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Postnatal Depression and Emotion: The Misfortune of Mother-Infant Interactions

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1. Introduction

“The movements of expression in the face and body (...) serve as the first means of communication between the mother and her child; she smiles approval, and thus encourages her child on the right path, or frowns disapproval” Charles Darwin (1872/1998, p. 359).

Emotional communication can be viewed as a fundamental factor in children's emotional, social, and cognitive development. Most developmental psychologists agree that the recognition and expression of emotions through early social interaction between the mother and the child play a particularly important role in children's development (Bandura, 1992; Bowlby, 1969; Sroufe, 1996; Trevarthen, 1979). Moreover, as Paul Ekman reminds us, nature and nurture are both intrinsically involved in children's psychological development: *“It is never a question only of nature or only of nurture. We are biosocial creatures, our minds are embodied, reflecting our lives and the lives of our ancestors.”* Ekman (1996, p. 393). This biosocial conception of emotional development, defended in the theories put forward by a number of pioneers in the child development field, therefore suggests that the child-caregiver relation constitutes a system which is simultaneously based on the innate skills of the baby while also having the task of elaborating and refining these skills.

As of the first months of life, emotional and social development is grounded in emotional communication, i.e. in a social environment which forms or modulates primary abilities (Izard, 1971; Sroufe, 1979). Therefore, the mother-infant interaction constitutes the first and main environmental context that might shape infants' abilities. Before the development of language in the child, mother-child communication is largely non-verbal. It is based on a whole range of non-verbal signals (e.g. facial expression, prosody, touch) produced by the mother. Numerous studies have shown that the quality of these different non-verbal signals is impaired in mothers suffering from postpartum depression. The question is: what are the effects of an early impairment of communication on children's development?

The aim of this chapter is therefore to review the literature relating to psychological studies of mothers suffering from depression and the impact of their depression on early mother-child

relationships. The originality of our contribution lies in the fact that it focuses on emotion, i.e. the emotional regulation and dysregulation themselves, as well as on their causes and consequences for both the mother and for the socio-emotional development of her baby.

2. An early ability to process emotion in infants: The mother as the preferred object of processing

A large body of literature has revealed that, from birth onwards, human babies are equipped with wide-ranging, deeply innate mechanism which serve an adaptive function. These biological mechanisms are thought to help human beings deal with their physical and social environments and thus contribute to both their survival and their well-being (Darwin, 1872/1998; Ekman, 1982; Izard & Malatesta, 1987; Leslie, 1987). As Trevarthen (1998) argues, newborns have innate intersubjectivity: *"The claim made, while not questioning that development involves learning or that infants depend on care, underlined that a child is born with motives to find and use the motives of other persons in 'conversational' negotiation of purposes, emotions, experiences and meaning."* (Trevarthen, 1998, p. 16). Such pre-adaptation for emotional communication in infants has been demonstrated by a number of well-known face discrimination studies that have described how neonates are extremely sensitive to human faces, how they respond selectively to them, and how they imitate emotions perceived in adults. In these studies, researchers presented neonates with a series of stimuli that represented human faces, non-human face-like patterns, or scrambled patterns (Figure 1). They then measured whether the neonates preferentially directed their gaze, or looked longer, at any one specific type of stimulus. They found that neonates, who have a minimal experience of faces, prefer human face-like patterns (Goren et al., 1975; Johnson et al., 1991; Mondloch et al., 1999). Using the same procedure, Batki et al. (2000) showed that neonates prefer to orient their attention toward faces which have open eyes (Batki et al., 2000). These studies therefore indicate that babies are innately interested in processing human faces.

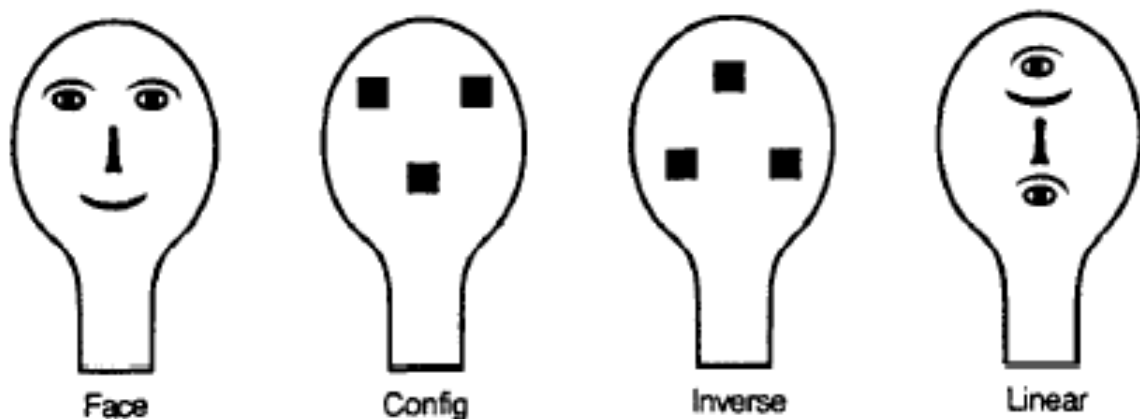


Fig. 1. Examples of face-related stimuli used to demonstrate the face-preference of babies. Source: Johnson et al. (1991).

In 1977, Meltzoff and Moore showed that neonates not only preferentially focus their attention on faces, but that they are also able to imitate the facial expressions perceived on those faces. From two to three weeks of life, when adults stick out their tongues, form a kiss with their lips, or open their mouth, infants imitate these facial expressions (see Figure 2).

There is also ample evidence that newborns are able to express some adult-like emotional facial patterns in response to emotion elicitors (Camras et al., 1991; Rosenstein & Oster, 1988). As of an early age starting shortly after birth, babies are therefore able to process other people's facial expressions, especially those of the mother, and embody other people's emotions through imitation.



Fig. 2. Sample photographs taken from videos of infants imitating an adult experimenter (a: tongue protrusion; b: mouth opening; c: lip protrusion). Source: Meltzoff & Moore (1977).

