

DOCTORATE IN CLINICAL PSYCHOLOGY

Maternal Responsiveness and Women's Self Report to Infant Stimuli in Pregnancy

Candidate no. 09-09019

Joy Macrae

Supervisors: Jonathan Evans & Rebecca Pearson

University of Exeter

Washington Singer Building

Perry Road

Exeter

EX4 4QG

DOCTORATE IN CLINICAL PSYCHOLOGY

Literature Review

Title: Perinatal Depression, Infant Outcomes and Maternal Responsiveness

Word count: 4000, excluding keywords, titles, figure titles and tables

Statement of academic probity and professional practice:

“I certify that all material in this assignment / assessment which is not my own work has been identified and properly attributed. I have conducted the work in line with the BPS DCP Professional Practice Guidelines. This research contributes to the Overall DClinPsy degree.”

DOCTORATE IN CLINICAL PSYCHOLOGY

Literature Review

Title: Perinatal Depression and Maternal Responsiveness

Word count: 4000, excluding keywords, titles, figure titles and tables

Statement of academic probity and professional practice:

“I certify that all material in this assignment / assessment which is not my own work has been identified and properly attributed. I have conducted the work in line with the BPS DCP Professional Practice Guidelines. This research contributes to the Overall DClinPsy degree.”

Abstract

Aim: This systematic review aimed to examine the literature the impact of perinatal depression on child outcomes, with a focus on the moderating effect of maternal responsiveness. The review also highlights future areas for research.

Background: The effects of perinatal depression on child outcomes are well documented in the research literature, including its impact on child language development, cognitive functioning, and ongoing risk of psychosocial and emotional difficulties (Murray & Cooper, 1997). Possible mechanisms of transmission include: heritability, disruption to neurotransmitter systems, stressful life events, and exposure to negative maternal cognitions, affect and behaviours (Goodman et al., 2011; Goodman & Gotlib, 1999). Increasingly research is looking at the role of maternal cognitions and maternal responsiveness in the pregnancy period, and the importance of how orientated or motivated the mother is to attend to infant related stimuli (Pearson, 2010). Growing research suggests that perinatal depression is associated with disrupted mother-infant interactions, and perinatal depression has been hypothesised to disrupt the development of a maternal response to infant stimuli (Pearson et al. 2010).

Conclusion: Literature looking at maternal responsiveness in women with and without perinatal depression indicates that there may well be processing and perceptual biases in women with perinatal depression, for example in response to infant stimuli (Pearson et al. 2010; Stein et al. 2010). However, further research is required looking at these biases, directionality, and the links between conscious and early cognitive processing. Scales looking at perceptions of maternal responsiveness also are in need of development.

KEYWORDS: Maternal responsiveness AND Pregnancy AND Depression

Conceptual and Definitional Problems

Maternal Responsiveness

This systematic review aims to examine the literature on perinatal depression and its impact on child outcomes, with a focus on the moderating impact of maternal responsiveness. Maternal responsiveness is an umbrella term used to describe several related care giving attributes. In their original construct, maternal responsiveness or maternal sensitive responsiveness was defined by Ainsworth (1979) as a mother's ability to perceive her infant's signals appropriately and to respond to them quickly, appropriately and contingently. The term 'maternal responsiveness' is used interchangeably and inconsistently in the research literature with other terms including maternal sensitivity and maternal competency (Shin et al. 2008). Although used in various ways in the research literature, maternal responsiveness describes a behavioural motivation towards anything infant related, involving an active desire to nurture and take care of an infant (Pearson, 2010). Maternal sensitivity in contrast is defined as the ability to accurately interpret and recognise communication cues from infants, responding in an appropriate way (Ainsworth, 1979). Due to the inconsistency of terminology used in the literature, papers looking at maternal responsiveness and maternal sensitivity are included within this review.

Perinatal, Post and Prenatal Depression

For the purposes of this review, perinatal is defined as the period before, during or up to twelve months after birth. Perinatal depression is defined as any major or minor depressive episode occurring in the period before, during or up to twelve months after

Women's Responses to Infant Faces in Pregnancy

birth. Prenatal depression is defined as any major or minor depressive episode occurring in the period before birth and postnatal depression defined as any major or minor depressive episode occurring up to twelve months after birth.

Description of the Ways in Which the Themes in the Literature are Organised by the Author for Review

In the absence of any Cochrane library reviews databases including Pubmed, Psychinfo, psycharticles and web of knowledge were used to search for relevant literatures. This included using the search terms maternal responsiveness (or) maternal sensitivity (or) maternal competency AND pregnancy AND depression. Additional searches also looked at maternal responsiveness AND infant stimuli. Papers within this review fall into two sections: the impact of perinatal depression on child outcomes and potential mechanisms of transmission in the perinatal period, with a focus on the role of maternal responsiveness.

Inclusion and Exclusion Criteria

Searching within these terms produced 245 papers, 99 of which are included in this review. Suitable papers included in this review include those looking at perinatal maternal responsiveness and the impact of perinatal depression on child outcomes. Papers were excluded from this literature review that were not written in the English language or were not peer reviewed. Papers were also excluded looking at screening for postnatal depression. Animal studies were also largely excluded with a focus on studies looking at human interactions. Comorbidity studies looking at other psychiatric disorders, other than

anxiety, were excluded. There were no date limitations imposed on the systematic review.

Orientation to the Literatures

This review aims to outline the literature relating to depression in pregnancy, with a particular focus on the role of maternal responsiveness in relation to child outcomes. Due to the considerable differences in these methodologies sample sizes vary from 6 (Nitschke et al. 2004) to 101 (Pearson et al. 2010). Most studies looking at perinatal depression compare mothers with depression with non-depressed controls. Studies are typically cross-sectional meaning the direction of effects cannot be established and predictive power is lowered. Because of the breadth and scope of these literatures, the inconsistent use of terminology and the variety of methodologies in the research area comparisons are difficult to make and a table is included, to orientate the reader (Table 1.). This review is structured as follows:

The impact of depression in pregnancy

The impact of depression in pregnancy on child outcomes

Potential mechanisms of transmission:

Neurotransmitter changes during pregnancy

Attachment

Maternal responsiveness postnatally

Maternal responsiveness in the pregnancy period

Gaps in the research literature and implications for clinical practice are highlighted.

Women's Responses to Infant Faces in Pregnancy

Table 1

Studies Including Aspects of Search Terms

Search term	No of papers	No. Included in Review	No Excluded From Review
Pregnancy and Depression	197	51	146
Inc. child outcomes and mechanisms of transmission			
Maternal Sensitivity <i>or</i> Responsiveness <i>or</i> Competency <i>and</i> Depression.	45	45	0
Maternal Sensitivity <i>or</i> Responsiveness <i>or</i> Competency <i>and</i> Depression <i>and</i> Pregnancy	1	1	0
Maternal Responsiveness <i>and</i> Infant Stimuli	2	2	0

Review of the Theoretical and Research Literature

Impact of Depression in Pregnancy

Perinatal depression, defined as depression in the pregnancy period, has been found to affect 10-15% of mothers (Gaynes et al. 2005). The effects of depression in pregnancy need to be viewed in the context of an interactive relationship between the mother, the infant and their environment, and research has found that characteristics of mothers, partners and infants combine to influence perinatal depressive symptoms (Crockenberg & Leerkes, 2003). Research has linked perinatal depression in mothers to parental experiences of rejection, marital satisfaction, maternal self esteem, partner marital behaviour and child reactivity (Crockenberg & Leerkes, 2003). Importantly links have been made between postnatal depression and infant outcomes and research highlights that variations in maternal responses are important in shaping the infants cognitive, physical and emotional development (Bigelow et al. 2009; Mantaymaa et al. 2003; Murray et al. 1996a; Murray et al. 1996c).

Impact on Child Outcomes

The effects of depression in the perinatal period on child outcomes are well documented in the research literature including its impact on cognitive, social and emotional development (Murray & Cooper, 1997). Studies indicate that the risk of psychiatric disorder is around four times greater in children whose mothers have experienced post natal depression (Pawlby et al. 2008). Children of mothers with postnatal depression are also seen to be at a greater risk of developing internalising and externalising problems (Connell, & Goodman, 2002; Garai et al. 2009), show less touching and tactile

Women's Responses to Infant Faces in Pregnancy

behaviours (Moszkowski et al. 2009), show lower social engagement fear regulation and higher stress reactivity (Feldman et al. 2009). Prenatal depression has also been associated with excessive activity and growth delays in the fetus, as well as prematurity, disorganised sleep and less responsiveness to stimulation in the neonate (See Field, 2011, for a review).

Although depression in mothers appears to be detrimental to infant outcomes throughout childhood, there appear to be 'windows of vulnerability' whereby the impact of maternal functioning on child development is greater. One of these critical periods appears to be pregnancy and after birth (Pawlby et al. 2008; Reck et al. 2009). Notably, most research has focused on the postnatal, as opposed to prenatal period. Why the perinatal period appears to be so important for child outcomes has been reviewed within several biopsychosocial models including the importance of attachment, disturbances in parenting such as the ability to protect and nurture (maternal responsiveness) and disruption to cortisol and Hypothalamic Pituitary Axis (HPA) functioning.

Potential Mechanisms of Transmission

Disruption to Neurotransmitter Systems

Studies highlight the importance of neurotransmitter changes in individuals with depression, and in particular how elevated maternal cortisol may have an impact on child outcomes. Although changes to child neuroregulatory systems may be linked in part to genetics and heritability researchers have also focused on how specific aspects of fetal environment may then lead to abnormal fetal developments, which then manifest themselves at birth as 'dysfunctional neuroregulatory mechanisms' (Goodman et al.

Women's Responses to Infant Faces in Pregnancy

1999). There is research to suggest that the fetus might be affected by neuroendocrine changes linked to depression in the mother, well before birth. For example studies by Handley et al. (1980) and Field (1998) have found higher levels of cortisol in women with depressed mood during pregnancy. Stress and anxiety, highly comorbid with depression, has also been linked to increased levels of epinephrine and norepinephrine in pregnant women. It is possible then, that as a evolutionary survival mechanism 'neuroendocrine correlates' of the woman's depression pass through the placenta to the infant (Goodman et al. 1999). So in theory, if the mother is living in an environment that is stressful, it may well be beneficial from an evolutionary perspective for the child to also be 'prepared' for such an environment at birth.

As yet it is unclear if high cortisol levels during pregnancy influence child outcomes directly or indirectly. For example it may be that exposure to maternal stress during critical periods of fetal development could alter HPA axis functioning in offspring through fetal programming mechanisms (Grant et al. 2009; Kaplan et al. 2008). However it may also be that elevated maternal cortisol levels influence child outcomes through disrupting the mother's ability to be responsive. For example, studies also indicate that early care experiences influence hypothalamic-pituitary-adrenal (HPA) axis functioning in children (Murray et al. 2010).

Studies linking maternal behaviours to infant cortisol levels include studies by Grant et al. (2009) who found that infants of mothers with anxiety and depression during the last six months of pregnancy showed elevated cortisol levels when engaging with a still face procedure after birth. The still face procedure is an experimental paradigm whereby the mother is videotaped interacting with their infants in three successive phases of

Women's Responses to Infant Faces in Pregnancy

interaction: face-to-face play; an episode when the mother adopts a 'still face' and is unreactive; and a period when play interactions are resumed. The videotapes can then be used to rate the attachment style of the child. Studies also indicate that postnatal maternal responsiveness such as withdrawal behaviours, but not responsiveness at 5 years, has also been linked to elevated morning cortisol secretion in children (Murray et al. 2010, O Connor et al. 2005). Supporting the view that pregnancy is likely to be fundamental in shaping child development, studies also highlight that maternal depression during pregnancy, but not postpartum is predictive of infant cortisol levels and negative affect in children aged six months (Huot et al. 2004).

Impact on Mother-Infant Attachment.

A number of research studies link maternal perinatal depression to insecure or disorganised mother infant attachments (Campbell et al. 2004; Wan & Green, 2009.) Although the research looking at the developmental trajectories of such children is still at an early stage, it may be that attachment relationships mediate the transmission of 'disorders' such as depression (Wan & Green 2009). There is evidence to suggest that maternal sensitivity or responsiveness is associated with attachment status (Ainsworth, 1979; Bigelow et al. 2010; Egeland & Farber, 1984; Isabella & Belsky, 1991; Meins et al. 2001). Postnatal depression is seen to influence attachment security and the mother's ability to engage with and comfort her baby. Sensitivity to infant distress appears to be particularly important in this interaction with studies finding that in depressed mothers greater sensitivity to distress, but not to non distress predicted a secure attachment style (McElwain & Booth-Laforce, 2006). It appears then that maternal responsiveness to

Women's Responses to Infant Faces in Pregnancy

infant needs is linked to, or predictive of attachment security (Mills-Koonce et al. 2008). It is possible that the impact of depression on child outcomes may be moderated by sensitive responsive parenting. In line with this, a prospective study by Grant et al. (2010) has shown that maternal sensitivity or responsiveness to distress may influence the relationship between prenatal anxiety and infant development. Importantly, when considered simultaneously, responsiveness to distress (not non distress) was found to be the most predictive of infant mental development. The study by Grant et al. (2010) can be critiqued in that there was substantial drop out, and for 80% of interactions only one rater coded responses to the still face procedure. There is therefore the potential for bias. Previous studies also did not find this effect (Grant et al. 2009). However, this study adds evidence to cumulative risk models in postnatal depression, indicating the potential importance of maternal responsiveness to distress. Animal studies have also shown that the postnatal rearing styles of mothers can modify the correlation between moderated exposure to stressors and offspring neurological and developmental outcomes (Francis et al. 1999 as cited by Grant et al. 2010).

Postnatal Maternal Responsiveness

Although as indicated above, the pregnancy period may act as a 'window of vulnerability' through altered maternal and subsequently infant cortisol and HPA functioning, it may also be that depression during and after pregnancy affects how able the mother is to respond sensitively and responsively to their child. Depression may impact on child biopsychosocial outcomes is through disruption to responsive maternal parenting behaviours (Murray et al. 2010). For example a study by Field (2010) found

Women's Responses to Infant Faces in Pregnancy

that postnatal depression affected early interactions, parenting, safety practices, and parental early interventions. Other studies have indicated that how responsive the mother is seen to be is predictive of the infant's future emotional, social, cognitive and physical health (Bigelow et al. 2009). Perhaps because of the focus in the research literature on observable maternal and infant behaviours, the majority of research looking at depression and maternal responsiveness has investigated maternal responsiveness in the postnatal period.

'Maternal Responsiveness' as discussed is an umbrella term describing several caregiving attributes, and is an aspect of parenting referred to in several research and theoretical frameworks including attachment, sociocultural and socialisation of young children (Landry, Smith & Swank, 2006). Maternal sensitive responsiveness is seen to be more than just a behavioural response to infants: in their original definition Ainsworth et al. (1974) defined sensitive responsiveness as a mother's ability to perceive her infants signals accurately and respond to them promptly, contingently and appropriately. Perhaps because of the broad and general original definition of responsiveness, its operationalisation is problematic, with very little consensus as to which specific behaviours constitute 'maternal sensitive responsiveness.' Important 'key' elements in the literature however include at least four important aspects, contingent responding, emotional affective support, support for infant foci of attention and language input (Landry et al. 2006). Within these four aspects, specific maternal responses studied include matching the intensity and temporal patterning of the infant's responses, responding to cues appropriately, mothers speech, mirroring, anticipating and structuring the environment appropriately, motivating the child to play, emotional availability,

enjoyment in joint interaction, and providing activities at the child's developmental level (Landry et al. 2006). It appears then, that 'maternal sensitive responsiveness' as opposed to being a unidimensional construct is more so a 'multicriterion concept' (Claussen & Crittenden, 2003) including motivational, behavioural, linguistic and cognitive aspects. Studies looking at maternal responsiveness typically measure this in one of two ways: by recording observed behaviour, or by measuring cognitive processing of salient stimuli such as infant faces.

Postnatal Maternal Responsiveness and Observable Behaviour

Depression in the postnatal period may mean that mothers are less responsive to their infant's needs, such as crying or wanting to be soothed. Chronic maternal depression is shown in the literature to impair maternal perspective taking, influencing maternal caregiving representations and emotional availability (Trapolini et al. 2008). Depression in mothers postnatally is also associated with low sensitivity and low responsiveness to infant needs (Campbell et al. 2007). The impact of depression on how responsive a mother is to their infants needs has been extensively studied. For example, research indicates that postnatal depression and levels of maternal responsiveness may influence how the mother cradles their infant (Reissland et al. 2009), the amount of maternal eye gaze, maternal language, the amount of gesturing and the level of co-ordinated attention between mother and child (Legerstee et al. 2007). Research also indicates that women with postnatal depression are the least sensitive and most aggressive when playing with their baby (Murray et al. 1996). Observational designs such as Murray et al. (1996) highlight that women with depression respond more to infant negative expressions than

Women's Responses to Infant Faces in Pregnancy

women without depression. In critique of these studies observational and naturalistic designs are clinically important; however they do not allow insight into the processing of infant stimuli and the factors influencing maternal behaviour (Stein et al. 2010). They are also potentially influenced by observer bias and social desirability factors.

