boys and girls, with the boys showing more dysregulated behavior than girls, and the mothers, in turn, being more affectively negative with their sons than with their daughters.

In a recent study with three-month-old infants, we found that sons of depressed mothers, when confronting an experimentally induced, stressful interaction in which the mother has been instructed to look at, but not respond to, the infant (that is, to hold a still face and not move), had the lowest levels of social play and interest, along with the highest levels of negative affect. In addition, depressed mothers of sons were found to engage in the lowest level of social play, and depressed mothers and their sons had more difficulty with reparation, especially after the still-face perturbation, than did depressed mothers and their daughters.¹² These findings are consistent with previous research by Murray,³⁸ who found compromises on the Bayley Scales of Infant Development in the 18-month-old male infants of depressed mothers, and by Tronick and Weinberg,²⁸ who found greater effects of maternal depression on the socio-emotional functioning of both six-month-old male infants and their mothers.

There are differences in the dyadic organization of interactions of boys and girls with their mothers. It seems surprising that there are higher levels of synchrony (a mathematical measure of how much infants and mothers are changing in the same way at the same time) in mother-son than in mother-daughter dyads. Though synchrony is often thought to measure a "good" quality of the mother-child attunement, we are now starting to think that it measures greater vigilance by the mother of her sons because of their

greater regulatory needs and emotional reactivity. Thus synchrony, in contrast to positive affective matching (mother and infant both positive together), may actually be an index of problems in the interaction. This view fits with the work of Gottman,³⁹ who found that couples with the most problematic marital relationship paradoxically show the highest degree of physiologic concordance.

Taken together, these data support the conclusion that male infants are more vulnerable—or perhaps more accurately, differently vulnerable—to maternal depression than female infants and that depressed mothers have more trouble interacting with their male infants. These findings suggest that a cycle of regulatory problems may become more easily established between depressed mothers and their sons. Male infants' greater negativity, less interest, and less social play during social interactions makes them difficult interactive partners, and this difficulty is manifest in mother-son dyads' problems with reparation. These difficulties challenge the ability of depressed mothers to provide their sons with the regulatory scaffolding needed for them to maintain regulation—which, in turn, dysregulates the infants and further dysregulates the mothers' interactive behavior. As a consequence, there is a self-amplification of their interactive problems. Further, combined with earlier findings that girls show more stability of sadness than boys, and boys show more stability of distancing and escape behaviors than girls, we think these gender differences in regulatory styles may presage the well-documented different development of problems in boys versus girls. Girls show more internalizing problems and more sadness and withdrawal than boys, which is a form of early pathology that may be related to girls' greater capacity for self-regulation. Boys show more externalizing problems and more acting out and aggression, which may be related to their greater emotional reactivity. Thus, it is not that girls are inherently depressed and boys inherently hyperactive. Rather, each has a different regulatory style that, over months and years of regulating themselves and their interactions in particular ways, makes one outcome more likely.

Though speculative, this perspective has implications for the higher rates of conduct and delinquency disorders in boys. We know from the literature on juvenile delinquency that boys commit many more crimes than girls, but there is no persuasive explanation for this phenomenon. Our research indicates that gender differences in infancy may already set the stage for this differential rate. The explanation, however, is not simply that boys are more aggressive than girls. Rather, boys have greater difficulty controlling their emotional reactions, and because of this difficulty, they are more likely than girls to fail to accomplish their goals. This failure generates frustration and anger, and may lead to aggression. These effects will be exacerbated when parenting behavior is compromised by an affective disorder, especially if it is intrusive.

CLINICAL IMPLICATIONS AND THERAPEUTIC CONSEQUENCES

In this article we have discussed the intergenerational transfer of depression and the process that establishes it. Whether looking at normal interactions or disturbed interactions, the ongoing, chronically reiterated quality of the emotional interchange and of the process of mutual regulation generates affective states and developmental effects in infants and children that have ongoing and long-term consequences for the way that they function and approach the world. We think that researchers have not taken sufficient account of how reactive children are to maternal affect, and that treating maternal depression and other affective disorders has important consequences for the children of these mothers.⁴⁰ Put perhaps too simply, the child of the intrusive mother is likely to have an angry affective state, whereas the child of a disengaged and withdrawn mother is likely to have a sad, depressed affective state. The infants of acutely depressed mothers are likely to have feelings of helplessness. Another consequence is that these interactive experiences organize the child's sense of a situation—one separate from interactions with the mother—in a way that may be unrelated to the situation itself. The angry child comes into situations biased to experience it as anger-generating, and the withdrawn child comes into them biased to experience situations as threatening, even though the situation might not otherwise provoke those feelings. The behavior is perplexing unless we begin to consider the core emotional moods that the children bring with them. Of course, the infant of a mother who is generally affectively positive and reparatory will more likely develop a positive affective state and come into situations with the expectation of a positive experience.