The fact that infants possess early emotional communication abilities is now a well-established psychological fact. As a result, researchers are agreed in considering that children's socio-emotional development may be shaped by their socio-emotional environment, and more particularly by their initial experiences during a period of life that is critical for the establishment of abilities. More precisely, it is now widely believed that the infant's ability to express and recognize affective states can be shaped by early interactions. The study conducted by Pascalis and his team (2002) clearly revealed the critical role of experience in the shaping of infant's face processing abilities. In their jolly study, they examined the ability of infants to discriminate between the identities of faces as a function of their experience of human faces. They presented pairs of human faces or monkey faces to infants of different ages. Their results showed that the infants were able to discriminate equally between two different identities in the two species at the age of 6 months, whereas they were able to do it only for human faces at the age of 9 months (Pascalis et al., 2002). Experience of human faces therefore leads to a sort of specialization in the processing of human faces. This is referred to as "perceptual narrowing" and clearly indicates the considerable impact of experience on the development of early social abilities.

Interactions between babies and their mothers represent the majority of the emotional interactions experienced by infants and thus constitute the primary environment for emotional learning (Papousek & Papousek, 1989; Tronick, 1989). Consequently, it may be assumed that non-verbal communication, for example in the form of emotional facial expressions, plays a critical role in the establishment of early social interaction and the development of social abilities. Facial expressions are indeed the main way in which two partners are able to interact and develop an intimate relationship, and in which mothers can understand their infants and respond to their needs. In line with the “intuitive parenting” concept, (Papousek & Papousek, 1978), Schoetzaue and Papousek (1977) illustrated how face-to-face contact is an essential part of the communication between the mother and her baby. Indeed, these authors showed that mothers watch their babies sleeping at a distance of 40-50 cm, but that as soon as their infants open their eyes, they immediately reduce the face-to-face distance and position their faces in the middle of the infant’s visual field. The postpartum period is thus a critical period during which links are established between the mother and her baby. However, this very special moment can be disrupted by a series of emotional and psychiatric disorders that can be experienced by mothers.

3. Risks of an early infant-mother interaction disrupted by the depression of the mother

The likelihood of mothers being admitted into a psychiatric unit appears to be multiplied by a factor of between 10 and 20 during the first month following delivery. After giving birth, mothers may present a variety of emotional disorders such as stress, anxiety and depression that vary in their severity and time of onset. Anxiety, stress and postpartum blues are generally short-lived. Postpartum blues takes the form of emotional disturbances such as crying, anxiety, and a depressed and unstable mood. It is thought to affect a non-negligible proportion of mothers, which varies from 20 to 80 % depending on the study. This disrupted emotional state can be observed during the first 15 days following the birth. It is in fact considered to be a premature form of postpartum depression. Indeed, numerous studies have shown that an intense and prolonged period of postpartum blues could represent the onset of postpartum depression. This latter condition can last for several months and affects 10 to 20 % of women who have just given birth (Beck, 2002). Moreover, the link between blues and depression has been documented on the basis of the Edinburgh Postnatal Depression Scale (EPDS) that is thought to evaluate the depressive component of postpartum blues and to predict the clinical diagnosis of postpartum depression (Chabrol & Teissèdre, 2004; Gonidakis et al., 2008). More rarely, mothers can also exhibit more serious disorders such as puerperal psychosis (1-2 per thousand deliveries). This dramatic state occurs within the first 2-4 weeks after delivery and is characterized by paranoid, delusions, confused cognitive manifestations, and a significant level of disorganized behavior (Sit et al., 2006). The symptoms of a depressive state are thus difficult for mothers to cope with, particularly during a period of their lives when they must both cope with a newborn child who is dependent upon them and adhere to the role of good mother as expected by their families and society. Moreover, as we will explain below, these depressive symptoms can lead to non-optimal early mother-child interactions, due to both a characteristic depressive style of emotional expressiveness and the way in which emotional cues are processed. As stated by de Haan et al. (2004, p. 1214), because *“linkages detected between maternal emotional disposition and infant face processing reflect, at least in part, the role of experience in shaping face*

processing," examining the behavior of depressed mothers during the first months of their babies' lives is a valuable way of gaining an understanding of their effect on children's socio-emotional development within the context of an early undertaking to care for the child.

Among the emotional behaviors, facial expressions play a crucial role in communication. As Ursula Hess (2001) stresses, facial expressions are important not only for the person who displays them, but also for the perceiver who has to associate them with a meaning in order to react appropriately (Keltner & Haidt, 2001; Frijda, 2007; Russell & Fernandez-Dols, 1997). In the case of depression, the predominant facial expression is that of sadness. As an emotion, sadness is an occasional phenomenon. However, in the case of depression, it is more like a mood, the affective component of emotions. Whereas emotions color life at a specific time, a mood fundamentally colors every part of our lives. It is therefore a continuous emotional state. According to the DSM IV criteria (American Psychiatry Association, 1994), sadness is a characteristic of a depressive mood. In this case, sadness is pathological because it is excessive, maladaptive, persistent and aggravated. More specifically, this pathological sad mood is a common criterion in the diagnosis of major depression and postpartum depression, the latter being considered as a special case of the former, although it is necessary to differentiate between them in terms of etiology and treatment (see Hendrick et al., 2000).

However, few studies have investigated the specificity of atypical emotional behavior in mothers with depressive symptoms after birth compared to women with major depression. In addition, it is not always easy to identify how major depression and postpartum depression have been differentiated in the studies published to date. This raises several questions concerning the etiology of depressive symptoms: Are women diagnosed as depressed because of their postpartum state or because it is the first time they have been screened for depression? Whatever the case, the present chapter focuses on the literature on depressed mothers who are characterized by an emotional depressive style such as those suffering from postpartum depression.