Postnatal maternal responsiveness has also been linked to observable behaviours in infants, most notably with child language development (Ruddy & Bornstein, 1982; Tamis-Lemonda et al. 2001; Tomasello & Farrar, 1986) child use of gesture (Bornstein & Tamis-Lemonda, 1997) and social and cognitive development (Beckwith et al. 1992; Jaffe et al. 2001; Murray et al. 1996c; Smith et al. 2006). Furthermore, a systematic review by Eshel et al. (2006) looking at infant development across developed and developing countries indicates that improving maternal sensitivity and responsiveness improves child cognitive development across several outcome measures. Although the exact mechanism through which maternal sensitivity influences these outcomes is unknown, it is largely accepted that maternal responsiveness and sensitivity to infant stimuli may allow for the transition of knowledge, emotional regulation, and social learning (Pearson, 2010; Rizzolatti & Craighero, 2004). Interestingly, studies highlight that there may well be culture-general and culture-specific patterns of maternal responsiveness (Bornstein et al. 1992).

Postnatal Maternal Responsiveness and Cognitions

Maternal cognitions are seen to be a fundamental aspect of maternal responsiveness (Meins, 1997) however; cognitions in women with postnatal depression have largely been ignored (Leigh & Milgrom, 2008). Maternal responsiveness and self perceptions appear

Women's Responses to Infant Faces in Pregnancy

to be the least intensively studied methodological area, with clear gaps in measures adequately assessing later cognitive maternal self report of responsiveness (Amankwaa & Pickler, 2007).

Research looking at maternal responsiveness and cognitive processing in women with postnatal depression has prioritised looking at the processing of infant stimuli and in particular infant faces, as it is generally accepted that most signals arising from the infant will come from their facial expression. The processing of infant faces is seen to be unique, having a different configuration to adults (Lorenz, 1971, Stein et al. 2010). Infant faces are seen to include features such as large eyes and round faces, which when experimentally modified increased women's ratings of 'cuteness' and 'motivation to take care' of the infant (Glocker et al. 2009; Sternglanz et al. 1977). Studies indicate that all humans but women in particular may have a 'babyschema' with a preference for infant related facial stimuli (Brosch et al. 2007; Little et al. 2008; Lorenz, 1971; Sternglanz et al. 1977). However studies have found differential processing in mothers compared to non mothers (Proverbio et al. 2006; Selfritz et al. 2003; Stallings et al. 2001) with the research evidence suggesting that mothers may process infant signals such as smell differently.

Research indicates that there is differential processing and responses for mothers own children as opposed to unknown baby faces (Bartels & Zeki, 2004; Nitschke et al. 2004; Noriuchi et al. 2008; Strathearn et al. 2009). Research investigating the cognitions of women in pregnancy highlights that women without postnatal depression appear to prioritise the processing of stimuli salient to motherhood and prioritise stimuli salient to threat (Walker et al. 2004) and show neural biases to signals of fear (Williams et al.

Women's Responses to Infant Faces in Pregnancy

2007). Stein et al. (2010) using a self rating study have also found that mothers with postnatal depression are differentially affected by particular infant facial expressions. In their study, consistent with research looking at adult faces in individuals with depression, Stein et al. (2010) found that women with depression rated or perceived negative infant faces more negatively than non depressed women. Although a key paper in looking at women's more conscious self report, the Stein et al. (2010) study can be critiqued in that only one scale was utilised presuming that maternal responses to faces are on a single one-dimensional continuum.

Research indicates that in mothers without depression, that interpretation, for example interpretations of their infant's behaviour, is largely accurate. However, studies indicate that where maternal perceptual 'distortions' occur, that mothers show less maternal responsiveness and greater interference (Nover et al. 1984). Postnatal depression is associated with ruminative thinking (O'Mahen et al. 2010) to differential expressions of emotion (Barnes et al. 2007; Dietz et al. 2009) to disruptions in the mothers ability to comment on the child's mind and internal states (Meins et al. 2001) and to impaired responsiveness to infant related stimuli (Pearson et al. 2010). Women with postnatal depression also show greater brain activation in response to infant distress and emotion (Proverbio et al. 2006).

Studies indicate that lower maternal responsiveness is associated with altered perceptions. For example, studies looking at maternal feeding behaviours have associated lower maternal responsiveness with poor perception of infant hunger and satiety (Gross et al. 2010). Research also indicates that maternal emotional distress is associated with lower levels of mother's self-reported infant responsiveness. This relationship was found

Women's Responses to Infant Faces in Pregnancy

to be mediated by mothers' perceptions of their parenting efficacy (Gondoli & Silverberg, 1997). Studies have also linked heightened maternal responsiveness with higher self-report of self esteem (Diehl, 1997). Because of the cross sectional nature of many of these studies directionality is often difficult to discern; for example it is not possible to tell if self esteem affects responsiveness or the other way round.

Studies looking at maternal report of efficacy during the transition to motherhood have found that maternal self reported efficacy is associated with measures of depression and anxiety (Porter & Chin-Hsu, 2003). The study also found that maternal perceptions of infant temperament accounted for a large amount of variance in postnatal reports of efficacy (Porter & Chin-Hsu, 2003).

Maternal Responsiveness and the Pregnancy Period

The majority of studies looking at the concept of maternal responsiveness, as outlined above have studied responsiveness postnatally. This is perhaps partly due to fact that it is easier to conceptualise how a mother may be responsive to their infant after they are born. However, increasingly researchers are becoming interested in maternal responsiveness in the pregnancy period, with the concept developing that across pregnancy women are, both neurologically and psychologically globally preparing for motherhood. The literature forming this theory has developed from evidence from both animal and human studies that suggest that maternal responsiveness develops before birth and across pregnancy (Fleming, Steiner, & Corter, 1997; Maestripieri & Zehr, 1998). Studies also indicate that sensitivity towards emotional faces and attentional biases towards infant stimuli develop across pregnancy (Pearson, Cooper, Penton-Voak,

Women's Responses to Infant Faces in Pregnancy

Lightman, & Evans, 2010; Pearson, Lightman, & Evans, 2010; Pearson, Lightman, & Evans, 2009). Importantly, the maternal responsiveness and mother-child attachment observed in pregnancy appears to be predictive of maternal sensitivity postnatally, indicating that the patterns observed in pregnancy may be indicators of later maternal responses (Pearson et al., 2011; Siddiqui & Hagglof, 2000; Shin, Park, & Kim, 2006; Thun-Hohenstein, Wienerroither, Schreuer, Seim, & Wienerroither, 2008).

Studies looking at cognitive processing and responsiveness in women with depression in pregnancy have largely utilised established early cognitive attentional bias and computerised paradigms. For example Pearson et al. 2010 in their study utilise a cognitive task whereby participants respond to a go/no go sign with infant faces appearing unconsciously in the centre of the screen. Within this attentional processing study, the effect of infant emotion was found to be influenced by depressive symptoms, with non depressed women taking longer to disengage from distressed infant faces. The operationalisation of disengagement is problematic in this study as it is unclear if the altered response times to infant faces shown in depressed women were women moving away from 'negative stimuli' (disengagement) or simply not showing the attentional bias towards distress seen in non depressed women. Studies looking at attentional biases often lack directionality, for example in the Pearson et al. (2010) study attentional biases were found between women with and without depression, however, it is unclear if women with depression showed an attentional bias towards neutral infant faces or away from distressed faces. Disengagement wasn't operationalised but rather assumed to be part of the process required to respond to a peripheral target and assumed to vary if the reaction time to the peripheral target varied. However regardless of directionality depressive

Women's Responses to Infant Faces in Pregnancy

symptoms in early pregnancy in this study were found to disrupt attentional processing of infant emotion (Pearson et al. 2010). Studies have also found that the processing of infant stimuli changes across pregnancy and with parity (Pearson, Lightman & Evans, 2009) and is seen to be different for women with and without depression (Pearson et al. 2010). Importantly, attentional biases have not been found in all studies looking at depression and facial stimuli (Stein et al. 2010) and early cognitive attentional tasks have been said to show inconsistent results as the emotional valence of a stimuli is thought to involve later conscious perception (Donaldson et al. 2007; Stein et al. 2010).

Studies looking at later cognitive maternal perceptions in pregnancy indicate that maternal and paternal perceptions and predictions of parenting competence before birth to correlate with maternal responsiveness at two years (Oates & Heinicke 1985). Studies looking at the interpretation of infant stimuli also indicate that mothers with depression are less likely to agree with researcher ratings of infant negativity, over rating infant's behaviour as negative (Field et al. 1993). Research suggests that maternal interpretations of infant expressions are likely to be crucial to later child development (Yarrow et al. 1984). To the authors knowledge no studies appear to have examined perceptions of own competence or emotional experience when looking at infant stimuli either pre or postnatally.

Overview of the Review Process, Gaps in Knowledge and Future Directions

The literature review outlined above highlights the impact of perinatal depression on child outcomes and the potential importance of maternal responsiveness, within a

Women's Responses to Infant Faces in Pregnancy

cumulative risk model. In reality, although potential mechanisms of transmission are presented in this paper separately, it is likely that the mechanisms interact on multiple levels. For example, neuroendocrine changes linked to depression in the mother may impact on the foetus directly, but also indirectly via affecting the mother's ability to respond sensitively. Complexities in this field arise from the multidimensional concept of maternal responsiveness, and the lack of specificity in studies with regards to what component of 'maternal responsiveness' or 'sensitivity' is actually been examined. Importantly, many studies examining responsiveness measure responses in terms of contingency, or frequency of response, overlooking the importance of *appropriateness*. There is also an assumption in the literature that heightened responsiveness is a positive, with some research suggesting that increased responsiveness has a correlation or association with intrusiveness (Claussen & Crittinden, 2003; Hobson et al, 2004). Perhaps because of the nature of maternal responsiveness, being readily observed through observation, the majority of studies have examined responsiveness and depression postnatally. The review indicates the need for more studies looking at maternal responsiveness in the pregnancy period, in both women with and without depression. There is increasing evidence from both animal and human studies to suggest that maternal responsiveness develops before birth and across pregnancy. Studies also indicate that sensitivity towards emotional faces and attentional biases towards infant stimuli develop across pregnancy. Importantly, the maternal responsiveness and mother-child attachment observed in pregnancy appears to be predictive of maternal sensitivity postnatally, indicating that the patterns observed in pregnancy may be indicators of later maternal responses. The literature suggesting that prenatal responsiveness may be

Women's Responses to Infant Faces in Pregnancy

indicative of later responsiveness, gives a rationale for the current study, examining maternal self reported responses in the pregnancy period. Although further studies looking at early cognitive processing are warranted in prenatal depression, a fundamental gap in the literature is studies looking at self reported responsiveness. To the author's knowledge, only one study has looked at maternal responsiveness, perinatal depression and perceptions of infant facial stimuli. Early cognitive tasks may or may not be directly linked to maternal caregiving behaviours, and self reported responsiveness may relate more strongly to parenting behaviours.

Reference List

Ainsworth, M. D. (1979). Infant-mother attachment. *American Psychologist*, *34*, 932-937.

Amankwaa, L., & Pickler, R. (2007). Measuring maternal responsiveness. *Journal of the Association of Black Nursing Faculty*, *18*, 4-15.

Barnes, J., Ram, B., Leach, P., Altmann, L., Sylva, K., Malmberg, L., Stein, A., & the FCCC Team (2007). Factors associated with negative emotional expression: a study of mothers of young infants. *Journal of Reproductive and Infant Psychology*, *25*, 122-138.

Bartels, A. & Zeki, S. (2004). The neural correlates of maternal and romantic love. *Neuroimage*, *21*, 1155-1166.

Beckwith, L., Rodning, C., & Cohen, S. (1992). Preterm children at early adolescence and continuity and discontinuity in maternal responsiveness from infancy. *Child Development*, *63*, 1198-1208.

Bigelow, A. E., Maclean, K., Proctor, J., Myatt, T., Gillis, R., & Power, M. (2010). Maternal sensitivity throughout infancy: Continuity and relation to attachment security. *Infant Behavioural Development*, *33*, 50-60.

Bornstein, M. H., Tamis-LeMonda, C. S., Tal, J., Ludemann, P., Toda, S., Rahn, C. W., Pecheux, M. G., Azuma, H., & Vardi, D. (1992). Maternal responsiveness to infants in three societies: the United States, France and Japan. *Child Development*, *63*, 808-821.

Women's Responses to Infant Faces in Pregnancy

Bornstein, M. H. & Tamis-Lemonda, C. S. (1997). Maternal responsiveness and infant mental abilities: Specific predictive relations. *Infant Behavioural Development, 20*, 283-296.

Brosch, T., Sander, D. & Scherer, K. R. (2007). That baby caught my eye...attention capture by infant faces. *Emotion, 7*, 685-689.

Campbell, S. B., Brownell, C. A., Hungerford, A., Spieker, S. I., Mohan, R., & Blessing, J. S. (2004). The course of maternal depressive symptoms and maternal sensitivity as predictors of attachment security at 36 months. *Developmental Psychopathology, 16*, 231-252.

Campbell, S. B., Matestic, P., Von Stauffenberg, C., Mohan, R., & Kirchner, T. (2007). Trajectories of maternal depressive symptoms, maternal sensitivity, and children's functioning at school entry. *Developmental Psychology, 43*, 1202-1215.

Claussen, A. H & Crittinden, P. M. K. (2003). *The organisation of attachment relationships. Maturation, culture and context*. Cambridge:Cambridge University Press.

Connell, A.M., & Goodman, S.H. (2002). The association between psychopathology in fathers versus mothers and children's internalizing and externalizing behaviour problems: a meta-analysis. *Psychological Bulletin, 128*, 746-773.

Crockenberg, S. C., & Leerkes, E. M. (2003). Parental acceptance, postpartum depression, and maternal sensitivity: mediating and moderating processes. *Journal of Family Psychology, 17*, 80-93.

Women's Responses to Infant Faces in Pregnancy

Diehl, K. (1997). Adolescent mothers: what produces positive mother-infant interactions? *American Journal of Maternal Child Nursing, 22*, 89-95.

Dietz, L.J., Jennings, K.D., Kelley, S.A., & Marshal, M. (2009). Maternal depression, paternal psychopathology, and toddlers' behavior problems. *Journal of Clinical Child and Adolescent Psychology, 38*, 48-61.

Donaldson, C., Lam, D., & Matthews, A. (2007). Rumination and attention in major depression. *Behaviour Research and Therapy, 45*, 2664-2678.

Egeland, B., & Farber, E. A. (1984). Infant-mother attachment: Factors related to its development and changes over time. *Child Development, 55*, 753-771.

Eshel, N., Daelmans, B., De Mello, M. C., & Martines, J. (2006). Responsive parenting: interventions and outcomes. *Bulletin World Health Organisation, 84*, 991-998.

Feldman, R., Granat, A., Pariente, C., Kanety, H., Kuint, J., Gilboa-Schechtman, E. (2009). Maternal depression and anxiety across the postpartum year and infant social engagement, fear regulation and stress reactivity. *Journal of the American Academy of Child and Adolescent Psychiatry, 48*, 919-927.

Field, T. M. (1998, April). *Depressed mothers and their newborns*. Paper presented at the 11th Biennial Conference on Infant Studies, Atlanta: GA.

Field, T. (2010). Postpartum depression effects on early interactions, parenting, and safety practices: a review. *Infant Behavioural Development, 33*, 1-6.

Women's Responses to Infant Faces in Pregnancy

Fleming, A. S., Steiner, M., & Corter, C. (1997). Cortisol, hedonics, and maternal responsiveness in human mothers. *Hormones and Behaviour*, *32*, 85-98.

Garai, E. P., Forehand, R. L., Colletti, C. J., Reeslund, K., Potts, J., & Compas, B. (2009). The relation of maternal sensitivity to children's internalising and externalizing problems within the context of maternal depressive symptoms. *Behaviour Modification*, *35*, 559-562.

Gaynes, B.N., Gavin, N., Meltzer-Brody, S., Lohr, K.N., Swinson, T., Gartlehner, G. (2005). Perinatal depression: Prevalence, screening accuracy, and screening outcomes. *Evidence Reproductive Technology Assessment*, *119*, 1-8.

Glocker, M. L., Langleben, D. D., Ruparel, K., Loughead, J. W., Valdez, J. N., Griffin, M. D., Sachser, N., & Gur, R. C. (2009). Baby schema modulates the brain reward system in nulliparous women. *Proceedings of the National Academy of Sciences, U. S. A.* *106*, 9115-0119.

Gondoli, D. M., & Silverberg, S. B (1997). Maternal emotional distress and diminished responsiveness: the mediating role of parenting efficacy and parental perspective taking. *Developmental Psychology*, *33*, 861-868.

Gotlib, I. H., Krasnoperova, E., Yue, D. N., & Joorman, J. (2004). Attentional biases for negative interpersonal stimuli in depression. *Journal of Abnormal Psychology*, *113*, 127-135.

Women's Responses to Infant Faces in Pregnancy

Goodman, S. H., & Glotlib, I. H. (1999). Risk for psychopathology in the children of depressed mothers: a developmental model for understanding mechanisms of transmission. *Psychological Review, 106*, 458-490.

Goodman, S. H., Rouse, M. H., Connell, A. M., Broth, M. R., Hall, C. M., & Heyward, D. (2011). Maternal depression and child psychopathology: a meta-analytic review. *Clinical Child and Family Psychological Review, 14*, 1-27.

Grant, K. A., McMahon, C., Austin, M. P., Reilly, N., Leader, L., & Ali, S. (2009). Maternal prenatal anxiety, postnatal caregiving and infants' cortisol responses to the still-face procedure. *Developmental Psychobiology, 51*, 625-637.