Clinically, we need to carefully consider the child's experience with the mutual regulation of affect in order to understand what affective states the child's regulatory experience might have generated. First, we need to figure out what affective state the child typically is in. We need to make this assessment because their affective states have long-term consequences. Affective states are continuously present and continuously organizing behavior. The most insidious of these consequences emerges from circular causality in which the operation of an affective negative state further compromises the child's functioning and makes his or her state even more negative. The angry child elicits anger, receives it, and gets angrier. The sad child elicits withdrawal and gets sadder. The affective regulatory process is self-amplifying and self-compromising. Positive states function in just the opposite fashion. They self-amplify and aid the child's coping with stress.

Second, we need to see that these emotional states give meaning to the world even though they are not cognitive. We need to try to understand that meaning. The angry child has a state of consciousness in which his impelling certitude

is that the world is threatening and intrusive. Likewise, the sad child is certain that the world is unavailable and cannot be connected to. For infants and young children, affective states are a primary and powerful way of making meaning. Of course, these states make meaning of the world for adolescents and adults as well.

Third, we need to treat affective states in infants and engage in practices to shift them. This sort of therapy will have to be an ongoing process of interaction and of providing a scaffold for the child's emotions and intentions—which, over time, will lead to the establishment of a new, more positive affective state. Perhaps the therapy would enable the child (or infant) to accumulate positive experiences with an individual who is able to control his or her own negative reactions to the child's negative behavior while sensitively engaging in increasingly positive exchanges. The therapeutic process would likely take advantage of the self-amplifying effects of the resulting, positive affective states, enabling small shifts to generate further shifts. And the intervention will need also to treat the child's social environment—primarily, his or her parenting environment—because that is the environment where most of the child's emotional experiences occur and accumulate. Whatever such therapy would actually look like, from our research on normal and abnormal development, we have come to see affective states as central to infants' and children's functioning, making it necessary to develop affectively focused therapies for infants and children.

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REFERENCES

1. Harvey ST, Pun PK. Analysis of positive Edinburgh depression scale referrals to a consultation liaison psychiatry service in a two-year period. *Int J Ment Health Nurs* 2007;16:161–7.
2. Matthey S, Barnett B, Howie P, Kavanagh DJ. Diagnosing postpartum depression in mothers and fathers: whatever happened to anxiety? *J Affect Disord* 2003;74:139–47.
3. Reck C, Struben K, Backenstrass M, et al. Prevalence, onset and comorbidity of postpartum anxiety and depressive disorders. *Acta Psychiatr Scand* 2008;118:459–68.
4. Bugdayci R, Sasmaz CT, Tezcan H. A cross-sectional prevalence study of depression at various times after delivery in Mersin province in Turkey. *J Womens Health (Larchmt)* 2004;13:63–8.
5. Rahman A, Iqbal Z, Harrington R. Life events, social support and depression in childbirth: perspectives from a rural community in the developing world. *Psychol Med* 2003;33:1161–7.