Moreover, as stated by Carroll Izard (1991), a depressed mood cannot be described in terms of sadness alone. It is a complex combination of different negative affects: "*The fundamental emotions involved in the phenomenology of depression are sadness – the key emotion – and anger, disgust, and contempt, fear, guilt, and shyness [...] There are other factors that are frequently present – decreased sexuality, decreased physical well-being and increased fatigue.*" (Izard, 1991, p. 218). There is now ample evidence that all these negative moods and negative emotions affect both physical and mental functioning in depressed mothers via a series of cortical, somatic and autonomic responses. They therefore disrupt many social and cognitive behaviors (e.g. Beukeboom & Semin, 2006; Gil & Droit-Volet, 2009). Among these behaviors, those involved in initial child care and education in general have been identified. Depressed mothers have indeed been found to be characterized by insensitivity, unresponsiveness, negativity, and disengagement (e.g. Cohn et al., 1986; Field, 1984, 1986). They exhibit either no affect or negative affects. Consequently, they exhibit a mechanical form of childcare as if they were simply rigidly adhering to the rules of infant care. Many studies have further examined and coded mother-infant interactions in terms of attentiveness and shared affective states. Figure 3 shows the results found in Field's study (Field et al., 1990). The results of this study indicate that mother-infant dyads are characterized by a higher level of angry behavior and disengagement, and fewer periods of play when the mother is depressed rather than non-

depressed. Moreover, Field also reported that depressed mothers spend less time engaged in shared behavior states (40%) than their non-depressed counterparts (54%).

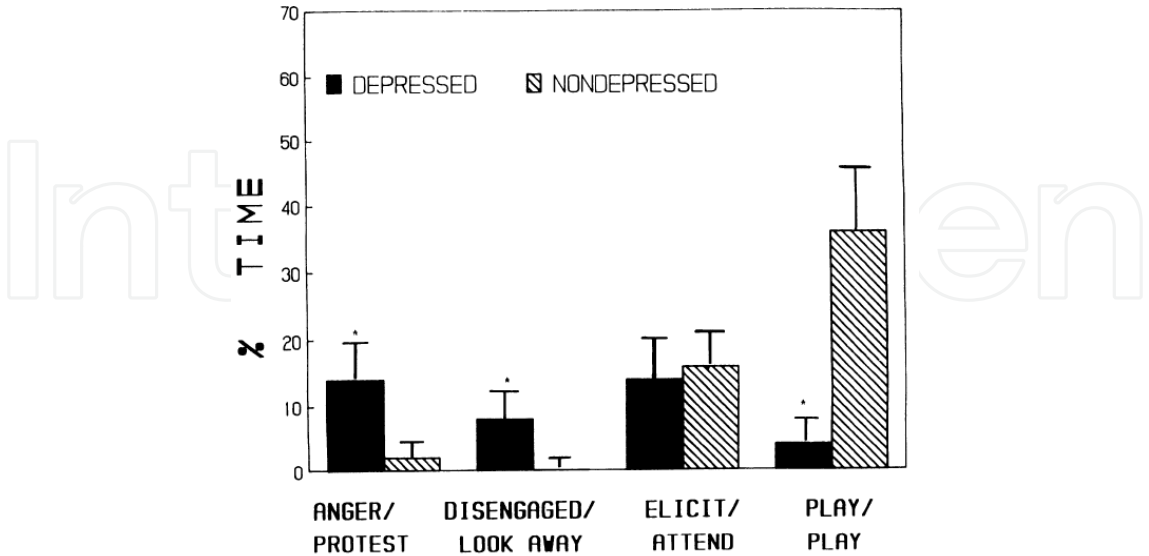


Fig. 3. Percentage of time that mothers and their infants shared behavior states, in 48 depressed mother-infant pairs and 48 nondepressed mother-infant pairs. Source: Field, Healy, Goldstein and Guthertz (1990).

Using self-report questionnaires, Righetti-Veltema and her colleagues (2002) showed that these depressed mothers are, in some respects, aware of their difficulties. They reported experiencing more difficulty in performing everyday activities with their 3-months-old infants. They also evaluated their behavior as more negative, and found their infants more demanding than non-depressed mothers. In line with this self-evaluation reported by depressed mothers, Lovejoy, Graczyk, O'Hare and Neuman's (2000) quantitative review of 46 observational studies conducted both in laboratory and home settings identified three types of maternal depression-related behaviors which have been categorized as disturbed: negative/coercive behaviors, positive behaviors and disengagement. Focusing more on emotional expressiveness, Martinez et al. (1996) videotaped infant-mother interactions and found that depressed mothers were indeed less expressive than non-depressed mothers, both when interacting with their own children and with the children of non-depressed mothers. Moreover, a number of studies have shown that depressed mothers produce fewer positive facial expressions and more neutral and negative facial expressions than non-depressed mothers (e.g. Cohn et al., 1986; Dawson et al., 2003; Field, 1992). Nevertheless, it is important to note that not all mothers with a similar level of depressive symptoms interact with their babies in the same way. Various studies have documented two distinct styles among depressed mothers which are referred to as "withdrawn" and "intrusive" (Cohn et al., 1990; Field et al., 1996; Field et al., 1990; Jones et al., 1997; Tronick, 1989). These two disruptive interactive styles are assumed to correspond to either understimulating or overstimulating behaviors. More precisely, the withdrawn mothers display fewer facial expressions. They are, in general, disengaged and unresponsive. In contrast, intrusive mothers are engaged but in a negative way. Although they exhibit emotional expressions, these are mostly negative, for example angry or irritated. They also commonly produce negative behaviors such as rough handling. However, as Field et al. (2006) add, 21% of

depressed mothers do not correspond to either of these profiles. Nonetheless, whatever the interactive style, there is ample evidence that depressed mothers manifest maladaptive behaviors toward their babies.