Grant, K. A., McMahon, C., Reilly, N., & Austin, M. P. (2010) Maternal sensitivity moderates the impact of prenatal anxiety disorder on infant mental development. *Early Human Development, 89*, 551-556.,

Gross R. S., Fierman A. H., Mendelsohn A. L., Chiasson M. A., Rosenberg T., J., Scheinmann, R., & Messito, M. J. (2010). Maternal perceptions of infant hunger, satiety, and pressuring feeding styles in an urban Latina WIC population. *American Academy of Pediatrics, 10*, 29-35.

Handley, S. L., Dunn, T. L., Waldron, G., & Baker, J. M. (1980). Tryptophan, cortisol and puerperal mood. *British Journal of Psychiatry, 136*, 498-508.

Women's Responses to Infant Faces in Pregnancy

Hobson, R. P., Patrick, M. P., Crandell, L. E., Garcia Perez, R. M., & Lee, A. Maternal sensitivity and infant triadic communication. *Journal of Child Psychology and Psychiatry*, 45, 470-480.

Huot, R. L., Brennan, P. A., Stowe, Z. N., Plotsky, P. M., & Walker, E. F. (2004). Negative Affect in Offspring of Depressed Mothers is Predicted by Infant Cortisol Levels at 6 Months and Maternal Depression During Pregnancy but not Postpartum. *Annals of the New York Academy of Sciences*, 1032, 234-236.

Isabella, R. A., & Belsky, J. (1991). Interactional Synchrony and the origins of infant-mother attachment: A replication study. *Child Development*, 62, 373-384.

Jaffe, J., Beebe, B., Feldstein, S., Crown, C., & Jasnow, M. D. (2001). Rhythms of dialogue in infancy: coordinated timing in development. *Monographs of the Society for Research of Child Development*, 66, 122-132.

Kaplan, L. A., Evans, L., & Monk, C. (2008). Effects of mothers' prenatal psychiatric status and postnatal caregiving on infant biobehavioral regulation: can prenatal programming be modified? *Early Human Development*, 84, 249-256.

Landry, S. H., Smith, K. E., & Swank, P. R. (2006). Responsive parenting: establishing early foundations for social, communication, and independent problem-solving skills. *Developmental Psychology*, 42, 627-642.

Legerstee, M., Markova, G. & Fisher, T. (2007). The role of maternal affect attunement in dyadic and triadic communication. *Infant Behavioural Development*, 30, 296-306.

Women's Responses to Infant Faces in Pregnancy

Leigh, B., & Milgrom, J. (2008). Risk factors for antenatal depression, postnatal depression and parenting stress. *BMC Psychiatry, 16*, 8-24.

Little, A. C., DeBruine, L. M., Jones, B. C., & Waite, C. (2008). Category contingent aftereffects for faces of different races, ages and species. *Cognition, 106*, 1537-1547.

Lorenz, K. (1971). *Studies in Animal and Human Behavior*. Cambridge: Harvard University Press.

Maestriperi, D. & Zehr, J. L. (1998). Maternal responsiveness increases during pregnancy and after estrogen treatment in macaques. *Hormones and Behaviour, 34*, 223-230.

Mantaymaa, M., Puura, K., Luoma, I., Salmelin, R., Davis, H., Tsiantis, J., Ispanovic-Radojkovic, V., Paradisiotou, A., & Tamminen, T. (2003). Infant-mother interaction as a predictor of child's chronic health problems. *Child Care Health Development, 29*, 181-191.

McElwain, N. L., & Booth-Laforce, C. (2006). Maternal sensitivity to infant distress and nondistress as predictors of infant-mother attachment security. *Journal of Family Psychology, 20*, 247-255.

Meins, E. (1997). *Security of attachment and the social development of cognition*. East Sussex UK: Psychology Press Ltd.

Women's Responses to Infant Faces in Pregnancy

Meins, E., Fernyhough, C., Fradley, E. & Tuckey, M. (2001). Rethinking maternal sensitivity: Mothers' comments on infants' mental processes predict security of attachment at 12 months. *Journal of Child Psychology and Psychiatry*, *42*, 637-648.

Moszkowski, R. J., Stack, D. M., Girouard, N., Field, T. M., Hernandez-Reif, M., & Diego, M. (2009). Touching behaviours of infants of depressed mothers during normal and perturbed interactions. *Infant Behavioural Development*, *32*, 183-194.

Mills-Koonce, W. R., Garipey, J. L., Sutton, K., & Cox, M. J. (2008). Changes in maternal sensitivity across the first three years: are mothers from different attachment dyads differentially influenced by depressive symptomatology? *Attachment and Human Development*, *10*, 299-317.

Murray, L., Halligan, S. L., Adams, G., Patterson, P., & Goodyer, I. M. (1996). Socioemotional development in adolescents at risk of depression: the role of maternal depression and attachment style. *Developmental Psychopathology*, *18*, 489-516.

Murray, L., Fiori-Cowley, A., Hooper, R., & Cooper, P. (1996a). The impact of postnatal depression and associated adversity on early mother-infant interactions and later infant outcome. *Child Development*, *67*, 2512-2526.

Murray, L., Hipwell, A., Hooper, R., Stein, A., & Cooper, P. (1996c). The cognitive development of 5-year-old children of postnatally depressed mothers. *Journal of Child Psychology and Psychiatry*, *37*, 927-935.

Women's Responses to Infant Faces in Pregnancy

Murray, L., Halligan, S. L., Goodyer, I., & Herbert, J. (2010). Disturbances in early parenting of depressed mothers and cortisol secretion in offspring: a preliminary study.

Journal of Affective Disorders, 122, 218-223.

Nitschke, J. B., Nelson, E. E., Rusch, B. D., Fox, A. S., Oakes, T. R. & Davidson, R. J. (2004). Orbitofrontal cortex tracks positive mood in mothers viewing pictures of their newborn infants.

Neuroimage, 21, 583-592.

Noriuchi, M., Kikuchi, Y., & Senoo, A. (2008). The functional neuroanatomy of maternal love: Mother's response to infant's attachment behaviours.

Biological Psychiatry, 63, 415-423.

Nover, A., Shore, M. F., Timberlake, E. M., & Greenspan, S. I. (1984). The relationship of maternal perception and maternal behaviour: a study of normal mothers and their infants.

American Journal of Orthopsychiatry, 54, 210-223.

Oates, D. S & Heinicke, C. M. (1985). Prebirth prediction of the quality of the mother-infant interaction: the first year of life.

Journal of Family Issues, 6, 523-542.

O Connor, T. G., Ben-Shlomo, Y., Heron, J., Golding, J., Adams, D., & Glover, V.

(2005). Prenatal anxiety predicts individual differences in cortisol in pre-adolescent children.

Biological Psychiatry, 1, 211-217.

O'Mahen, H. A., Flynn, H. A & Nolen-Hoeksema, S. (2010). Rumination and

interpersonal functioning in perinatal depression.

Journal of Social and Clinical Psychology, 29, 646-667.

Women's Responses to Infant Faces in Pregnancy

Pawlby, S., Hay, D. F., Sharp, D., Waters, C. S., O'Keane, V. (2008). Antenatal depression predicts depression in adolescent offspring: prospective longitudinal community-based study. *Journal of Affective Disorders, 113*, 236-243.

Pawlby, S., Sharp, D., Hay, D., & O'Keane, V. (2008) Postnatal depression and child outcomes and 11 years: the importance of accurate diagnosis. *Journal of Affective Disorders, 107*, 241-245.

Pearson, R. M. (2010). *Psycho-Physiological Preparations for Motherhood and the Relationship with Affective Disorder Symptoms (Doctoral dissertation)*. University of Bristol.

Pearson, R. M., Cooper, R. M., Penton-Voak, I. S., Lightman, S. L., & Evans, J. (2010). Depressive symptoms in early pregnancy disrupt attentional processing of infant emotion. *Psychological Medicine, 40*, 621-631.

Pearson, R. M., Heron, J., Melotti, R., Joinson, C., Stein, A., Ramchandani, P. G. et al. (2011). The association between observed non-verbal maternal responses at 12 months and later infant development at 18 months and IQ at 4 years: A longitudinal study. *Infant Behavior and Development, 34*, 525-533.

Pearson, R. M., Lightman, S. L., & Evans, J. (2009). Emotional sensitivity for motherhood: late pregnancy is associated with enhanced accuracy to encode emotional faces. *Hormones and Behaviour, 56*, 557-563.

Women's Responses to Infant Faces in Pregnancy

Pearson, R. M., Lightman, S. L., & Evans, J. (2010). Attentional processing of infant emotion during late pregnancy and mother-infant relations after birth. *Archives of Womens Mental Health, 14*, 23-31.

Porter, C. L., & Chin-Hsu, H. (2003). First time mothers' perceptions of efficacy during the transition to motherhood: links to infant temperament. *Journal of Family Psychology, 17*, 54-64.

Proverbio, A. M., Brignone, V., Matarazzo, S., Del, Z. M., & Zani, A. (2006). Gender and parental status affect the visual cortical response to infant facial expression. *Neuropsychologia, 44*, 2987-2999.

Reck, C., Stehle, E., Reinig, K., & Mundt, C. (2009). Maternity blues as a predictor of DSM-IV depression and anxiety in the first three months postpartum. *Journal of Affective Disorders, 113*, 77-87.

Reissland, N., Hopkins, B., Helms, P., & Williams, B. (2009). Maternal stress and depression and the lateralisation of infant cradling. *The Journal of Child Psychology and Psychiatry, 50*, 263-269.

Rizzolatti, G., & Craighero, L. (2004). The mirror-neuron system. *Annual Review of Neuroscience, 27*, 169-192.

Ruddy, M. G., & Bornstein, M. H. (1982). Cognitive correlates of infant attention and maternal stimulation over the first year of life. *Child Development, 53*, 183-188.

Women's Responses to Infant Faces in Pregnancy

Selfritz, E., Esposito, F., Neuhoff, J. G., Luthi, A., Mustovic, H., Dammann, G., Von, B. U., Radue, E. W., Cirillo, S., Tedeschi, G., & Di, S. F. (2003). Differential sex-independent amygdala response to infant crying and laughing in parents versus non parents. *Biological Psychiatry*, *54*, 1367-1375.

Shin, H., Park, Y. J., & Kim, M. J. (2006). Predictors of maternal sensitivity during the early postpartum period. *Journal of Advanced Nursing*, *55*, 425-434.

Siddiqui, A. & Hagglof, B. (2000). Does maternal prenatal attachment predict postnatal mother-infant interaction? *Early Human Development*, *59*, 13-25.

Smith, K. E., Landry, S. H., & Swank, P. R. (2006). The role of early maternal responsiveness in supporting school-aged cognitive development for children who vary in birth status. *Pediatrics*, *117*, 1608-1617.

Stallings, J., Fleming, A., Corter, C., Worthman, C., & Steiner, M. (2001). The effects of infant cries and odors on sympathy, cortisol and autonomic responses in new mothers and non-postpartum women. *Parenting Science and Practice*, *1*, 71-100.

Stein, A., Arteché, A., Lehtonen, A., Craske, M., Harvey, A., Counsell, N. et al. (2010). Interpretation of infant facial expression in the context of maternal postnatal depression. *Infant Behaviour and Development*, *33*, 273-278.

Sternglanz, S. H., Gray, J. L., & Murakami, M. (1977). Adult preferences for infantile facial features: an ethological approach. *Animal Behaviour*, *25*, 108-115.

Women's Responses to Infant Faces in Pregnancy

Strathearn, L., Fonagy, P., Amico, J., & Montague, P. R. (2009). Adult attachment predicts maternal brain and oxytocin response to infant cues. *Neuropsychopharmacology*, *34*, 2655-2656.

Tamis-Lemonda, C. S., Bornstein, M. H., & Baumwell, L. (2001). Maternal responsiveness and children's achievement of language milestones. *Child Development*, *72*, 748-767.

Thun-Hohenstein, L., Wienerroither, C., Schreuer, M., Seim, G., & Wienerroither, H. (2008). Antenatal mental representations about the child and mother-infant interaction at three months post partum. *European Child and Adolescent Psychiatry*, *17*, 9-19.

Tomasello, M., & Farrar, M. J. (1986). Joint attention and early language. *Child Development*, *57*, 1454-1463.

Trapolini, T., Ungerer, J. A., McMahon, C. A. (2008). Maternal depression: relations with maternal caregiving representations and emotional availability during preschool years. *Attachment and Human Development*, *10*, 73-90.

Walker, C. D., Deschamps, S., Proulx, K., Tu, M., Saltzman, C., Woodside, B., Lupien, S., Gallo-Payet, N., & Richard, D. (2004). Mother to infant or infant to mother? Reciprocal regulation of responsiveness to stress in rodents and the implications for humans. *Journal of Psychiatry and Neuroscience*, *29*, 364-382.

Wan, M. W., & Green, J. (2009). The impact of maternal psychopathology on child-mother attachment. *Archives of Women's Mental Health*, *12*, 123-134.

Women's Responses to Infant Faces in Pregnancy

Williams, L. M., Kemp, A. H., Felmingham, K., Liddell, B. J., Palmer, D. M., Bryant, R. A. (2007). Neural biases to covert and overt signals of fear: dissociation by trait and anxiety and depression. *Journal of Cognitive Neuroscience*, *19*, 1595-1608.

Yarrow, L. J., Macturk, R. H., Vietze, P. M., McCarthy, M. E., Klein, R. P., & McQuinston, S. (1984). Developmental course of parental stimulation and its relationship to mastery motivation during infancy. *Developmental Psychology*, *20*, 492-503.

Contents Page

Page	Contents
39	Abstract
41	Introduction
45	Method
46	Procedure
46	Measures
55	Materials
43	Analysis Plan
59	Results
66	Discussion
74	References
94	Appendices
121	Dissemination plan

DOCTORATE IN CLINICAL PSYCHOLOGY

Research Paper

Title: Maternal Responses to Infant Stimuli in Pregnancy in Women with and without
Depression

Target journal:

Journal of Affective Disorders

Word count: 6,908 excluding keywords, titles, figure titles and tables

Statement of academic probity and professional practice:

“I certify that all material in this assignment / assessment which is not my own work has been identified and properly attributed. I have conducted the work in line with the BPS DCP Professional Practice Guidelines. This research contributes to the Overall DClinPsy degree.

Abstract

Background: Research suggests that prenatal depression is associated with disrupted maternal responses to infant stimuli, with depressed women not showing the bias towards distressed infants observed in non depressed women (Pearson, 2010). The current study examined depression related differences in women's self reported responses to infant stimuli, early in pregnancy, investigating if maternal responses in pregnancy are more associated with a reduced comforting response, or a heightened avoidant response.

Method: Women in this study were referred by community midwives as part of a cohort study. Pregnant women with clinical depression (n=38), and comparison non-depressed women (n=67), were exposed to images of distressed, neutral and happy infant faces. The women were asked to rate how they responded to the images, along three scales: wanting to comfort, wanting to turn away, and feelings of anxiety.

Results: Women with depression showed significantly different response patterns to women without depression. Women with depression were substantially more likely to be in the highest quartile for ratings of wanting to turn away from distressed infant faces (odds ratio 4.15, $p < .01$, 95% confidence intervals (CI) = 1.63-10.5). They were also substantially less likely to be in the highest quartile for wanting to comfort a distressed infant face (odds ratio .22, $p < .01$, 95% confidence intervals (CI) = .09-.54).

Conclusions: The findings from this study are consistent with both a heightened avoidant and a reduced comforting response towards distressed infants in depressed pregnant women. This study provides further evidence that depression disrupts maternal preparations at a conscious level.

Women's Responses to Infant Faces in Pregnancy

Keyword: Depression; Maternal Responsiveness; Self Report; Pregnancy; Prenatal; Perinatal.

Introduction

The effects of maternal depression on child outcomes are well documented, including its impact on child language development, cognitive functioning, and ongoing risk of psychosocial and emotional difficulties (Goodman et al., 2011). Although the exact mechanisms through which depression impacts on child outcomes is not known, possible mechanisms include: heritability, disruption to neurotransmitter systems, stressful life events, and exposure to negative maternal cognitions, affect and behaviours (Goodman et al., 2011; Goodman & Gotlib, 1999). A growing body of research has begun to examine the influence of maternal responsiveness on mother-child interactions, and the importance of how orientated or motivated the mother is to attend to infant related stimuli. Subsequently, a number of studies have found that postnatal depression is associated with disrupted mother-infant interactions (Murray, Fiori-Cowley, Hooper, & Cooper, 1996).

Maternal Responsiveness and Depression

Maternal responsiveness is defined as an attraction or motivation towards anything that is infant related (Pearson, 2010). Although the research to date has focused on maternal responsiveness postnatally, there is increasing evidence from both animal and human studies to suggest that maternal responsiveness develops before birth and across pregnancy (Fleming, Steiner, & Corter, 1997; Maestripieri & Zehr, 1998). Studies also indicate that sensitivity towards emotional faces and attentional biases towards infant stimuli develop across pregnancy (Pearson, Cooper, Penton-Voak, Lightman, & Evans, 2010; Pearson, Lightman, & Evans, 2010; Pearson, Lightman, & Evans, 2009).

Women's Responses to Infant Faces in Pregnancy

Importantly, the maternal responsiveness and mother-child attachment observed in pregnancy appears to be predictive of maternal sensitivity postnatally, indicating that the patterns observed in pregnancy may be indicators of later maternal responses (Pearson et al., 2011; Siddiqui & Hagglof, 2000; Shin, Park, & Kim, 2006; Thun-Hohenstein, Wienerroither, Schreuer, Seim, & Wienerroither, 2008).