6. Josefsson A, Berg G, Nordin C, Sydsjö G. Prevalence of depressive symptoms in late pregnancy and postpartum. *Acta Obstet Gynecol Scand* 2001;80:251–5.
7. Reck C, Hunt A, Weiss R, et al. Interactive regulation of affect in postpartum depressed mothers and their infants: an overview. *Psychopathology* 2004;37:272–80.
8. Tronick E, Weinberg MK. Depressed mothers and infants: failure to form dyadic states of consciousness. In: Murray L, Cooper PJ, eds. *Postpartum depression and child development*. New York: Guilford, 1997:54–81.
9. Moehler E, Brunner R, Parzer P, Wiebel A, Reck C, Resch F. Maternal depressive symptoms in the postnatal period are associated with long-term impairment of mother-child bonding. *Arch Womens Ment Health* 2006;9:273–8.
10. Reck C, Klier CM, Pabst K, et al. The German version of the Postpartum Bonding Instrument: psychometric properties and association with postpartum depression. *Arch Womens Ment Health* 2006;9:265–71.
11. Field T, Hernandez-Reif M, Diego M, et al. Still-face and separation effects on depressed mother-infant interactions. *Infant Ment Health J* 2007;28:314–23.
12. Weinberg KW, Olson K, Beeghly M, Tronick E. Making up is hard to do, especially for mothers with high levels of depressive symptoms and their infant sons. *J Child Psychol Psychiatry* 2006;47:670–83.
13. Murray L, Hipwell A, Hooper R, Stein A, Cooper P. The cognitive development of 5-year-old children of postnatally depressed mothers. *J Child Psychol Psychiatry* 1996;37:927–35.
14. Tronick E. *The neurobehavioral and social emotional development of infants and young children*. New York: Norton, 2007.
15. Weinberg MK, Tronick EZ. The impact of maternal psychiatric illness on infant development. *J Clin Psychiatry* 1998;59:53–61.
16. Moehler E, Kagan J, Parzer P, et al. Behavioural inhibition at fourteen months is associated with maternal depression during the first six months. *Psychopathology* 2007;40:446–52.
17. Downey G, Coyne JC. Children of depressed parents: an integrative review. *Psychol Bull* 1990;108:50–76.
18. Murray L, Cooper P, eds. *Postpartum depression and child development*. New York: Guilford, 1997.
19. Weinberg MK, Tronick E. Maternal depression and infant maladjustment: a failure of mutual regulation. In: Noshpitz J, ed. *The handbook of child and adolescent psychiatry*. New York: Wiley, 1997.
20. Tronick E. Emotions and emotional communication in infants. *Am Psychol* 1989; 44:112–9.
21. Tronick E. Dyadically expanded states of consciousness and the process of therapeutic change. *Infant Ment Health J* 1998;19:290–9.
22. Tronick E, Field T. *Maternal depression and infant disturbance*. San Francisco: Jossey-Bass, 1987.
23. Weinberg MK, Tronick E. Beyond the face: an empirical study of infant affective configurations of facial, vocal, gestural, and regulatory behaviors. *Child Dev* 1994; 65:1503–15.
24. Beeghly M, Olson KL, Weinberg MK, Pierre SC, Downey N, Tronick E. Prevalence, stability, and socio-demographic correlates of depressive symptoms in black mothers during the first 18 months postpartum. *Matern Child Health J* 2003;7:157–68.
25. Beeghly M, Weinberg MK, Olson K, Kernan H, Riley J, Tronick, EZ. Stability and change in level of maternal depressive symptomatology during the first postpartum year. *J Affect Disord* 2002;71:169–80.
26. Weinberg MK, Tronick E, Beeghly M, Olson KL, Kernan H, Riley J. Subsyndromal depressive symptoms and major depression in postpartum women. *Am J Orthopsychiatry* 2001;71:87–97.
27. Murray L. The impact of postnatal depression on infant development. *J Child Psychol Psychiatry* 1992;33:543–61.
28. Tronick E, Weinberg MK. Gender differences and their relation to maternal depression. In: Johnson SL, Hayes AM, Field TM, Schneiderman N, McCabe PM, eds. *Stress, coping, and depression*. Mahwah, NJ: Erlbaum, 2000:23–34.
29. Reck C, Stehle E, Reinig K, Mundt C. Maternity blues as a predictor of DSM-IV depression and anxiety disorders in the first three months postpartum. *J Affect Disord* 2009;113:77–87.
30. Cohn JF, Tronick E. Three-month-old infants' reaction to simulated maternal depression. *Child Dev* 1983;54:185–93.
31. Field T. Infants of depressed mothers. *Infant Behav Dev* 1995;18:1–13.
32. Cohn JF, Matias R, Tronick E, Connell D, Lyons-Ruth K. Face-to-face interactions of depressed mothers and their infants. In: Tronick E, Field T, eds. *Maternal depression and infant disturbance*. San Francisco: Jossey-Bass, 1986:31–44.
33. Bell L, Ham J, Weinberg MK, Yergeau E, Tronick E. In naturalistic home observations depressed mothers have a less positive and contingent relationship with their infants. Paper presented at the International Conference on Infant Studies, Chicago, IL, May 2004.
34. Radloff L. The CES-D Scale: a self-report depression scale for research in the general population. *Appl Psychol Meas* 1977;1:385–401.
35. Reck C. Depressionen und Angststörungen im Peripartalzeitraum: Epidemiologie, Mutter-Kind-Beziehung und Behandlungskonzept. *Nervenheilkunde* 2008;6:489–90.
36. Tronick E, Cohn J. Infant-mother face-to-face interaction: age and gender differences in coordination and the occurrence of miscoordination. *Child Dev* 1989;60:85–92.
37. Weinberg M, Tronick E, Cohn J, Olson K. Gender differences in emotional expressivity and self-regulation during early infancy. *Dev Psychol* 1999;35:175–88.
38. Murray L, Kempton C, Woolgar M, Hooper R. Depressed mothers' speech to their infants and its relation to infant gender and cognitive development. *J Child Psychol Psychiatry* 1993;34:1083–101.
39. Levenson RW, Gottman JM. Marital interaction: physiologic concordance and affective exchange. *J Pers Soc Psychol* 1983;45:587–97.
40. Pilowsky DJ, Wickramaratne P, Talati A, et al. Children of depressed mothers 1 year after the initiation of maternal treatment: findings from the STAR*D-Child Study. *Am J Psychiatry* 2008;165:1136–47.