4. The consequences of atypical mother-child interactions for infants' socio-emotional development

As reported above, mothers suffering from depression find it difficult to respond to their babies' needs and to communicate with them. The scientific literature suggests that this initial dysfunctioning of mother-baby relationships affects children's development by impairing babies' psychomotor and socio-emotional development. Embodiment theories suggest that, if they are to develop their own socio-emotional skills, children need to perform embodied simulations of emotions expressed by others, and in particular those expressed by the mother who is the focal point of this first social relationship (Niedenthal et al., submitted). Within this framework, the large number of negative emotional cues perceived by the babies of depressed mothers, both in terms of facial expression and comprehension, seems to cause such children to exhibit "atypical" emotional behavior and competences from the first months (Murray et al., 1999). Below, we report the various studies that can help explain or reveal how and why the behavior of depressed mothers can have consequences for their babies and their socio-emotional development.

There is ample evidence that the majority of mothers primarily display positive emotions when interacting with their infants. For example, in a well-designed experiment, Malatesta and Haviland (1982) reported that, during a six-minute period of interaction, mothers displayed 100 times more happiness than anger, and 40 times more anger than sadness. This positive attitude toward infants is assumed to contribute to attachment. As Bowlby (1951) has argued, attachment is *"essential for mental health in that an infant or young child should experience a warm, intimate and continuous relationship with (his or her) mother in which both find satisfaction and enjoyment"*. Attachment thus plays a critical role in how infants develop at the emotional level and how they cope with their social environment. Mary Ainsworth et al. (1978) has operationalized this concept attachment in a "strange situation paradigm" in which the infant is alternately in the presence of his or her mother or a stranger. Ainsworth identified different kinds of behavioral patterns in babies as a function of the quality of attachment, namely secure or insecure. In the strange situation, *secure attachment* causes the child to protest when his or mother leaves but to welcome her warmly again when she returns. The mother remains the reference point throughout the situation and the child continuously seeks her contact and proximity. In such cases, the mother is perfectly capable of responding adequately to her child's needs. In contrast, in the case of insecure attachment, Ainsworth distinguishes between three different styles (avoidance, ambivalent/resistant, and disorganized). However, all of these different insecure attachment styles are associated with a similar disruption in the child's behavior in the strange situation, i.e. the child is disturbed when the mother returns but not when she leaves. This specific type of reaction on the part of children is thought to result from their mothers' unresponsiveness or negative responses during everyday life. For our purposes here, it should be noted that maternal depression has been repeatedly linked to insecure parent-child attachments (Murray, 1992; Radke-Yarrow et al., 1985). In addition, longitudinal studies have revealed that postnatal depression has a harmful effect on infants during the first months of life and that these

persists at school age. This phenomenon has been explained primarily in terms of the insecure nature of attachment between the infant and the depressed mother during the first few months following birth. Within this perspective, infants aged 18 months should be more likely to exhibit an insecure style of attachment if their mothers were depressed when their children were aged 2 months (Murray, 1992). Moreover, Murray and collaborators (1999) examined whether the behavior of 5-year-olds at home with their mothers or at school with their peers is indeed predicted by the mother's postnatal depression and the insecure attachment observed at 18 months. Their analyses of mediation confirmed that children's attitudes at the age of 5 years are predicted by the mother's depression and mediated by the initial style of attachment (Murray et al., 1999).

With reference to the regulation of the infant-adult dyad, a considerable body of literature has examined how the two partners develop what theorists call attunement or synchrony. These two terms refer to the fact that, during their interactions, mothers and infants establish coordinated behaviors that help bring about a behavioral and physiological harmony based on contingency. Within this framework, researchers have examined infants' responses to the atypical maternal behavioral characteristics of depressed mothers, i.e. negativity, unresponsiveness. One commonly employed paradigm is the non-contingent maternal behavior paradigm (Nadel et al., 1999). This procedure consists of three phases: (1) infant-mother interactions are initially videotaped during a free play period; (2) the mother's videotaped behavior is played back to the infant with the result that the infant-mother behavior is now non-contingent; and, finally, (3) a return to the free play situation, i.e. to natural contingent interactions. Similarly, Tronick et al. (1978) used the still-face paradigm which employs the same three phases, except that in the second phase, the recorded mother suddenly displays a neutral, motionless face. Using these two paradigms, many studies have shown that in the second phase, infants generally exhibit negative emotions, produce stressful behaviors and cry because they perceive a violation of harmonious interactions. They thus react negatively to this breakdown in natural communication (Muir et al., 2005; Tronick, 2005). In contrast, the infants of depressed mothers have been found to exhibit atypical behaviors and to produce fewer negative reactions in the disrupt phase. This is probably due to the fact that they are familiar with atypical rhythms of communication, i.e. those associated with their depressed mothers. They have grown accustomed to a lack of responsiveness and to passivity on the part of their depressed mother and to a low level of exposure to positive emotions (e.g. Field et al., 2005; Field et al., 2007; Pelaez-Nogueras et al., 1996).

As far as emotional behavior *per se* in children of depressed mothers is concerned, Reissland and Shepherd (2006) have shown that the infants of depressed mothers are also unresponsive to various situations in which emotions are elicited. These authors designed a play situation involving mothers and their children in the presence of a toy assumed to produce surprise: a Jack-in-the-box. Their results showed that the infants of mothers who reported a depressed mood were unreactive and displayed fewer emotional facial expressions than those of non-depressed mothers. The atypical behavior of infants therefore "mirrors" their mothers' unresponsiveness. Indeed, several studies have reported dysfunctions in the regulation of affects in the babies of depressed mothers, thus suggesting that they mirror the mother's mood. The babies of depressed mothers are indeed reported to be particularly likely to produce negative expressions, irritability and inconsolable screaming (Britton, 2011; Field, 1994; Hanington et al., 2010; Zuckerman et al., 1990).