Studies looking at maternal responsiveness typically measure this in one of two ways: by recording observed behaviour, or by measuring cognitive processing of salient stimuli such as infant faces. Research investigating observable behaviour indicates that depression influences observed maternal responsiveness including how the mother cradles her infant (Reissland, Hopkins, Helms, & Williams, 2009), the amount of maternal eye gaze, maternal language, the amount of gesturing and the level of coordinated attention between mother and child (Legerstee, Markova, & Fisher, 2007). Research also indicates that women who have antenatal depression are less sensitive and more 'aggressive' when playing with their baby, compared to non depressed women (Murray et al., 1996).

Research using cognitive processing measures has predominantly investigated the processing of infant faces, as important signals from the non-verbal infant will come from their facial expression. There is also evidence suggesting that the processing of infant faces is distinct from that of adult faces due to the fact that infants have a different facial configuration (Lorenz, 1971; Stein et al., 2010).

Women's Responses to Infant Faces in Pregnancy

Using this approach to measuring maternal responsiveness during pregnancy, Pearson et al. (2010) found that depressed pregnant women did not show the attentional bias towards distressed compared with non-distressed infant faces that was found in non-depressed pregnant women. However, it is not clear from these findings alone whether women with depression were showing an attention bias away from distressed faces, a bias towards non-distressed faces, or no distinction between the two. Another limitation of this study is that it looked at early cognitive processing only. Studies examining the early cognitive processing of facial stimuli have found inconsistent results, as the length of the presentation of stimuli is thought to influence its emotional valence, with increased presentation time being associated with increased emotionality (Stein et al., 2010). For example, in a design utilising later cognitive processing, Stein et al. (2010) found that when infant facial stimuli were presented for 200 milliseconds as opposed to 100 milliseconds, mothers rated the infant emotions more extremely. Women with postnatal depression also rated 'negative' infant faces more 'negatively' than non-depressed women. Although this study indicates that mothers with depression may rate negative infant stimuli more negatively, the study did not investigate the mother's own emotional response to the infant stimuli. The methodology utilised by Stein et al. (2010) also makes the assumption that negative and positive ratings are at opposite ends of a single continuum. It is likely that processing in perinatal depression is complex, and it may be that mothers can feel very negative about an infant image in some senses, but highly positive in others.

Women's Responses to Infant Faces in Pregnancy

There are two main hypotheses that could explain the findings of atypical processing of infant stimuli found in women with perinatal depression. The first is that maternal responses may be over stimulated in women with depression. This is supported by studies indicating that individuals with depression show hypersensitivity to, followed by avoidance of, punishment and negative stimuli (Elliott, Sahakian, Herrod, Robbins, & Paykel, 1997; Eshel & Roiser, 2010). The second hypothesis is that women with depression may be experiencing an under-stimulation of maternal responses due to impaired reward responses (Forbes, 2009; Swain, Lorberbaum, Kose, & Strathearn, 2007). For example, there is evidence from functional MRI studies to suggest that women with depression show less brain activation in neural areas involved in reward processing in response to their own infant's cry than women without depression (Laurent & Ablow, 2011). These two hypotheses may not be mutually exclusive, with recent studies exploring how depressed patients show differential reward and punishment processes, linking these two facets together (Eshel & Roiser, 2009). So rather, than being competing hypotheses, it may be that women experiencing depression during pregnancy show both reduced reward and increased avoidance.

Present Study

The current study aimed to examine women's self reported emotional responses to infant stimuli from early to mid pregnancy (6-18 weeks), in both women with and without depression. Looking at women's self-reported responses to stimuli early in pregnancy may help to develop understanding of the pathways between early cognitive processing and observable behaviour. If women with depression report different response patterns to

Women's Responses to Infant Faces in Pregnancy

infant faces early in pregnancy, this also has implications for the timing of interventions. The study aimed to determine if depressed women's responses were most consistent with a lack of reward (not wanting to comfort) or an avoidant response (wanting to turn away). To control for the fact that a woman may not want to soothe as they are experiencing anxiety (avoidant response) scales were also included to assess whether comforting responses were independent of anxiety responses. Whether women are showing a reduced comforting or a heightened avoidant response to infant stimuli has implications for the management of treatment for depression in pregnancy.

We hypothesised that pregnant women with depression would report heightened avoidance (turning away) and a reduced comforting response to the presentation of infant faces. Following previous evidence, we also hypothesised that this effect would be the strongest for distressed infant faces.

Method

Participants

A total of 176 pregnant women were recruited for a study aiming to validate a depression screening instrument, which also included a pilot CBT trial. Women were referred by community midwives in the North Bristol region, at their booking appointments. Women were invited to participate in the study if they were less than 18 weeks pregnant, were free from psychotic illness and were able to fluently read English. The average gestational age at assessment was 14 weeks. Only a sub sample of the women who were originally recruited completed the Maternal Response Scale (MRS) task, as the task was completed where time allowed. The study was approved by the National Health Service

Women's Responses to Infant Faces in Pregnancy

(NHS) Research Ethics Committee and North Bristol Trust, as part of a wider NHS CBT trial. All participants gave informed consent.

Procedure

Women who were invited to take part in the study were visited at home by a researcher. The women were then asked to complete the CIS-R (Lewis, Pelosi, Araya, & Dunn, 1992), the EPDS (Cox, Holden, & Sagovsky, 1987), a questionnaire regarding demographic and pregnancy information, an attention bias task not reported here (see Pearson et al. 2010 for a full description and previous findings) and the Maternal Response Scales (MRS). The women were always asked to complete the attention bias task before the MRS task, in case the more conscious processing involved in the MRS task contaminated women's responses in the less conscious attention bias task.

Measures

Clinical Interview Schedule-Revised (CIS-R)

The CIS-R is widely used with community samples and is a computerised self administered interview that generates severity scores on a scale of 0-4 for 14 classified neurotic symptoms, encompassing both anxiety and depression (Lewis et al. 1992). These symptoms then cluster according to ICD-10 criteria. The interview is fully standardised, is as reliable as the composite international diagnostic interview and is as reliable when conducted by a lay or trained interviewer (Lewis et al. 1992). The CIS-R uses a total symptom score of 12 or above to classify individuals as having a clinically significant, diagnosable mental health disorder. Because some of the CIS-R symptoms classifying a

Women's Responses to Infant Faces in Pregnancy

diagnosis of depression are problematic indicators in pregnancy, the EPDS was also completed, which is more specific to pregnancy.

EPDS

The EPDS (Cox et al. 1987) is a self report questionnaire that screens for postnatal depression symptoms by avoiding the use of physical prognostic indicators. The EPDS is rapid to use, and has high reliability and validity for both postnatal and antenatal women (Cox et al. 1996). The EPDS uses a symptom score from 9-12 to classify mild to moderate depression and over 13 to classify major depression.

Self Report Measures

Scale Development

A measure of self-reported emotional response to infant facial expressions was developed for this study. Initially women in a small pilot study were presented with nine images, three happy, three neutral and three distressed. By each picture was the sentence 'How does looking at this baby make you feel?' On presentation with the images, women were told 'Please type next to the infant faces any emotions or emotional responses that you feel. No emotions are right or wrong. Please type what your first reaction is.' Women's responses from this pilot were used to develop the MRS scales. The scales were then piloted for understanding of language and ease of use. Previous use of similar scales in the research literature (Stein et al. 2010) was examined and the scales were amended after piloting to be on a scale from 1-8 to be a more sensitive measure able to detect subtle variations in emotional self report. These scales were designed, developed and used for

Women's Responses to Infant Faces in Pregnancy

first use on this study and for the purpose of identification were named Maternal Response Scales (MRS). Women's responses from the piloting study are included descriptively in Table 2. The MRS scales developed from this pilot were developed and analysed for correlation and internal consistency, with a sample of 105 women. Correlation analyses indicated that comforting and anxiety scales for responses to distressed faces were not correlated ($r=-.13$, $p>.05$). However, turning away and anxiety scales for responses to distressed faces were correlated ($r=.62$, $p<.01$) (refer to Table 3. for full correlation matrix). Scatter plots showing the relationship between scale items are shown in figures 1, 2 and 3. Overall scales and subscales were also examined for internal consistency (refer to Table 4). Total anxiety, turning away and comforting scales all had an alpha co-efficient of $>.9$. This is classified as being 'Excellent' (George & Mallery, 2003). All of the subscales had an alpha co-efficient of $>.8$ indicative of 'good' to 'excellent' internal consistency.

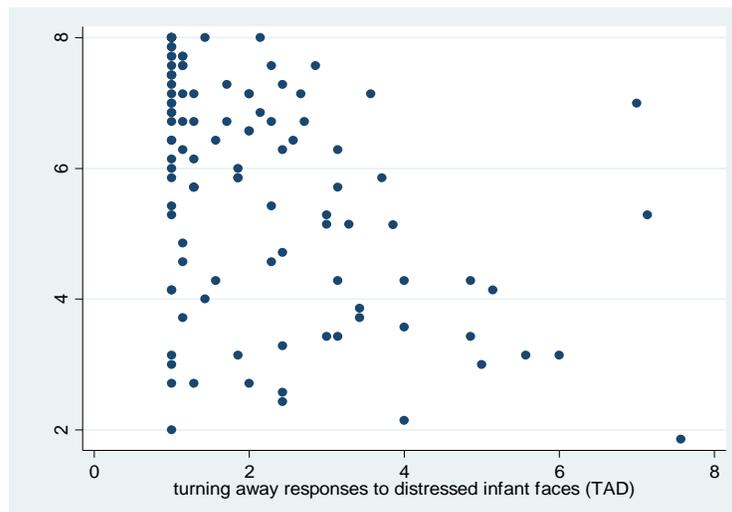


Figure 1. *Correlation between turning away and comforting responses*

Women's Responses to Infant Faces in Pregnancy

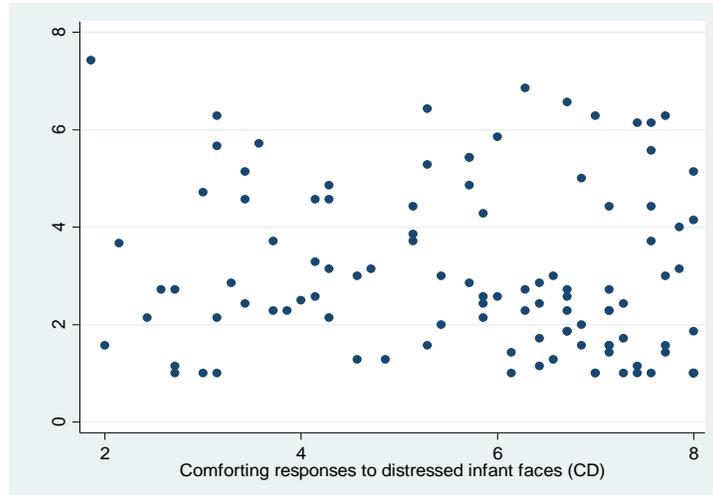


Figure 2. *Correlation between comforting and anxiety responses*

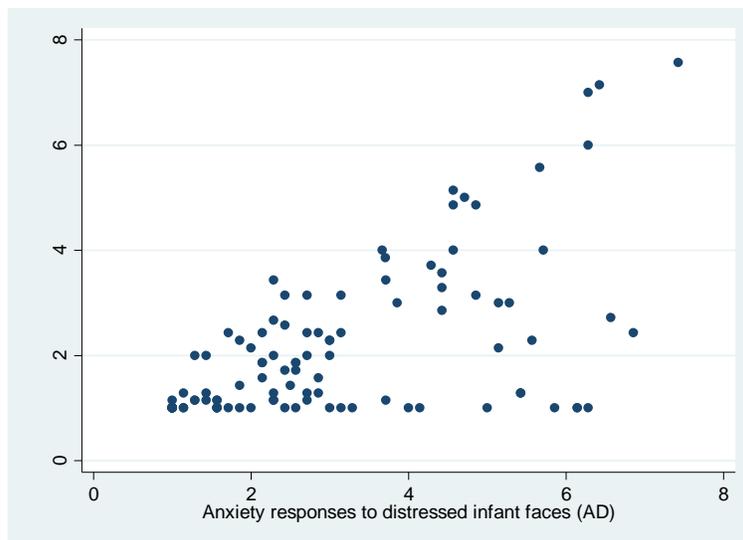


Figure 3. *Correlation between anxiety and turning away responses*

Women's Responses to Infant Faces in Pregnancy

Table 2

Women's Self Report Responses to Distressed Neutral and Happy Infant Stimuli

Participant no.	Emotional responses: Happy faces	Emotional responses: Distressed faces	Emotional responses: Neutral faces
1	Happy Relaxed Restful	Tired <i>Anxious</i> Stressed Agitated	Calm Relaxed
2	Happiness Excitement Affection	Sadness Affection Sympathy Exasperation Helplessness <i>Nervousness</i> <i>Want to help</i>	Curiousness Neutral Affection Love
3	Smiled Happy Smiley	Unhappy Upset Sad <i>Want to comfort</i>	Scared demon eyes Troubled Pensive
4	Made me smile and feel happy Makes you want to play as baby looks cheeky Makes you feel happy, makes you want to make the baby smile more	Made me empathise and wonder what was wrong, wanted to pick baby up for cuddle Looks as if baby is in pain, <i>want to help</i> . <i>Want to help</i>	Very little want to engage with baby to get it to smile Think how cute, has endearing face
5	Happy Loving	<i>I want to comfort baby, protective</i> Weary <i>Anxious</i> <i>Makes me want to soothe and comfort</i>	Neutral Not sure Warmth
6	Loved As though I'm entertaining, wondering what they've been up to Odd that this one doesn't evoke too much response (lack of eye contact I'm	Concerned, want to help Concerned to find out what's wrong, are they in pain?	Scared, very concerned, want to try and get a response from the baby Scrutinised Disconnected Uncomfortable

Women's Responses to Infant Faces in Pregnancy

	guessing), but nice to see a contented looking baby		Wanting to reassure the baby / check is okay / elicit a smile
7	Happy Makes me smile Neutral	<i>Anxious</i> Makes me wince <i>Makes me want to turn away</i>	Fine Confused Makes me want to pick up this baby
8	Happy Melting Laughing I think that they are cheeky looking and would maybe be a fun handful This one looks quite relaxed, I think I might tickle him	Oh dear, sad, sympathetic to their upset Oh dear I have really upset this one, how will I calm him down <i>Oh dear, this baby is really not happy, she/he needs some quiet words and soothing and reassurance</i>	Puzzled and interested in what baby thinking about She/he's not sure about me, she/he looks a bit worried – I will have to try and get a smile They look a bit unsure of me, it may take a little time to get a smile
9	Warm Smiley Playful Cuddly	<i>Protective</i> Sore Helpless <i>Odd Disturbed</i>	Sad Protective Concerned Wanting to smile at him Calm Relaxed Watchful Attentive
10	My first response was to smile at this picture First response was to laugh Smiling as this baby looks a bit cheeky	My first response was a bit upset and I wondered why the baby was upset Sadness again and <i>wanting to make the child feel happy</i> Sad again and <i>wanting to make the baby feel happy</i>	First response was a bit confused as not quite sure what this baby is feeling. No feeling as this child isn't happy or sad Slightly amused as the baby looks a bit surprised

Women’s Responses to Infant Faces in Pregnancy

Table 3

Spearman’s Correlation Matrix, Turning Away, Anxiety and Comforting Responses, n=105

	Anxiety Distressed	Anxiety Happy	Anxiety Neutral	Comforting Distressed	Comforting Happy	Comforting Neutral	Turning Away Distressed	Turning Away Happy	Turning away Neutral
Anxiety Distressed	1.00								
Anxiety Happy	.47**	1.00							
Anxiety Neutral	.76**	.74**	1.00						
Comforting Distressed	-.13	-.29*	-.09	1.00					
Comforting Happy	-.27*	.05	-.12	.34**	1.00				
Comforting Neutral	-.18	-.07	-.04	.60**	.81 **	1.00			
Turning Away Distressed	.62**	.52**	.42**	-.42**	-.06	-.22	1.00		
Turning Away Happy	.44**	.86**	.64**	-.38**	-.016	-.19	.58**	1.00	
Turning away Neutral	.49**	.71**	.59**	-.35**	-.029	-.15	.68**	.87**	1.00

*Significant at the $p < 0.05$ level

**Significant at the $p < 0.001$ level

Women's Responses to Infant Faces in Pregnancy

Table 4

Internal Consistency (Cronbach's Alpha)

<i>Scale</i>	<i>Alpha co-efficient</i>	<i>Mean</i>	<i>Standard Deviation (sd)</i>	<i>Variance</i>
<i>Anxiety happy faces</i>	<i>.940</i>	<i>10.14</i>	<i>6.279</i>	<i>39.421</i>
<i>Anxiety distressed faces</i>	<i>.930</i>	<i>20.73</i>	<i>12.128</i>	<i>147.082</i>
<i>Anxiety neutral faces</i>	<i>.878</i>	<i>13.40</i>	<i>7.539</i>	<i>56.840</i>
<i>Turning away happy faces</i>	<i>.866</i>	<i>9.73</i>	<i>5.096</i>	<i>25.966</i>
<i>Turning away distressed faces</i>	<i>.958</i>	<i>15.44</i>	<i>11.236</i>	<i>126.249</i>
<i>Turning away neutral faces</i>	<i>.852</i>	<i>11.56</i>	<i>6.068</i>	<i>36.821</i>
<i>Comforting happy faces</i>	<i>.957</i>	<i>23.01</i>	<i>14.469</i>	<i>209.337</i>
<i>Comforting distressed faces</i>	<i>.952</i>	<i>40.79</i>	<i>12.863</i>	<i>165.464</i>
<i>Comforting neutral faces</i>	<i>.936</i>	<i>28.72</i>	<i>12.885</i>	<i>166.023</i>
<i>All anxiety (anxiety full scale)</i>	<i>.949</i>	<i>36.73</i>	<i>20.102</i>	<i>404.095</i>
<i>All turning away (TA full scale)</i>	<i>.962</i>	<i>36.73</i>	<i>20.102</i>	<i>404.095</i>
<i>All comforting (comforting full scale)</i>	<i>.962</i>	<i>92.53</i>	<i>34.716</i>	<i>1205.188</i>

MRS Scales

The maternal response (MRS) task involved the presentation of distressed, neutral and happy infant faces images (7 of each). These images were randomised and presented in e-Prime, with no time limit, allowing for conscious processing. Under these pictures, a scale was presented (refer to Figure 4). Three MRS Likert scales were presented: I want to comfort, I want to turn away, and I feel anxious. Each image was presented three times, in random order, each time with one of the scales presented underneath the pictures (anxiety, comforting, turning away). Participants were asked to press the number key that felt the most relevant to them for each picture and scale. To reduce social desirability effects, participants were encouraged to press the most meaningful response for them, and told that no answer was right or wrong.

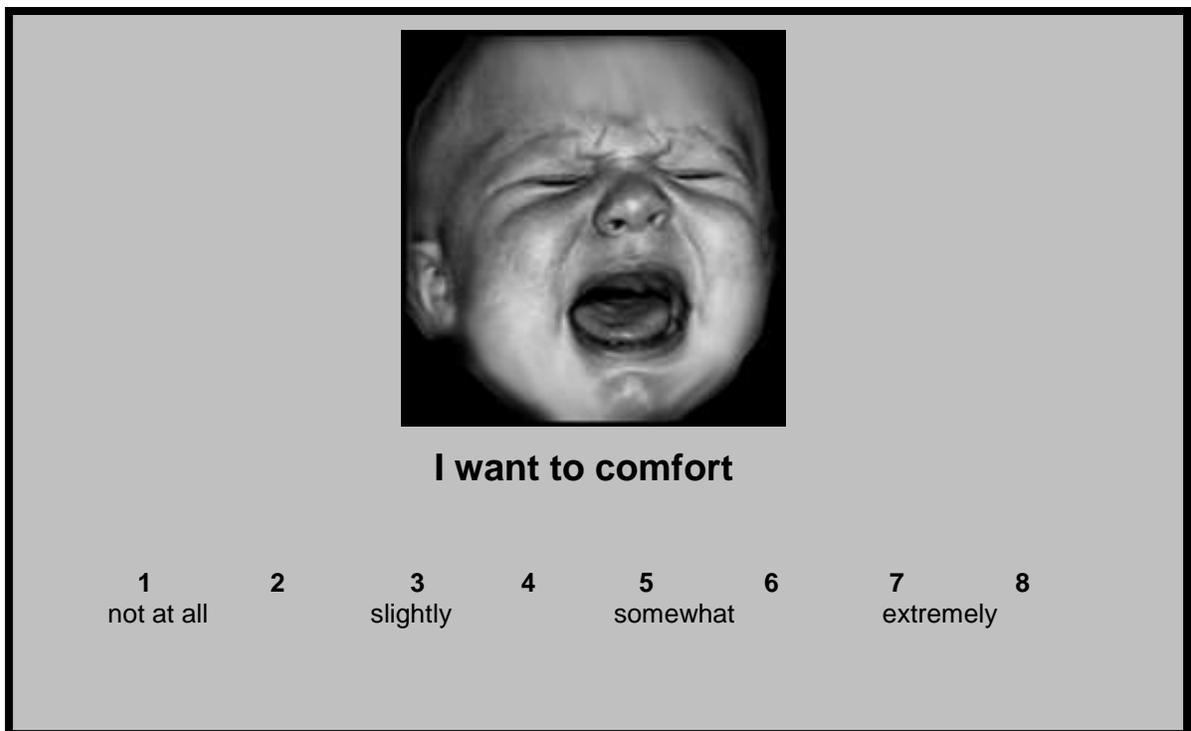


Figure 4. MRS wanting to comfort scale with a distressed infant face (not to size). Scales were developed along three axes. Wanting to comfort (reward), wanting to turn away (avoidance) and feelings of anxiety.

Materials

Infant Stimuli

The infant faces used in this study were those developed by Pearson et al. 2010. The Pictures were cropped, converted into grayscale and matched to adult faces (Ekman & Friesen, 1971) for brightness positioning and contrast. Pictures included distressed, neutral and happy faces (Figure 5.) These images were piloted on non pregnant women to test for emotional valence, and participants were forced to make a decision regarding whether the infant was distressed, neutral or happy. Mean accuracy for this was between 90-100%. These images have been validated in previous studies examining perinatal attentional processing (Pearson et al. 2010), and were used, with full permission from the authors.

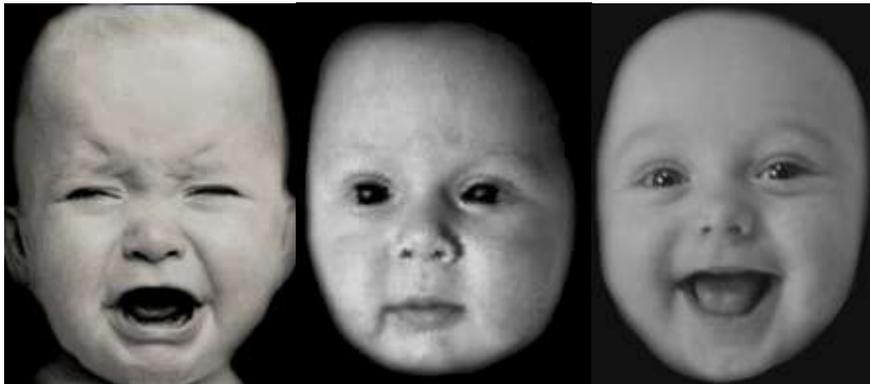


Figure 5. Distressed, neutral and happy infant faces (Taken from Pearson et al. 2010).

Power Analyses

Means and standard deviations were collected from the first 15 participants within the pilot RCT. These data were collected from women with and without depression (independent groups coded and anonymised). Following from previous research indicating that mothers with perinatal depression may show less of a nurturing response

towards infant stimuli, wanting to comfort (negative faces) was taken as the main variable ($SD=1.27$), and a power calculation was performed using previously found significant differences (Altman, 1991; Stein et al. 2010). Clinically relevant differences have been found to be 0.9 standard deviations in similar research (Stein et al. 2010). A nonogram by Altman, (1991) was then used to estimate power using standardised difference between those with depression and those without¹. The power calculation indicated that with 60 women in each group we would be able to detect a standardized effect size of 0.9 S.D's with 80% power and a significance level of 0.05. This is a graphical estimation of power, using previously found significant differences.

Analysis

Analysis Plan

The analysis for this study followed three stages. The first stage, following from our hypotheses, examined the relationship between depression and the primary responses of turning away and wanting to comfort, for distressed infant faces. The second stage examined these responses towards neutral and happy faces. The third analysis stage aimed to examine if there was an independent effect of distress on depressed and non depressed women's responses.

For all analyses, the independent variable was depression (depressed/non depressed according to CIS-R classification), with the dependent variable being maternal response (MRS). These analyses were conducted using ordinal logistic regressions, as the dependent variable (MRS responses) was not normally distributed and could not be normalized using transformations. Transformation were utilised with the lowest chi2

¹ Previously found significant difference .9 SD's/current data 1.3. Standard difference=.7.

value, using identity, inverse, log, square root and 1/square root. Regressions were run using predicted values, however all scales, with the exception of soothing neutral faces showed non normally distributed residuals, with non significant Shapiro Wilk r-values (see Table 5).

As such the MRS data were grouped into quantiles in order to derive an ordinal variable. The data fitted most evenly into four quartiles, with close to equal frequencies. The quartiles, and their score ranges are shown in Table 6. Single predictor unadjusted ordinal logistic models were initially run on the data. The models were then adjusted for parity and age.

Table 5

Transformations and Residual Data

	Transformation with lowest chi2	Sig	Swilk r (residuals)
Ad	Identity	P=.012	w=.91, v=6.98, p=.0001
Ah	Inverse	P=0.003	w=.92, v=6.79, p=.0001
An	Log	P=0.002	w=.95 v=4.55, p=.00038
Sd	Square Root	P=0.008	w=.92, v=7.08, p=.00001
Sh	Identity	P=0.006	w=.90, v=8.69, p=.00000
Sn	Square Root	P=0.286	w=0.99 v=1.08, p=.43590
Tad	Log	P=0.009	w=0.92 v=6.91, p=0.0001
Tah	Inverse	P=0.001	w=0.89 v=9.46, p=0.00000
Tan	1/Square root	P=0.005	w=0.94 v=5.08, p=0.00015

Key note: Ad=anxiety distressed faces, Ah=anxiety happy faces, An=anxiety neutral faces, Sd=comforting distressed faces, Sh=comforting happy faces, Sn=comforting neutral faces, Tad=turning away distressed faces, Tah=turning away happy faces, Tan=turning away neutral faces.

Maternal Responsiveness and Women's Self Report to Infant Stimuli in Pregnancy

Table 6

Minimum and Maximum Ratings, and % Depressed for Each Quartile

Response	Quartile	Frequency	Frequency (%) Depressed women in quartile	Frequency (%) Non Depressed women in quartile	Minimum rating	Maximum rating
Wanting to comfort (distressed faces)	1	28	18(47.4)	10(26.3)	1.8	4.3
	2	24	4(10.5)	5(13.2)	4.3	6.1
	3	29	10(26.3)	7(18.4)	6.1	7.1
	4	24	6(15.8)	16(42.1)	7.2	8.0
Turning away (distressed faces)	1	33	11(16.4)	23(34.3)	1.0	1.0
	2	20	19(28.4)	14(20.9)	1.1	1.6
	3	26	19(28.4)	20(29.8)	1.6	2.7
	4	26	18(26.9)	10(14.9)	2.8	7.6

Ordinal logistic regression models examine the odds ratio of an individual scoring at one level of an ordinal variable compared to the lowest level. Generalised rather than simple ordinal logistic regressions were conducted as the proportionality of odds assumption was violated. The generalised ordinal logistic regression models calculated the odds ratio for being in each quartile of MRS (compared to the lowest quartile) according to whether or not women were depressed.

Primary analyses investigated the relationship between depression and responses of wanting to comfort and wanting to turn away. In line with previous findings, our primary analyses focused on these responses to distressed infant faces. This was because previous evidence suggests that depression appears to particularly affect responses to distressed infant stimuli (Pearson et al. 2010). Turning away and anxiety responses were correlated, see correlation matrix, (Table 3.) however, we also investigated anxiety responses in secondary analyses.

Results

Of the 176 women who agreed to participate in the wider validation study and trial, 105 women took part in the current study. Of the 105 women taking part in the current study, 38 women were identified as depressed using the CIS-R according to ICD-10 diagnostic criteria (n=38) and 67 women were identified as having no diagnosis of depression (n=67). Mean age of participants was 30 (S.D.=5.4) years. Full sample demographics are included in Table 7.

Table 7

Sample Demographics. Occupation Defined by the National Statistics Socio-Economic Classification System (NS-SEC.)

Characteristic	Full sample recruited (n=176)	Current study whole sample (n=105)	Current study depressive symptom group (n=38)	Current study non-symptom group (n=67)
Mean age in years (range)	30 (18-44)	31 (19-44)	30 (20-41)	31(19-44)
Mean gestation in weeks (range)	13 (9-19)	13 (9-19)	14 (9-19)	13 (10-18)
Primiparous, n (%)		49 (47)	21 (55)	28 (41)
Occupation n(%)				
1.Higher managerial/professional	22(13)	12(11)	3(8)	9(13)
2.Lower managerial/professional	34(19)	27(26)	6(16)	21(31)
3.Intermediate	63(36)	35(33)	16(41)	18(27)
4.Small employers	2(1)	2(2)	0(0)	2(3)
5.Lower supervisory/technical	7(4)	3(3)	1(3)	2(3)
6.Semi routine	9(5)	5(5)	2(5)	3(4)
7.Routine	3(2)	1(1)	1(3)	0(0)
8.Unemployed	13(7)	4(4)	4(11)	0(0)
No data for occupation	23(13)	16(15)	5(13)	12(18)
Ethnicity, n (%)				
White Caucasian	161(91)	105(100)	38(100)	67(100)
Other	15(9)	0(0)	0(0)	0(0)

Table 8

Descriptive Statistics Across Conditions

		Comforting Distressed	Comforting Neutral	Comforting Happy	Turning Away distressed	Turning Away Neutral	Turning Away Happy	Anxiety Distressed	Anxiety Neutral	Anxiety Happy
Mean	Depressed	5.08	3.74	3.19	2.76	1.89	1.60	3.68	2.45	1.84
	Non Depressed	6.06	4.12	3.17	1.80	1.39	1.20	2.67	1.70	1.23
SD	Depressed	1.99	1.79	1.83	1.85	0.95	0.94	1.84	1.33	1.16
	Non Depressed	1.51	1.83	2.12	1.08	0.60	0.38	1.52	0.79	0.42
Min	Depressed	1.68	1.00	1.13	1.85	1.00	1.00	1.00	1.00	1.00
	Non Depressed	2.71	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max	Depressed	8.00	8.00	8.00	7.57	5.71	5.29	7.43	6.57	6.14
	Non Depressed	8.00	8.00	8.00	7.14	4.00	2.57	6.86	4.14	2.86

Women with sub threshold symptomatology according to the EPDS were examined in a secondary analysis; however, there was no evidence that sub-threshold depression influenced MRS scores. Effect sizes were stronger with EPDS data, but consistent across both CIS-R and EPDS classifications. Means and standard deviations of depressed and non depressed women across conditions are included in full in Table 8.

Primary Analysis

Impact of Depression on Turning Away to Distressed Faces

The ordinal logistic regression model, adjusted for age and parity, provided evidence that depressed women were substantially *more likely* to be in the highest (compared to the lowest) quartile for reporting wanting to turn away compared to women without depression (OR=4.15, $p < .01$, CI 1.63-10.5). Depression did not influence the likelihood of being in the second or third quartile compared to the lowest quartile. The percentage of depressed and non-depressed women in quartiles one and four is shown in Figure 6. Response patterns were reversed in depressed and non depressed groups of women.

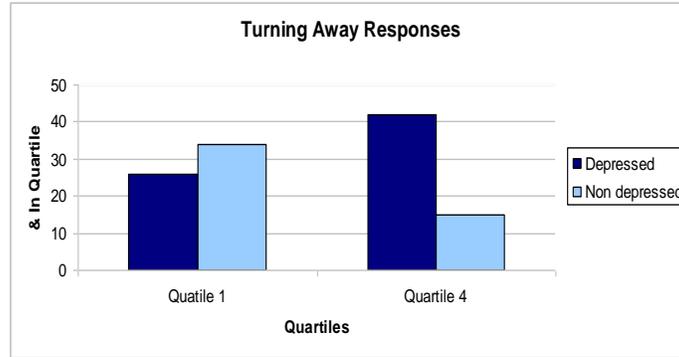


Figure 6. Turning away responses in depressed and non depressed women to distressed infant stimuli.

Confidence intervals quartile 1: Depressed 15-49%, Non Depressed 51-84%. Confidence Intervals quartile 4: Depressed 41-80%, Non Depressed, 20-59%.

Impact of Depression on Wanting to Comfort Distressed Faces

The ordinal logistic regression model provided evidence that depressed women were significantly *less likely* to be in the highest category (compared to lowest) for wanting to comfort (OR=.22, $p < .01$ CI=.09-0.54). Depression did not influence the likelihood of being in the second or third quartile compared to the lowest quartile. The percentage of depressed and non depressed women in the lowest and highest quartiles (Figure 7.) shows again a reversed trend for depressed and non-depressed women.

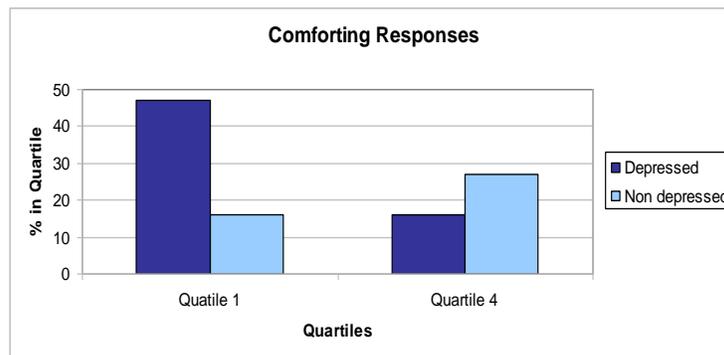


Figure 7. Wanting to comfort responses in depressed and non depressed women towards distressed infant stimuli. Confidence intervals quartile 1: Depressed 42-72%, Non Depressed 21-58%. Confidence Intervals quartile 4: Depressed 10-46%, Non Depressed, 53-90%.

Secondary Analyses

Neutral Faces

The same response pattern for depressed and non depressed women was observed for turning away to neutral faces, with depressed women being significantly *more likely* to be in the highest versus the lowest quartile for turning away (OR=4.46, $p=.04$, CI 1.59-12.49) However, the lack of a comforting response towards stimuli was found to be specific to distressed faces for women with depression. There was a non significant effect of depression on wanting to comfort neutral faces² (OR=.72, $p=.5$, CI=.28-1.87).