Recent neuroscientific studies have provided arguments in support of the behavioral measures that indicate the presence of emotion disturbances in the babies of depressed mothers. More precisely, a right-frontal asymmetry in EEG activation has been observed in depressive individuals and more generally in states characterized by high levels of negative affects. There is now growing evidence that this specific pattern of brain activation is also found in the babies of depressed mothers. Furthermore, this specific activation of the right-frontal cortex is observed as of the very first months of life (i.e. 1 month) and continues to be present up to preschool age, (i.e. 3-years old) (Diego et al., 2004; Jones et al., 2000; Jones et al., 1997ab; Jones et al., 2009). Figure 4 illustrates the results obtained by Diego et al. These clearly show a greater right-frontal EEG activation in the infants of depressed mothers than in those of non-depressed mother when they are presented with different emotional expressions. In addition, as reported above, this specific pattern of brain activity in the infants of depressed mothers has been observed not only in response to their mothers' faces but also in response to the faces of unknown women, and is thus consistent with a generalization process. In other words, the general processing of emotional cues, in this case facial expressions, seems to be disrupted in these children.

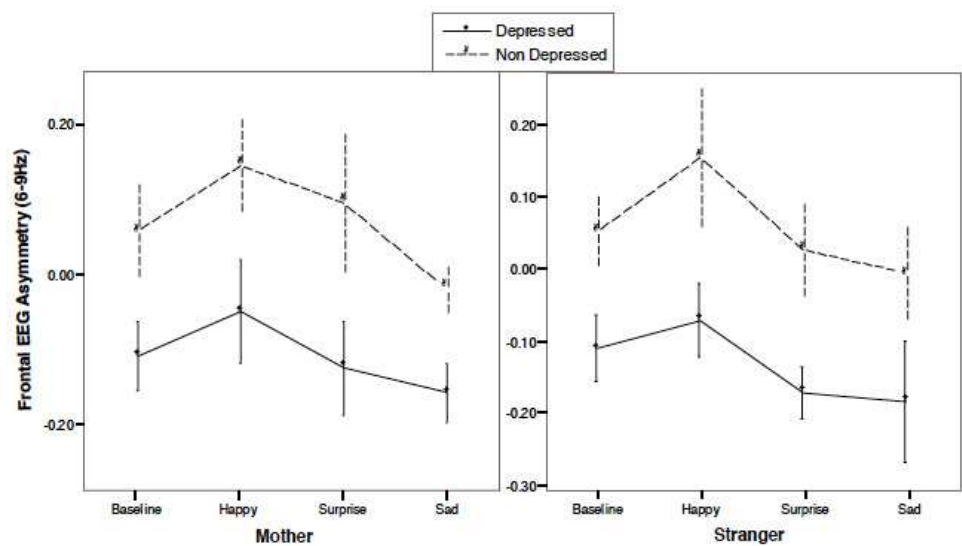


Fig. 4. Mean frontal EEG asymmetry (i.e. 6-9 Hz) of infants of depressed or non-depressed mothers in response to baseline, happy, surprised, sad expressions modeled by their mother (left panel) or an unknown female (right panel); positive values reflect greater left frontal EEG activation, negative scores reflect relatively greater right frontal EEG activation. Source: Diego et al. (2004).

Using experimental procedures more specifically designed to examine babies' emotional recognition competences, numerous studies have confirmed deficits in the processing of emotional facial expressions in the babies of depressed mothers. Based on the finding that infants look longer at new than at familiar stimuli, researchers have used the habituation paradigm to study the ability of babies to discriminate different emotional expressions. In this paradigm, infants are habituated through the repeated presentation of an initial stimulus (e.g. neutral face). Following habituation, i.e. when the time they spend looking at this initial stimulus has significantly decreased, they are presented with a second, new stimulus (e.g. happy face). If they look for significantly longer at the new stimulus, thus

exhibiting what is referred to as a "novelty preference", this means that they discriminate between the two types of expression. The literature based on this and related paradigms provides considerable evidence that 4/5-month-old infants are able to discriminate a wide range of emotional expressions (e.g. Bornstein & Arteberry, 2003; Montague & Walker-Andrews, 2001; Serrano et al., 1992). Moreover, the few studies that have been conducted among the babies of depressed mothers have revealed that their ability to discriminate emotional expressions is impaired or atypical (e.g. de Haan et al., 2004; Lundy et al., 1997; Striano et al., 2002). For example, the results obtained by Bornstein et al. (2011) and presented in Figure 5, showed that whereas 5 month-old infants of non-depressed mothers are able to discriminate between happy and neutral faces, this ability is impaired in the infants of depressed mothers.

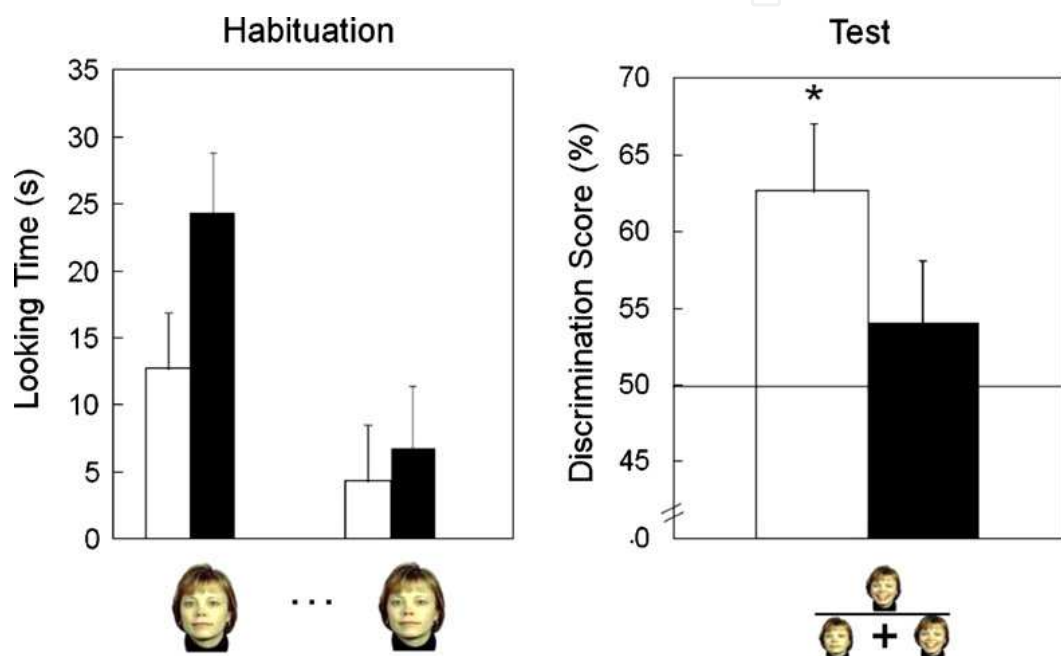


Fig. 5. Habituation (left panel) and novelty responsiveness (right panel) in infants of non-depressed (white bars) and depressed (black bars) mothers. Source: Bornstein et al. (2011).