Happy Faces

There was a significant effect of depression on wanting to turn away from happy infant stimuli, with depressed women being significantly *more likely* to be in the highest quartile for turning away (OR=4.14, $p<.01$, CI=1.63-10.51) compared to non-depressed women. However there was no effect of depression on the likelihood of wanting to comfort happy faces (OR=.61, $p=.33$, CI=.23-1.64).

Independent effect of depression on distress.

These models were re-run, in a combined model including responses towards distressed, neutral and happy faces. This allowed us to explore whether there were any independent effects of depression on responses to distress specifically, over and above responses

² Using transformed continuous data the impact of depression on wanting to comfort a neutral face was also non significant, $b=-.63$, $t=-1.75$, $p=>.05$, CI=-1.35-.08.

towards infant faces of any emotion. This model indicated that the effect of depression on women's desire to comfort a distressed infant remained following adjustments for comforting responses towards happy and neutral faces (OR=.16, $p=.003$, CI=.05-.53). This suggests a specific effect of depression on comforting responses towards distress. However, there was not an independent effect of depression on women's desire to turn away from a distressed infant, the effect diminished following adjustment for turning away responses to neutral and happy faces (OR=2.61, $p=.091$, CI=.86-7.92). This suggests that there may be a general effect of depression on turning away from infant faces regardless of emotion expressed.

Anxiety as a primary diagnosis.

Women with anxiety as a primary diagnosis showed a similar response pattern to women with no diagnosis, indicative of a depression-specific effect on comforting responses. There was no evidence that anxiety as a primary diagnosis influenced MRS scores ($n=12$).

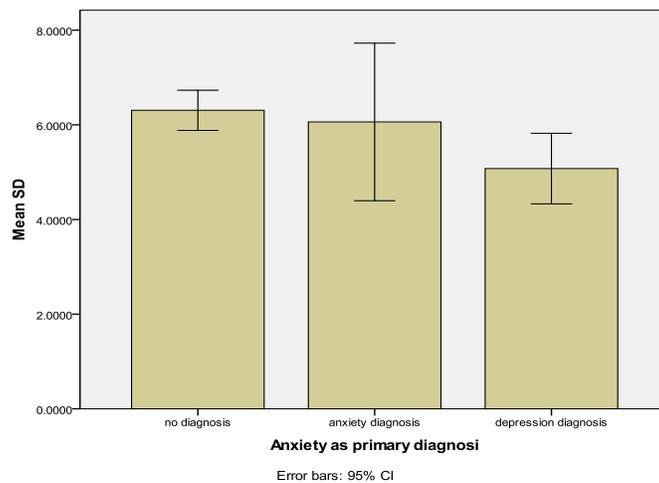


Figure 8. Anxiety as a primary diagnosis.

EPDS data.

The EPDS data enabled classification of depression under three sub groups 'no depression' 'sub threshold depression' or 'depression'. There was a high level of agreement between EPDS and CIS-R classifications of depression. Unlike less conscious attention bias tasks (see Appendix C for correlations between less conscious ABI tasks and MRS tasks within this study), there was no evidence that sub-threshold depression influenced MRS scores. Repeating the analyses with EPDS data, effect sizes were stronger with EPDS data, but consistent across both CIS-R and EPDS classifications. (Figures 9 & 10) (low depression n=60, sub threshold depression n=12, depression n=33).

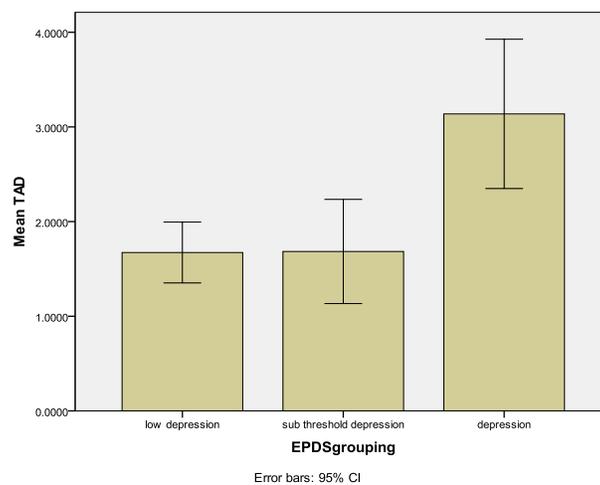


Figure 9. Turning away responses according to EPDS classifications

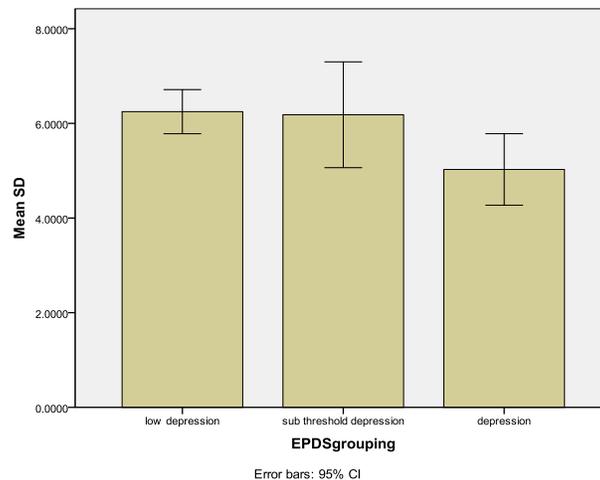


Figure 10. *Comforting responses according to EPDS classification*

Discussion

Although the exact mechanisms through which depression impacts on child outcomes is not known, possible mechanisms hypothesised include: heritability, disruption to neurotransmitter systems, stressful life events, and exposure to negative maternal cognitions, affect and behaviours (Goodman et al., 2011; Goodman & Gotlib, 1999). Recent studies indicate that maternal depression may disrupt how able a woman is to respond appropriately and contingently to their infant's signals, most notably to fear and distress signals. Investigating responsiveness in pregnancy is important, as there is evidence to suggest that pregnancy may be important in the development of emotional and behavioural responses to infants in preparation for the maternal role and that depression may disrupt this. For example, research suggests that depression in pregnancy is predictive of maternal ratings of child affect at six months postpartum (Huot, 2004).

Although the concept of maternal sensitive responsiveness in its original format is broad and generalised, and therefore difficult to operationalise, recent research has begun to 'pick apart' the key aspects of maternal responsiveness, and to focus on specific areas of

maternal responsiveness such as maternal language (Meins et al. 2001) and maternal cognitions and affect. For example, recent research by Pearson et al. (2010) looking at early cognitive processing has found that depression is associated with disrupted maternal responses to infant stimuli, with depressed women not showing the bias towards distressed infants observed in non depressed women (Pearson, 2010). Studies examining more conscious processing of infant stimuli also indicate that women with postnatal depression rate infant faces more extremely than women without depression (Stein et al. 2010).

Perhaps due to the nature of attachment, and the observable nature of the mother-child bond after birth, there is a paucity of research investigating maternal 'responsiveness' in pregnancy, a known period of vulnerability. This is perhaps an oversight, given evidence from animal studies suggesting that responsive behaviours appear to develop across pregnancy (Fleming, Steiner, & Corter, 1997; Maestripieri & Zehr, 1998). Studies also indicate that sensitivity towards emotional faces and attentional biases towards infant stimuli develop across pregnancy (Pearson, Cooper, Penton-Voak, Lightman, & Evans, 2010; Pearson, Lightman, & Evans, 2010; Pearson, Lightman, & Evans, 2009). There is therefore a small but developing consensus that across pregnancy women are both neurologically and psychologically globally preparing for motherhood. Importantly, the maternal responsiveness and mother-child attachment observed in pregnancy appears to be predictive of maternal sensitivity postnatally, indicating that the patterns observed in pregnancy may be indicators of later maternal responses (Pearson et al., 2011; Siddiqui & Hagglof, 2000; Shin, Park, & Kim, 2006; Thun-Hohenstein, Wienerroither, Schreuer, Seim, & Wienerroither, 2008).

This study aimed to examine maternal responsiveness by looking at self reported responsiveness and cognitive processing in women during pregnancy. To the author's knowledge, this is the first study investigating self reported responses to infant stimuli in prenatally depressed women. The study indicates that prenatally depressed women, in early-mid pregnancy (8-19 weeks) already report an altered response pattern to infant stimuli, compared to women who are not depressed.

The finding that prenatally depressed women showed an altered emotional response to infant stimuli is in itself perhaps not surprising. We hypothesised, on the basis of clinical knowledge and the existing literature that women with depression would self-report reduced comforting, and heightened avoidance. What was perhaps surprising was the strength of this finding: Early in pregnancy, depressed women were much *less likely* to be in the highest quartile for comforting (OR=.22, $p < .01$ CI=.09-.54) and much *more likely* to be in the highest quartile for turning away (OR=4.15, $p < .01$, CI=1.63-10.5). This effect was independent of parity and maternal age. The fact that women are showing a different self reported response to infant stimuli, implies that depression during pregnancy may affect global preparedness for responding to infants postnatally.

Interestingly in this research there is an implicit assumption that wanting to comfort an infant, and not wanting to turn away from an infant is an indicator of 'sensitive' and responsive parenting. This has face validity, however, one critique of studies that examine contingency in responses, is that 'appropriateness' of responses is not controlled for. It may be that in some circumstances, for example in women who are experiencing high levels of anxiety, that comforting may be insensitive if 'over responsive'. This is consistent with research suggesting that maternal responsiveness is negatively related to

intrusiveness. To examine the importance of self reported enhanced turning away and reduced comforting responses in pregnancy, future research needs to investigate the links between self reported responses prenatally with observed behaviours and child outcomes postnatally.

Potential Mechanisms: The Understimulation or the Overstimulation Hypothesis

This study aimed to explore further whether women with prenatal depression were more likely to report reduced reward responses (not wanting to comfort) or heightened avoidant responses (wanting to turn away) when presented with infant faces. This study indicates that women with prenatal depression have *both* reduced reward responses and heightened avoidant responses to infant distressed faces, compared to comparison non-depressed women. This study, is then concordant with studies indicating that depression in pregnancy may impact on multiple systems in a 'push pull' manner, potentially reducing both the desire to comfort (nurturant processes) *and* enhancing the desire to move away (avoidant processes). This research on women with depression during pregnancy is consistent with studies from more generalised literatures on depression suggesting that disruption of reward processing occurs as part of the essential pathophysiology of the disorder (Forbes, 2009), and with studies suggesting that avoidant processes are more activated in individuals with depression stimuli (Elliott, Sahakian, Herrod, Robbins, & Paykel, 1997; Eshel & Roiser, 2010).

Although as a group women with depression showed both responses, it may be that in women with depression that there are different response patterns depending on the

individual. For example, it may be that some women experience a turning away response to infant stimuli, with other women with depression showing no avoidance, but a reduced desire to comfort. However, this research indicates group specific enhanced avoidance *and* reduced nurturant processing in depressed women, early in pregnancy. This result implies that the development of maternal responsiveness across pregnancy, observed in non depressed women, may not develop in the same way in depressed women, with women being aware of this at a conscious level.

The Independent Effect of Distress

It could be argued that depressed women will show an altered response to almost any stimuli, and not specifically to infant stimuli. Importantly within this study although women showed both an increased avoidant and a lowered reward response to the distressed infant pictures, the reduced comforting responses were only observed for distressed infant faces, and not for neutral and happy faces. This can be compared to the heightened turning away response, which was seen in depressed women for all faces (distressed, neutral and happy). This result indicates that women with prenatal depression were more likely to report heightened wanting to turn away from all of the infant stimuli regardless of level of distress. However, the strongest observed effect, reduced comforting responses, was only seen in depressed women, for distressed infant faces. This result indicates that women with depression during pregnancy are not just simply generally unresponsive to infant faces but specifically have a reduced desire to comfort distressed infants. This is consistent with previous literatures suggesting that sensitivity to infant distress is a key aspect of responsiveness, with studies finding that in depressed

mothers greater sensitivity to distress, but not to non distress predicted a secure attachment style (McElwain & Booth-Laforce, 2006). The fact that the depressed women in this study showed the strongest response to distressed infant faces is potentially highly significant for behavioural responses towards infants postpartum. In critique of this finding, the specificity of a comforting response towards distressed infants may be partially related to women showing confusion as to whether they should want to 'comfort' a happy or a neutral infant.

The Specificity of Depression on Women's Responses

The results of this study indicate that there was a specific effect of depression on women's responses, with women with anxiety as a primary diagnosis showing a similar response pattern to women with no diagnosis, indicative of a depression-specific effect on women's responses. There was no evidence that anxiety as a primary diagnosis influenced MRS scores (n=12). This indicates that there may be something specific about the nature or experience of depression for women that affects how much they want to turn away from infant stimuli, and how much they want to comfort. It is important to consider that scale data for 'I feel anxious' and 'I want to turn away' were correlated, indicating that where women wanted to turn away from the infant stimuli, this may have been linked to anxiety and avoidance. However, these responses were shown only in women with a primary diagnosis of depression according to EPDS and CIS-R classifications, and not in women with a primary diagnosis of anxiety.

Limitations

The scales used in this research were developed specifically for the study and there is limited evidence of construct validity. It cannot be assumed that not wanting to comfort indicates a lack of reward. However, the study clearly indicates that this response was not related to anxiety as measured by self-report, and that depressed women show a reduced comforting response towards distressed infant stimuli, compared to women without depression. This finding is consistent with other research indicating a potentially diminished reward pathway, in response to distressed infant stimuli, in women with depression (Laurent & Ablow, 2011). Another potential critique of the scales used in this design is that although measuring emotional and largely cognitive self report, 'wanting to comfort' and 'wanting to turn away' could also be seen to tap into a behavioural motivation. It is therefore unclear if what the women are reporting is an emotional or behavioral response to the stimuli.

It should also be recognised that the scales developed were a relatively crude measure of emotional self-report, and that although they have face validity, they have not been tested for reliability. Limitations to this study also include the fact that emotional self-report is prone to bias. Although not wanting to comfort was the strongest effect in this study, it is possible that women felt that it was more socially desirable for women with depression to report that they do not want to comfort, as opposed to saying that they want to turn away. Further limitations include the fact that the infant images used in this design were not the women's own children. It could be argued that the women in this study's responses to unknown infant faces cannot be generalised to their responses and behaviours that they

would show later in response to their own infants. However, the different response patterns shown in depressed and non-depressed women suggest that the stimuli did not affect all of the women in the same way. What cannot be determined from this study is the impact of global maternal responses towards unknown infants in pregnancy, on maternal behaviours and attributions towards women's own infants postnatally. More research is required to investigate the relationship between less conscious and more conscious maternal responses in pregnancy, and specific maternal behaviours after birth.

Conclusion

This study indicates that early in pregnancy, women with depression are less likely to report wanting to comfort distressed infant faces, and are more likely to report wanting to turn away from all infant faces whatever the emotion displayed. Although the strongest effect observed in this study was a reduced comforting response, supporting the hypothesis that there is a lack of reward in women with depression, these women also showed a general avoidant response to infant stimuli. It may be clinically important that women with depression show both responses. The women with depression in this study were more likely to say that they did not want to comfort, but also that something about the pictures made them want to turn away. The fact that this response was present so early in pregnancy has implications for the ways in which depressed mothers may interact with their infants behaviourally before and after birth, and has implications for early intervention for depression in pregnancy.

Acknowledgement

This research was conducted in partnership with the Academic Unit of Psychiatry, Bristol, UK (NIHR Project Grant PB-PG-1207-15063) and the University of Exeter, Exeter, UK.

We would like to thank all of the participants for agreeing to take part in this study.

Conflict of Interests

None to declare

Authors Notes

This work was completed as a part of Clinical Psychology Doctorate Training.

Macrae, J. A; University of Exeter, Exeter, UK

Pearson, R. M; Academic Unit of Psychiatry, Bristol, UK

Chauhan, D; Academic Unit of Psychiatry, Bristol, UK

Bennert, K; Academic Unit of Psychiatry, Bristol, UK

Noble, A; Academic Unit of Psychiatry, Bristol, UK

Baxter, H; Academic Unit of Psychiatry, Bristol, UK

Evans, J; Academic Unit of Psychiatry, Bristol, UK

Reference List

Ainsworth, M. D. (1979). Infant-mother attachment. *American Psychologist*, *34*, 932-937.

Amankwaa, L., & Pickler, R. (2007). Measuring maternal responsiveness. *Journal of the Association of Black Nursing Faculty*, *18*, 4-15.

Barnes, J., Ram, B., Leach, P., Altmann, L., Sylva, K., Malmberg, L., Stein, A., & the FCCC Team (2007). Factors associated with negative emotional expression: a study of mothers of young infants. *Journal of Reproductive and Infant Psychology*, *25*, 122-138.

Bartels, A. & Zeki, S. (2004). The neural correlates of maternal and romantic love. *Neuroimage*, *21*, 1155-1166.

Beckwith, L., Rodning, C., & Cohen, S. (1992). Preterm children at early adolescence and continuity and discontinuity in maternal responsiveness from infancy. *Child Development*, *63*, 1198-1208.

Bigelow, A. E., Maclean, K., Proctor, J., Myatt, T., Gillis, R., & Power, M. (2010). Maternal sensitivity throughout infancy: Continuity and relation to attachment security. *Infant Behavioural Development*, *33*, 50-60.