However, even though there is a general consensus that the infants of depressed mothers perform worse in emotional tasks than the infants of non-depressed mothers, it should be noted that the results and the interpretations of them remain contradictory. For example, using a habituation paradigm, Striano et al. (2002) showed that the 6-month-old infants of depressed mothers preferred to look at happy faces. Using a matching task, Lundy et al. (1997) also showed that, unlike the 10-month-old babies of non-depressed mothers, those of depressed mothers performed less well on happy than on sad faces and preferred to look at the latter rather than the former. These different results lead to two contrasting interpretations. On the one hand, it can be claimed that the children of depressed mothers prefer smiling faces because their mothers do not often display this emotion (i.e. the salience hypothesis). On the other, it can be argued that these infants display a preference for sad expressions because they directly correspond to the usual mode of communication observed in depressed mothers (i.e. the exposure hypothesis). Further investigations will therefore be required if we are to successfully validate one or other of these hypotheses. However,

whatever the explanation, the socio-emotional environment of the children of depressed mothers is different than that of other children and consequently results in different social behaviors and different patterns of socio-emotional development. In addition, the pathology of depressed mothers may also mean that they have to cope with difficulties in responding appropriately to and understanding their infants' needs. If this line of argument is correct then not only would depressed mother send out negative emotional cues to their children, but they would also have difficulty understanding the emotions expressed by them. Having now presented the results relating to children and their socio-emotional abilities, we will now focus more on the results relating to mothers.

5. Emotional processing in depressed mothers

The literature reporting studies of depressed individuals shows that they perform poorly when asked to evaluate emotional faces (George et al., 1998; Gur et al., 1992; Leppänen et al., 2004; Mendlewicz et al., 2005; Rubinow & Post, 1992; Suslow et al., 2001). This poorer performance is generally explained in terms of a bias in the processing of emotional cues. One initial type of bias takes the form of an attention-bias effect, with a depressed mood producing a selective attention-bias toward negative or mood-congruent incoming stimuli (e.g. sad faces). Negative cues are therefore processed faster than positive cues (Gotlib et al., 2004; Suslow et al., 2001). In addition, depressed individuals find it difficult to shift their attentional focus away from the negative cues. A second type of bias takes the form of the "mood congruence effect" and suggests that we see the world through the prism of our own mood (Niedenthal et al., 2000). While someone in love sees life through rose-tinted spectacles, the spectacles worn by depressed individuals are grey. This mood congruence effect explains why neutral faces are evaluated as negative, and negative faces as more negative by depressed compared to non-depressed individuals (Demenescu et al. 2010; Gollan et al., 2008; Gur et al., 1992). Finally, people with depression generally achieve poorer performances when asked to evaluate emotional faces (George et al., 1998; Gur et al., 1992; Leppänen et al., 2004; Mendlewicz et al., 2005; Rubinow & Post, 1992; Suslow et al., 2001).

One recent line of research to emerge from this literature has focused on mothers' emotional processing of their environments. The assumption is that if mothers with depression experience difficulties or exhibit atypical behavior when processing their babies' faces, this may explain why they experience problems in interacting with them. Reasoning within this framework, Stein et al. (2009) suggested that insensitivity or maladaptive adjustment between depressed mothers and their children would effectively be due to an attention-bias. More precisely, these authors describe mothers as being "preoccupied", a state that consumes all their attentional resources. They define preoccupation as "*a state of narrowed or self-focused attention in which one's mind is dominated by recurrent negative intrusive thoughts that are difficult to control, difficult to dismiss and recur even if dismissed*" (Stein et al., 2009, p.12). This working memory load explains distortions in the processing of information such as the mood congruence effect which is thought to lead to the preferential processing of congruent stimuli. It also explains why depressed mothers are less available for their children than non-depressed mothers. However, some caution must be exercised when attempting to generalize from general depression to postpartum depression because the processing of information in depressed mothers may exhibit specific characteristics related to their maternal status and their close relationships with their babies.

Surprisingly, as far as postnatal depression *per se* and its impact on emotional face processing are concerned, only four experimental studies have been published in recent years. In 2011, Flanagan and his colleagues examined potential impairments in the perception of emotional faces by women with postpartum depression, non-postpartum depression and female control subjects. These authors presented their participants with emotional facial expressions of adults displaying anger, fear, happiness and disgust. They showed that depressed women – of both postpartum and non-postpartum type – performed less well than the controls. Furthermore, the results revealed a difference in impairment as a function of the type of depression, with the postpartum-depressed women achieving poorer performances in the processing of disgusted and fearful faces, and the women with a different type of depression performing less well when asked to process happy faces. This study is therefore valuable in that it reveals that, as reported in the literature on depression, postpartum depression involves the atypical processing of emotional faces. However, the question that needs to be addressed by developmental psychologists is whether this atypical processing is also observed in response to infants' faces. Two other studies have therefore attempted to examine this question by presenting valence-related infant faces (positive, muted positive, neutral, muted negative and negative) (Stein et al., 2010), and morphed discrete-emotional faces (happy *vs.* sad faces) (Arteche et al., 2011). The results of Stein's study involving faces of infants showed that the depressed mothers evaluated infant faces expressing a negative emotion more negatively than the female controls, but that this was only the case when the participants saw the faces for a long (2000 ms) rather than a short (100 ms) period of time. Moreover, these results also suggest that depression was the only factor explaining the atypical response to the emotional faces. Neither comorbid postnatal psychopathology nor anxiety had an impact. Conversely, the study conducted by Arteche et al. (2011) indicated that depressed mothers were less accurate than female controls in identifying the faces of happy infants, with the performance on sad faces being unrelated to the depressive mood. Finally, Gil and colleagues (2011) addressed a related question: is the impairment in the processing of faces in women with postpartum depression greater in response to infant than to adult faces. To do this, these authors asked mothers who had only recently given birth (i.e. on the third day after delivery) to perform an emotional facial expressions task involving both adult and baby faces, each expressing the emotion of anger, happiness, sadness and fear (see Figure 6). Unlike Stein's findings, their results revealed differences in the recognition of negative emotions when these were displayed by baby and adult faces. In line with the mood congruence hypothesis, the women with postpartum depression judged the neutral baby faces to be less neutral and sadder than the control subjects. In addition, anxiety, as measured by the State-Trait Anxiety Inventory (STAI), and which was found to be greater in the women with postpartum depression than in the controls, appears to play a critical role in the evaluation of emotions (Spielberger et al., 1983). As the level of anxiety increased, both the neutral and angry facial expressions were indeed judged to be more disgusted. However, this was the case for both the infant and the adult faces.

Consequently, depression during the early postpartum period distorts the way mothers interpret children's facial expressions. Recent neuroscientific studies have shown that this depression affects the interpretation not only of the visual signals produced by babies but also of their auditory signals, such as their cries. In a pioneering study, Lorberbaum and colleagues (1999) used magnetic resonance imaging to investigate activity in the mother's brain in response to hearing a baby cry or listening to a white noise for 30 s. This study has

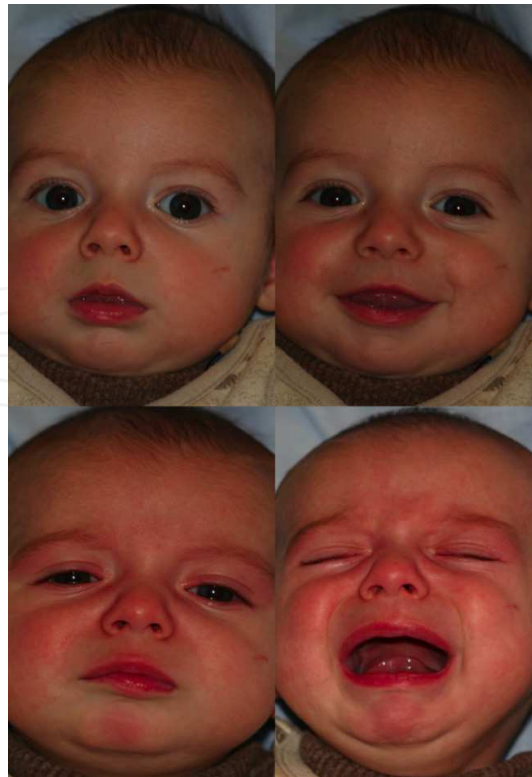


Fig. 6. Examples of babies' emotional facial expressions presented to mothers: neutrality, happiness, sadness, anger, in Gil et al.'s study (2011).

since been replicated by other studies which have used the crying of different babies, namely the mother's own child and that of another infant. All these studies have systematically shown that mothers' brains exhibit a higher level of activation than those of female controls when they hear their own baby crying (Lorberbaum et al., 2002; Purhonen et al., 2001). In addition, the activated brain regions are those related to alertness, empathy and/or the regulation of emotions. Unfortunately this new area of neuroscientific research has not as yet yielded any significant findings with regard to the postpartum depressive mood. Nonetheless, Swain and his team in 2008 have not directly address the question of postpartum depression, but a complementary one. In the same way as in conventional research, the authors scanned mothers some 2 to 4 weeks after giving birth when hearing babies crying (either their own or other babies), taking account of the mode of delivery. The mode of delivery is indeed considered as being a crucial factor contributing to the mother's mood. Delivery by cesarean section is thought to increase the risk of postpartum depression compared to vaginal delivery (Lobel & Deluca, 2007). The authors found that the brains of mothers who had given birth by means of cesarean section were less responsive to the crying of their own babies' cries than those of mothers who had experienced vaginal delivery. Only the insula was more activated in the mothers who had given birth by cesarean section. It is interesting to note that the literature on emotions reports that the insula is specifically involved in the processing of negative emotions, such as distress, pain or disgust (Adolphs et al., 2003; Craig et al., 2003; Wicker et al., 2003). This study therefore shows that mothers at risk of a depressive symptomatology are biologically less sensitive to their own babies' signals. However, the link between cesarean section and depression is still unclear (Carter et al., 2006), and the depression scores reported in this study are inversely related to the mode of delivery.

Whatever the case may be, the specific characteristics exhibited by mothers with postpartum depression in response to the visual and auditory emotional signals given by their babies has led psychologists to consider that the quality of the mother-infant relationship is impaired (for a review, see Swain, 2011). Researchers even speak about a particular parental pattern that can be observed in depressed mothers, in the same way as for the insecure style of attachment. Within this framework, Swain (2011) has, on the basis of studies conducted in humans and animals, proposed an integrative model of “the parental brain” that identifies the information processing operations and associated brain structures thought to govern parenting behaviors (see Figure 7). In this model, (A) the first step involves the sensory signals emitted by babies that are essential for parenting and which are then (B) detected by sensory cortices of the parent's brain. This first appraisal of infant stimuli is assumed, with enough motivation, to activate brain circuits (C) that are referred to as cortico-limbic modules. These modules refer to three kinds of cognitive activity and the associated brain structures: (I) the interaction between the reflexive caring functions, (II) high-level cognitive processes and (III) emotion-related mechanisms that produce a parental output behavior (D). In addition, due to feedback, the type of parental output behavior may modify the infant's behavior and the subsequent infant input stimuli, thus establishing a specific mother-child relationship. In the case of post-partum depression, we may suppose that mothers might find it difficult to accurately detect and process the input signals received from their babies due to their disturbed cognitive processes and underlying cortical structures. This might in turn lead to inappropriate output behaviors on the part of the mothers which might ultimately affect the input received from the infants. However, future research will be required in order to further investigate the question of the links between parental behavior and brain structures in mothers with postpartum depression and their evolution during different periods of child development.