Bornstein, M. H., Tamis-LeMonda, C. S., Tal, J., Ludemann, P., Toda, S., Rahn, C. W., Pecheux, M. G., Azuma, H., & Vardi, D. (1992). Maternal responsiveness to infants in three societies: the United States, France and Japan. *Child Development*, *63*, 808-821.

Bornstein, M. H. & Tamis-Lemonda, C. S. (1997). Maternal responsiveness and infant mental abilities: Specific predictive relations. *Infant Behavioural Development*, 20, 283-296.

Brosch, T., Sander, D. & Scherer, K. R. (2007). That baby caught my eye...attention capture by infant faces. *Emotion*, 7, 685-689.

Campbell, S. B., Brownell, C. A., Hungerford, A., Spieker, S. I., Mohan, R., & Blessing, J. S. (2004). The course of maternal depressive symptoms and maternal sensitivity as predictors of attachment security at 36 months. *Developmental Psychopathology*, 16, 231-252.

Campbell, S. B., Matestic, P., Von Stauffenberg, C., Mohan, R., & Kirchner, T. (2007). Trajectories of maternal depressive symptoms, maternal sensitivity, and children's functioning at school entry. *Developmental Psychology*, 43, 1202-1215.

Claussen, A. H & Crittinden, P. M. K. (2003). *The organisation of attachment relationships. Maturation, culture and context*. Cambridge:Cambridge University Press.

Connell, A.M., & Goodman, S.H. (2002). The association between psychopathology in fathers versus mothers and children's internalizing and externalizing behaviour problems: a meta-analysis. *Psychological Bulletin*, 128, 746-773.

Conroy, S., Marks, M. N., Schacht, R., Davies, H. A., & Moran, P. (2010). The impact of maternal depression and personality disorder on early infant care. *Social Psychiatry and Psychiatric Epidemiology*, 45, 285-292.

- Cox, J. L., Holden, J. M., & Sagovsky, R. (1987). Detection of postnatal depression. Development of the 10-item Edinburgh Postnatal Depression Scale. *British Journal of Psychiatry, 150*, 782-786.
- Crockenberg, S. C., & Leerkes, E. M. (2003). Parental acceptance, postpartum depression, and maternal sensitivity: mediating and moderating processes. *Journal of Family Psychology, 17*, 80-93.
- Deldin, P. J., Keller, J., Gergen, J. A., & Miller, G. A. (2000). Right-Posterior face processing anomaly in depression. *Journal of Abnormal Psychology, 109*, 116-121.
- Diehl, K. (1997). Adolescent mothers: what produces positive mother-infant interactions? *American Journal of Maternal Child Nursing, 22*, 89-95.
- Dietz, L.J., Jennings, K.D., Kelley, S.A., & Marshal, M. (2009). Maternal depression, paternal psychopathology, and toddlers' behavior problems. *Journal of Clinical Child and Adolescent Psychology, 38*, 48-61.
- Donaldson, C., Lam, D., & Matthews, A. (2007). Rumination and attention in major depression. *Behaviour Research and Therapy, 45*, 2664-2678.
- Egeland, B., & Farber, E. A. (1984). Infant-mother attachment: Factors related to its development and changes over time. *Child Development, 55*, 753-771.
- Ekman, P. & Friesen, W. V. (1971). Constants across cultures in the face and emotion. *Journal of Personality and Social Psychology, 17*, 124-129.

Elliott, R., Sahakian, B. J., Herrod, J. J., Robbins, T. W., & Paykel, E. S. (1997).

Abnormal response to negative feedback in unipolar depression: evidence for a diagnosis specific impairment. *Journal of Neurology, Neurosurgery and Psychiatry*, *63*, 74-82.

Eshel, N., Daelmans, B., De Mello, M. C., & Martines, J. (2006). Responsive parenting: interventions and outcomes. *Bulletin World Health Organisation*, *84*, 991-998.

Eshel, N. & Roiser, J. P. (2010). Reward and punishment processing in depression. *Biological Psychiatry*, *68*, 118-124.

Feldman, R., Granat, A., Pariente, C., Kanety, H., Kuint, J., Gilboa-Schechtman, E. (2009). Maternal depression and anxiety across the postpartum year and infant social engagement, fear regulation and stress reactivity. *Journal of the American Academy of Child and Adolescent Psychiatry*, *48*, 919-927.

Field, T. M. (1998, April). *Depressed mothers and their newborns*. Paper presented at the 11th Biennial Conference on Infant Studies, Atlanta: GA.

Field, T. (2010). Postpartum depression effects on early interactions, parenting, and safety practices: a review. *Infant Behavioural Development*, *33*, 1-6.

Flemming, A. S., Ruble, D., Krieger, H., & Wong, P. Y. (1997a). Hormonal and experiential correlates of maternal responsiveness during pregnancy and the puerperium in human mothers. *Hormones and Behaviour*, *31*, 145-158.

Fleming, A. S., Steiner, M., & Corter, C. (1997). Cortisol, hedonics, and maternal responsiveness in human mothers. *Hormones and Behaviour*, *32*, 85-98.

Garai, E. P., Forehand, R. L., Colletti, C. J., Reeslund, K., Potts, J., & Compas, B. (2009).

The relation of maternal sensitivity to children's internalising and externalizing problems within the context of maternal depressive symptoms. *Behaviour Modification*, *35*, 559-562.

Gaynes, B.N., Gavin, N., Meltzer-Brody, S., Lohr, K.N., Swinson, T., Gartlehner, G.

(2005). Perinatal depression: Prevalence, screening accuracy, and screening outcomes. *Evidence Reproductive Technology Assessment*, *119*, 1-8.

George, D., & Mallery, P. (2003). *SPSS for Windows step by step: A simple guide and reference. 11.0 update* (4th ed.). Boston: Allyn & Bacon.

Glocker, M. L., Langleben, D. D., Ruparel, K., Iougan, J. W., Valdez, J. N., Griffin, M.

D., Sachser, N., & Gur, R. C. (2009). Baby schema modulates the brain reward system in nulliparous women. *Proceedings of the National Academy of Sciences, U. S. A.* *106*, 9115-0119.

Gollan, J. K., Pane, H. T., McCloskey, M. S., Coccaro, E. M. (2007). Identifying

differences in biased affective processing in major depression. *Psychiatry Research*, *159*, 18-24.

Gondoli, D. M., & Silverberg, S. B (1997). Maternal emotional distress and diminished

responsiveness: the mediating role of parenting efficacy and parental perspective taking. *Developmental Psychology*, *33*, 861-868.

Gotlib, I. H., Krasnoperova, E., Yue, D. N., & Joorman, J. (2004). Attentional biases for negative interpersonal stimuli in depression. *Journal of Abnormal Psychology, 113*, 127-135.

Goodman, S. H., & Glotlib, I. H. (1999). Risk for psychopathology in the children of depressed mothers: a developmental model for understanding mechanisms of transmission. *Psychological Review, 106*, 458-490.

Goodman, S. H., Rouse, M. H., Connell, A. M., Broth, M. R., Hall, C. M., & Heyward, D. (2011). Maternal depression and child psychopathology: a meta-analytic review. *Clinical Child and Family Psychological Review, 14*, 1-27.

Grant, K. A., McMahon, C., Austin, M. P., Reilly, N., Leader, L., & Ali, S. (2009). Maternal prenatal anxiety, postnatal caregiving and infants' cortisol responses to the still-face procedure. *Developmental Psychobiology, 51*, 625-637.

Grant, K. A., McMahon, C., Reilly, N., & Austin, M. P. (2010) Maternal sensitivity moderates the impact of prenatal anxiety disorder on infant mental development. *Early Human Development, 89*, 551-556.,

Gross R. S., Fierman A. H., Mendelsohn A. L., Chiasson M. A., Rosenberg T., J., Scheinmann, R., & Messito, M. J. (2010). Maternal perceptions of infant hunger, satiety, and pressuring feeding styles in an urban Latina WIC population. *American Academy of Pediatrics, 10*, 29-35.

Handley, S. L., Dunn, T. L., Waldron, G., & Baker, J. M. (1980). Tryptophan, cortisol and puerperal mood. *British Journal of Psychiatry*, *136*, 498-508.

Hankin, B. L., Gibb, B. E., Abela, J. R. Z., & Flory, K. (2010). Selective attention to affective stimuli and clinical depression among youths: role of anxiety and specificity of emotion. *Journal of Abnormal Psychology*, *119*, 491-501.

Hobson, R. P., Patrick, M. P., Crandell, L. E., Garcia Perez, R. M., & Lee, A. Maternal sensitivity and infant triadic communication. *Journal of Child Psychology and Psychiatry*, *45*, 470-480.

Huot, R. L., Brennan, P. A., Stowe, Z. N., Plotsky, P. M., & Walker, E. F. (2004). Negative Affect in Offspring of Depressed Mothers is Predicted by Infant Cortisol Levels at 6 Months and Maternal Depression During Pregnancy but not Postpartum. *Annals of the New York Academy of Sciences*, *1032*, 234-236.

Isabella, R. A., & Belsky, J. (1991). Interactional Synchrony and the origins of infant-mother attachment: A replication study. *Child Development*, *62*, 373-384.

Jaffe, J., Beebe, B., Feldstein, S., Crown, C., & Jasnow, M. D. (2001). Rhythms of dialogue in infancy: coordinated timing in development. *Monographs of the Society for Research of Child Development*, *66*, 122-132.

Joorman, J., & Gotlib, I. H. (2007). Selective attention to emotional faces following recovery from depression. *Journal of Abnormal Psychology*, *116*, 80-85.

Joorman, J., Talbot, L., & Gotlib, I. H. (2007). Biased processing of emotional information in girls at risk for depression. *Journal of Abnormal Psychology, 116*, 135-143.

Kaplan, L. A., Evans, L., & Monk, C. (2008). Effects of mothers' prenatal psychiatric status and postnatal caregiving on infant biobehavioral regulation: can prenatal programming be modified? *Early Human Development, 84*, 249-256.

Landry, S. H., Smith, K. E., & Swank, P. R. Responsive parenting: establishing early foundations for social, communication, and independent problem-solving skills. *Developmental Psychology, 42*, 627-642.

Laurent, H. K. & Ablow, J. C. (2011). A cry in the dark: depressed mothers show reduced neural activation to their own infant's cry. *Social Cognitive and Affective Neuroscience*, doi: 10.1093/scan/nsq091. First published online: January 5, 2011.

Legerstee, M., Markova, G. & Fisher, T. (2007). The role of maternal affect attunement in dyadic and triadic communication. *Infant Behavioural Development, 30*, 296-306.

Leigh, B., & Milgrom, J. (2008). Risk factors for antenatal depression, postnatal depression and parenting stress. *BMC Psychiatry, 16*, 8-24.

LeMoult, J., Joorman, J., Sherdell, L., Wright, Y., & Gotlib, I. H. (2009). Identification of emotional facial expressions following recovery from depression. *Journal of Abnormal Psychology, 4*, 828-833.

Lewis, G., Pelosi, A. J., Araya, R., & Dunn, G. (1992). Measuring psychiatric disorder in the community: a standardized assessment for use by lay interviewers. *Psychological Medicine*, *22*, 465-486.

Little, A. C., Debruine, L. M., Jones, B. C., & Waitt, C. (2008). Category contingent aftereffects for faces of different races, ages and species. *Cognition*, *106*, 1537-1547.

Lorenz, K. (1971). *Studies in Animal and Human Behavior*. Cambridge: Harvard University Press.

Maestripieri, D. & Zehr, J. L. (1998). Maternal responsiveness increases during pregnancy and after estrogen treatment in macaques. *Hormones and Behaviour*, *34*, 223-230.

Mantaymaa, M., Puura, K., Luoma, I., Salmelin, R., Davis, H., Tsiantis, J., Ispanovic-Radojkovic, V., Paradisiotou, A., & Tamminen, T. (2003). Infant-mother interaction as a predictor of child's chronic health problems. *Child Care Health Development*, *29*, 181-191.

McElwain, N. L., & Booth-Laforce, C. (2006). Maternal sensitivity to infant distress and nondistress as predictors of infant-mother attachment security. *Journal of Family Psychology*, *20*, 247-255.

Meins, E. (1997). *Security of attachment and the social development of cognition*. East Sussex UK: Psychology Press Ltd.

Meins, E., Fernyhough, C., Fradley, E. & Tuckey, M. (2001). Rethinking maternal sensitivity: Mothers' comments on infants' mental processes predict security of attachment at 12 months. *Journal of Child Psychology and Psychiatry*, *42*, 637-648.

Mogg, K., Millar, N. & Bradley, B. P. (2000). Biases in eye movements to threatening facial expressions in generalised anxiety disorder and depressive disorder. *Journal of Abnormal Psychology*, *109*, 695-704.

Moszkowski, R. J., Stack, D. M., Girouard, N., Field, T. M., Hernandez-Reif, M., & Diego, M. (2009). Touching behaviours of infants of depressed mothers during normal and perturbed interactions. *Infant Behavioural Development*, *32*, 183-194.

Mills-Koonce, W. R., Garipey, J. L., Sutton, K., & Cox, M. J. (2008). Changes in maternal sensitivity across the first three years: are mothers from different attachment dyads differentially influenced by depressive symptomatology? *Attachment and Human Development*, *10*, 299-317.

Murray, L., Halligan, S. L., Adams, G., Patterson, P., & Goodyer, I. M. (1996). Socioemotional development in adolescents at risk of depression: the role of maternal depression and attachment style. *Developmental Psychopathology*, *18*, 489-516.

Murray, L., Fiori-Cowley, A., Hooper, R., & Cooper, P. (1996a). The impact of postnatal depression and associated adversity on early mother-infant interactions and later infant outcome. *Child Development*, *67*, 2512-2526.

Murray, L., Hipwell, A., Hooper, R., Stein, A., & Cooper, P. (1996c). The cognitive development of 5-year-old children of postnatally depressed mothers. *Journal of Child Psychology and Psychiatry*, 37, 927-935.

Murray, L., Halligan, S. L., Goodyer, I., & Herbert, J. (2010). Disturbances in early parenting of depressed mothers and cortisol secretion in offspring: a preliminary study. *Journal of Affective Disorders*, 122, 218-223.

Nitschke, J. B., Nelson, E. E., Rusch, B. D., Fox, A. S., Oakes, T. R. & Davidson, R. J. (2004). Orbitofrontal cortex tracks positive mood in mothers viewing pictures of their newborn infants. *Neuroimage*, 21, 583-592.

Noriuchi, M., Kikuchi, Y., & Senoo, A. (2008). The functional neuroanatomy of maternal love: Mother's response to infant's attachment behaviours. *Biological Psychiatry*, 63, 415-423.

Nover, A., Shore, M. F., Timberlake, E. M., & Greenspan, S. I. (1984). The relationship of maternal perception and maternal behaviour: a study of normal mothers and their infants. *American Journal of Orthopsychiatry*, 54, 210-223.

Numan, M (2007). Motivational systems and the neural circuitry of maternal behavior in the rat. *Developmental Psychobiology*, 49, 12-21.

Oates, D. S & Heinicke, C. M. (1985). Prebirth prediction of the quality of the mother-infant interaction: the first year of life. *Journal of Family Issues*, 6, 523-542.

O Connor, T. G., Ben-Shlomo, Y., Heron, J., Golding, J., Adams, D., & Glover, V. (2005). Prenatal anxiety predicts individual differences in cortisol in pre-adolescent children. *Biological Psychiatry, 1*, 211-217.

O'Mahen, H. A., Flynn, H. A & Nolen-Hoeksema, S. (2010). Rumination and interpersonal functioning in perinatal depression. *Journal of Social and Clinical Psychology, 29*, 646-667.

Page, M., Wilhelm, M. S., Gamble, W. C., & Card, N. A. (2010). A comparison of maternal sensitivity and verbal stimulation as unique predictors of infant social-emotional and cognitive development. *Infant Behavioural Development, 33*, 101-110.

Pawlby, S., Hay, D. F., Sharp, D., Waters, C. S., O'Keane, V. (2008). Antenatal depression predicts depression in adolescent offspring: prospective longitudinal community-based study. *Journal of Affective Disorders, 113*, 236-243.

Pawlby, S., Sharp, D., Hay, D., & O'Keane, V. (2008) Postnatal depression and child outcomes and 11 years: the importance of accurate diagnosis. *Journal of Affective Disorders, 107*, 241-245.

Pearson, R. M. (2010). *Psycho-Physiological Preparations for Motherhood and the Relationship with Affective Disorder Symptoms (Doctoral dissertation)*. University of Bristol.

Pearson, R. M., Cooper, R. M., Penton-Voak, I. S., Lightman, S. L., & Evans, J. (2010). Depressive symptoms in early pregnancy disrupt attentional processing of infant emotion.

Psychological Medicine, 40, 621-631.

Pearson, R. M., Heron, J., Melotti, R., Joinson, C., Stein, A., Ramchandani, P. G. et al. (2011). The association between observed non-verbal maternal responses at 12 months and later infant development at 18 months and IQ at 4 years: A longitudinal study. *Infant Behavior and Development, 34*, 525-533.

Pearson, R. M., Lightman, S. L., & Evans, J. (2009). Emotional sensitivity for motherhood: late pregnancy is associated with enhanced accuracy to encode emotional faces. *Hormones and Behaviour, 56*, 557-563.

Pearson, R. M., Lightman, S. L., & Evans, J. (2010). Attentional processing of infant emotion during late pregnancy and mother-infant relations after birth. *Archives of Womens Mental Health, 14*, 23-31.