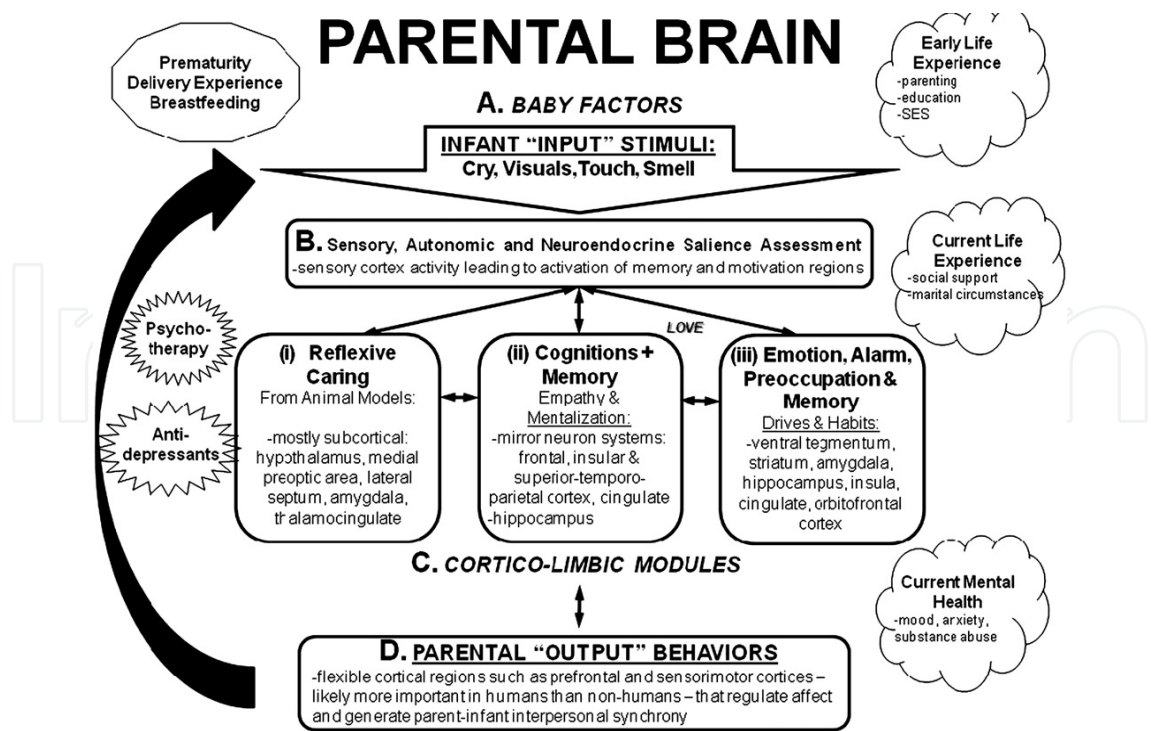


Fig. 7. The parental brain model: brain regions thought to be important for human parenting. Source: Swain (2011).

6. Conclusion

An examination of the ability and readiness of both mothers and infants to deal with emotional expressiveness in cases where the mother suffers from depression shows that, as of an early stage, depression affects the relationship between the two partners. Indeed, as we have reported, depressed mothers experience difficulties in their emotional communication with their children and exhibit atypical behavior, especially at the level of emotional facial expressions. For their part, the babies of such mothers exhibit impairments and dysregulations in their socio-emotional development in both the short and long term. However, few studies have examined the long-term effect of depressed mothers on children once they have acquired verbal language and found other persons of attachment. Indeed, many different factors may potentially compensate for the initial difficulties experienced by these babies. In addition, many questions remain unresolved, for example relating to the role of the father in the mother-child relationship when the mother is suffering from depression.

To summarize, because the first few months following birth represents a sensitive and critical period for children's socio-emotional development, it is very important to be able to detect mothers who present a depressive symptomatology as early as possible so that both they and their children can be given the care required in order to counteract the emotional consequences of postpartum depression for both the mother and the child. The socio-emotional development of children and the various problems associated with depressive mothers therefore represent an important research domain which deserves further investigation.

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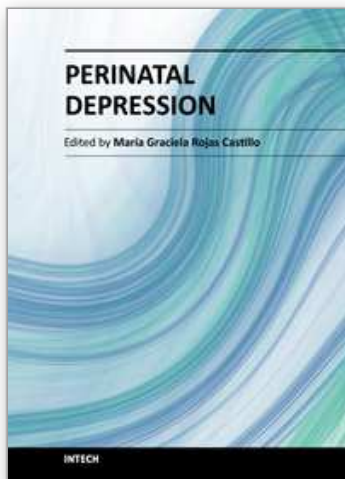
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This book presents ten chapters that give us important information about epidemiological, biological, clinical and psychological aspects of common mental disorders during pregnancy and in the postnatal period. Some of the issues covered in this book are: detecting postnatal depression using different instruments at the right time, which is very important to avoid the negative effects on the children of depressed mothers; understanding the impact of anxiety and depression during pregnancy and in the postnatal period; biological issues of perinatal anxiety and depression; epidemiological information about perinatal mental health problems among minorities, like immigrant population and underserved rural women. Some information is also provided on postnatal depression in men, which is frequently overlooked.

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