Porter, C. L., & Chin-Hsu, H. (2003). First time mothers' perceptions of efficacy during the transition to motherhood: links to infant temperament. *Journal of Family Psychology, 17*, 54-64.

Proverbio, A. M., Brignone, V., Matarazzo, S., Del, Z. M., & Zani, A. (2006). Gender and parental status affect the visual cortical response to infant facial expression. *Neuropsychologia, 44*, 2987-2999.

Reck, C., Stehle, E., Reinig, K., & Mundt, C. (2009). Maternity blues as a predictor of DSM-IV depression and anxiety in the first three months postpartum. *Journal of Affective Disorders, 113*, 77-87.

Reissland, N., Hopkins, B., Helms, P., & Williams, B. (2009). Maternal stress and depression and the lateralisation of infant cradling. *The Journal of Child Psychology and Psychiatry, 50*, 263–269.

Rizzolatti, G., & Craighero, L. (2004). The mirror-neuron system. *Annual Review of Neuroscience, 27*, 169-192.

Ruddy, M. G., & Bornstein, M. H. (1982). Cognitive correlates of infant attention and maternal stimulation over the first year of life. *Child Development, 53*, 183-188.

Selritz, E., Esposito, F., Neuhoff, J. G., Luthi, A., Mustovic, H., Dammann, G., Von, B. U., Radue, E. W., Cirillo, S., Tedeschi, G., & Di, S. F. (2003). Differential sex-independent amygdala response to infant crying and laughing in parents versus non parents. *Biological Psychiatry, 54*, 1367-1375.

Shin, H., Park, Y. J., & Kim, M. J. (2006). Predictors of maternal sensitivity during the early postpartum period. *Journal of Advanced Nursing, 55*, 425-434.

Siddiqui, A. & Hagglof, B. (2000). Does maternal prenatal attachment predict postnatal mother-infant interaction? *Early Human Development, 59*, 13-25.

Smith, K. E., Landry, S. H., & Swank, P. R. (2006). The role of early maternal responsiveness in supporting school-aged cognitive development for children who vary in birth status. *Pediatrics, 117*, 1608-1617.

Stallings, J., Fleming, A., Corter, C., Worthman, C., & Steiner, M. (2001). The effects of infant cries and odors on sympathy, cortisol and autonomic responses in new mothers and non-postpartum women. *Parenting Science and Practice, 1*, 71-100.

Stein, A., Arteché, A., Lehtonen, A., Craske, M., Harvey, A., Counsell, N. et al. (2010). Interpretation of infant facial expression in the context of maternal postnatal depression. *Infant Behaviour and Development, 33*, 273-278.

Sternglanz, S. H., Gray, J. L., & Murakami, M. (1977). Adult preferences for infantile facial features: an ethological approach. *Animal Behaviour, 25*, 108-115.

Strathearn, L., Fonagy, P., Amico, J., & Montague, P. R. (2009). Adult attachment predicts maternal brain and oxytocin response to infant cues. *Neuropsychopharmacology, 34*, 2655-2656.

Swain, J. E., Lorberbaum, J. P., Kose, S., & Strathearn, L. (2007). Brain basis of early parent-infant interactions: psychology, physiology, and in vivo functional neuroimaging studies. *Journal of Child Psychology and Psychiatry, 48*, 262-287.

Tamis-Lemonda, C. S., Bornstein, M. H., & Baumwell, L. (2001). Maternal responsiveness and children's achievement of language milestones. *Child Development, 72*, 748-767.

Thun-Hohenstein, L., Wienerroither, C., Schreuer, M., Seim, G., & Wienerroither, H. (2008). Antenatal mental representations about the child and mother-infant interaction at three months post partum. *European Child and Adolescent Psychiatry, 17*, 9-19.

Tomasello, M., & Farrar, M. J. (1986). Joint attention and early language. *Child Development, 57*, 1454-1463.

Trapolini, T., Ungerer, J. A., McMahon, C. A. (2008). Maternal depression: relations with maternal caregiving representations and emotional availability during preschool years. *Attachment and Human Development, 10*, 73-90.

Walker, C. D., Deschamps, S., Proulx, K., Tu, M., Saltzman, C., Woodside, B., Lupien, S., Gallo-Payet, N., & Richard, D. (2004). Mother to infant or infant to mother? Reciprocal regulation of responsiveness to stress in rodents and the implications for humans. *Journal of Psychiatry and Neuroscience, 29*, 364-382.

Wan, M. W., & Green, J. (2009). The impact of maternal psychopathology on child-mother attachment. *Archives of Women's Mental Health, 12*, 123-134.

Williams, L. M., Kemp, A. H., Felmingham, K., Liddell, B. J., Palmer, D. M., Bryant, R. A. (2007). Neural biases to covert and overt signals of fear: dissociation by trait and anxiety and depression. *Journal of Cognitive Neuroscience, 19*, 1595-1608.

Yarrow, L. J., Macturk, R. H., Vietze, P. M., McCarthy, M. E., Klein, R. P., & McQuinston, S. (1984). Developmental course of parental stimulation and its

relationship to mastery motivation during infancy. *Developmental Psychology*, 20, 492-503.

Yoon, L. K., Wook-Hong, S., Joorman, J., & Kang, P. (2009). Perception of facial expressions of emotion during binocular rivalry. *Emotion*, 9, 172-182.

Appendix A

Instructions to authors

Submission of a manuscript implies that it contains original work and has not been published or submitted for publication elsewhere. It also implies the transfer of the copyright from the author to the publisher. Authors should include permission to reproduce any previously published material. Any potential conflict of interest should be disclosed in the cover letter. Authors are also requested to include contact information (name, address, telephone, fax, and e-mail) for three potential peer reviewers, to be used at the Editor's discretion. The review process requires 2 to 5 months.

Ethics in publishing

For information on Ethics in publishing and Ethical guidelines for journal publication (including the necessity to avoid plagiarism and duplicate publication) see ⇨

<http://www.elsevier.com/ethicalguidelines> and ⇨

<http://www.elsevier.com/publishingethics>

Manuscript Submission

The *Journal of Affective Disorders* now proceeds totally online via an electronic submission system. Mail submissions will no longer be accepted. By accessing the online submission system through the Author Gateway, ⇨ <http://ees.elsevier.com/jad/>, you will be guided stepwise through the creation and uploading of the various files. When

submitting a manuscript online, authors need to provide an electronic version of their manuscript and any accompanying figures and tables.

The author should select from a list of scientific classifications, which will be used to help the editors select reviewers with appropriate expertise, and an article type for their manuscript. Once the uploading is done, the system automatically generates an electronic (PDF) proof, which is then used for reviewing. All correspondence, including the Editor's decision and request for revisions, will be processed through the system and will reach the corresponding author by e-mail.

Once a manuscript has successfully been submitted via the online submission system authors may track the status of their manuscript using the online submission system (details will be provided by e-mail). If your manuscript is accepted by the journal, subsequent tracking facilities are available on Elsevier's Author Gateway, using the unique reference number provided by Elsevier and corresponding author name (details will be provided by e-mail).

Authors may send queries concerning the submission process or journal procedures to the appropriate Editorial Office:

For Europe, Asia (except Japan), and Australasia: C. Katona, Kent Institute of Medicine and Health Sciences, Research and Development Centre, University of Kent, Canterbury, Kent CT2 7PD UK; E-mail: journalad@kent.ac.uk.

For the American Hemisphere, Africa, and Japan: H.S. Akiskal, Director of International Mood Center, University of California at San Diego, 9500 Gilman Drive #0737, La Jolla, CA 92093-0737, USA, USA; E-mail: hakiskal@ucsd.edu.

For further details on how to submit online, please refer to the online EES Tutorial for authors or contact Elsevier's Author Support Team at authorsupport@elsevier.com.

Types of Papers

The Journal primarily publishes

full-length Research Reports describing original work (4000-5000 words, excluding references and up to 6 tables/figures)

Brief Reports (1500-2000 words, excluding references and a maximum of 2 tables/figures)

evidence-based Review Articles (up to 8000 words, excluding references and up to 10 tables/figures). Reviews should be systematic and give details as to search strategy used.

Rapid Communications (1500-2000 words, excluding references and a maximum of 2 tables/figures).

Preliminary Communications (up to 3000 words, excluding references and maximum 3 tables/figures).

Books for review should be sent to the appropriate editorial office (see above).

At the discretion of the accepting Editor-in-Chief, and/or based on reviewer feedback, authors may be allowed fewer or more than these guidelines.

Preparation of Manuscripts

Articles should be in English. The title page should appear as a separate sheet bearing title (without article type), author names and affiliations, and a footnote with the corresponding author's full contact information, including address, telephone and fax numbers, and e-mail address (failure to include an e-mail address can delay processing of the manuscript).

Papers should be divided into sections headed by a caption (e.g., Introduction, Methods, Results, Discussion). A structured abstract of no more than 250 words should appear on a separate page with the following headings and order: Background, Methods, Results, Limitations, Conclusions (which should contain a statement about the clinical relevance of the research). A list of three to six key words should appear under the abstract.

Authors should note that the 'limitations' section both in the discussion of the paper AND IN A STRUCTURED ABSTRACT are essential. Failure to include it may delay in processing the paper, decision making and final publication.

Ethical Considerations. Authors of reports on human studies, especially those involving placebo, symptom provocation, drug discontinuation, or patients with disorders that may impair decision-making capability, should consider the ethical issues related to the work

presented and include (in the Methods and Materials section of their manuscript) detailed information on the informed consent process, including the method or methods used to assess the subject's capacity to give informed consent, and safeguards included in the study design for protection of human subjects. Specifically, authors should consider all ethical issues relevant to their research, and briefly address each of these in their reports.

When relevant patient follow-up data are available, this should also be reported.

Specifically, investigators reporting on research involving human subjects or animals must have prior approval from an institutional review board. This approval should be mentioned in the methods section of the manuscript. In countries where institutional review boards are not available; the authors must include a statement that research was conducted in accordance with the Helsinki Declaration as revised 1989. All studies involving animals must state that the authors followed the guidelines for the use and care of laboratory animals of the author's institution or the National Research Council or any national law pertaining to animal research care.

Author Disclosure

Funding body agreements and policies Elsevier has established agreements and developed policies to allow authors whose articles appear in journals published by Elsevier, to comply with potential manuscript archiving requirements as specified as conditions of their grant awards. To learn more about existing agreements and policies please visit <http://www.elsevier.com/fundingbodies>

The second aspect of the Journal's new policy concerns the **Conflict of Interest**. ALL authors are requested to disclose any actual or potential conflict of interest including any financial, personal or other relationships with other people or organizations within three (3) years of beginning the work submitted that could inappropriately influence, or be perceived to influence, their work.

Examples of potential conflicts of interest which should be disclosed include employment, consultancies, stock ownership (except for personal investment purposes equal to the lesser of one percent (1%) or USD 5000), honoraria, paid expert testimony, patent applications, registrations, and grants. If there are no conflicts of interest, authors should state that there are none.

eg, Author Y owns shares in pharma company A. Author X and Z have consulted for pharma company B. All other authors declare that they have no conflicts of interest.

Finally, before the references, the Journal will publish **Acknowledgements**, in a separate section, and not as a footnote on the title page.

eg, We thank Mr A, who kindly provided the data necessary for our analysis, and Miss B, who assisted with the preparation and proof-reading of the manuscript.

The submitting author is also required to make a brief statement concerning each named

author's contributions to the paper under the heading **Contributors**. This statement is for editorial purposes only and will not be published with the article.

eg, Author X designed the study and wrote the protocol. Author Y managed the literature searches and analyses. Authors X and Z undertook the statistical analysis, and author W wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

NB. During the online submission process the author will be prompted to **upload these four mandatory author disclosures as separate items**. They will be automatically incorporated in the PDF builder of the online submission system. **Please do not include in the main manuscripts.**

References

References should be cited in text by authors' names and year of publication (Harvard system). When referring to a work of more than two authors, the name of the first author should be used with 'et al.'(examples: Brown, 1992; Brown and Bifulco, 1992; Brown et al., 1993, a, b).

All references cited in text should be listed at the end of the paper (double spaced) arranged in alphabetical order of first author. More than one paper from the same author in the same year should be identified by the letter (a, b, c, etc.) after the year of

publication.

The reference list should contain names and initials of all authors, year, title of paper referred to, abbreviated title of periodical (per Index Medicus), volume, and inclusive page numbers. This Journal should be cited in the list of references as *J. Affect. Disord.* Periodicals, books, and multi-author titles should accord with the following examples:

Bauer, M.S., Shea, N., McBride, L., Gavin, C., 1997. Predictors of service utilization in veterans with bipolar disorder: a prospective study. *J. Affect. Disord.* 44, 159-168.

Gelenberg, A.J., Bassuk, E.L., Schoonover, S.C., 1991. *The Practitioner's Guide to Psychoactive Drugs*. Plenum Medical Book Company, New York, NY.

Willner, P., 1995. Dopaminergic mechanisms in depression and mania. In: Bloom, F.E. and Kupfer, D.J. (Eds.), *Psychopharmacology: The Fourth Generation of Progress*. Raven Press, NY, pp. 921-931.

Figures and Photographs

Figures and Photographs of good quality should be submitted online as a separate file.

Please use a lettering that remains clearly readable even after reduction to about 66%. For every figure or photograph, a legend should be provided. All authors wishing to use illustrations already published must first obtain the permission of the author and publisher

and/or copyright holders and give precise reference to the original work. This permission must include the right to publish in electronic media.

Tables

Tables should be numbered consecutively with Arabic numerals and must be cited in the text in sequence. Each table, with an appropriate brief legend, comprehensible without reference to the text, should be typed on a separate page and uploaded online. Tables should be kept as simple as possible and wherever possible a graphical representation used instead. Table titles should be complete but brief. Information other than that defining the data should be presented as footnotes.

Please refer to the generic Elsevier artwork instructions: 

<http://authors.elsevier.com/artwork/jad>.

Preparation of supplementary data

Elsevier accepts electronic supplementary material to support and enhance your scientific research. Supplementary files offer the author additional possibilities to publish supporting applications, movies, animation sequences, high-resolution images, background datasets, sound clips and more. Supplementary files supplied will be published online alongside the electronic version of your article in Elsevier web products, including ScienceDirect:  <http://www.sciencedirect.com>. In order to ensure that your

submitted material is directly usable, please ensure that data is provided in one of our recommended file formats. Authors should submit the material in electronic format together with the article and supply a concise and descriptive caption for each file. For more detailed instructions please visit our Author Gateway at: <http://www.elsevier.com/authors>

<http://www.elsevier.com/authors>

Colour reproduction

The *Journal of Affective Disorders* is now also included in a new initiative from Elsevier: 'Colourful e-Products'. Through this initiative, figures that appear in black & white in print can appear in colour, online, in ScienceDirect at <http://www.sciencedirect.com>. There is no extra charge for authors who participate.

For colour reproduction in print, you will receive information regarding the costs from Elsevier after receipt of your accepted article. Please indicate your preference for colour in print or on the Web only. Because of technical complications which can arise by converting colour figures to "grey scale" (for the printed version should you not opt for colour in print) please submit in addition usable black and white versions of all the colour illustrations. For further information on the preparation of electronic artwork, please see <http://authors.elsevier.com/artwork/jad>.

Copyright Transfer

Upon acceptance of an article, you will be asked to transfer copyright (for more information on copyright see <http://authors.elsevier.com/journal/jad>). This transfer will ensure the widest possible dissemination of information. If excerpts from other copyrighted works are included in the submission, the author(s) must obtain written permission from the copyright owners and credit the source(s) in the article. Elsevier has preprinted forms for use by authors in these cases: contact Elsevier's Rights Department, Philadelphia, PA, USA: phone (+1) 215 238 7869, fax (+1) 215 238 2239, e-mail healthpermissions@elsevier.com.

Requests for materials from other Elsevier publications may also be completed on-line via the Elsevier homepage <http://www.elsevier.com/locate/permissions>

Proofs

One set of proofs in PDF format will be sent by email to the corresponding Author, to be checked for typesetting/editing. No changes in, or additions to, the accepted (and subsequently edited) manuscript will be allowed at this stage. Proofreading is solely your responsibility. A form with queries from the copyeditor may accompany your proofs.

Please answer all queries and make any corrections or additions required. The Publisher reserves the right to proceed with publication if corrections are not communicated.

Return corrections within 2 days of receipt of the proofs. Should there be no corrections, please confirm this.

Elsevier will do everything possible to get your article corrected and published as quickly and accurately as possible. In order to do this we need your help. When you receive the (PDF) proof of your article for correction, it is important to ensure that all of your corrections are sent back to us in one communication. Subsequent corrections will not be possible, so please ensure your first sending is complete. Note that this does not mean you have any less time to make your corrections, just that only one set of corrections will be accepted.

Reprints

The corresponding author, at no cost, will be provided with a PDF file of the article via e-mail. The PDF file is a watermarked version of the published article and includes a cover sheet with the journal cover image and a disclaimer outlining the terms and conditions of use. There are no page charges.

Author enquiries For enquiries relating to the submission of articles please visit Elsevier's Author Gateway at <http://authors.elsevier.com/journal/jad> . The Author Gateway also provides the facility to track accepted articles and set up e-mail alerts to inform you of when an article's status has changed, as well as detailed artwork guidelines, copyright information, frequently asked questions and more. Contact details for questions arising after acceptance of an article, especially those relating to proofs, are provided after registration of an article for publication.

Appendix B





Trial Participant Consent Form

Title of project: **ANTICIPATE**
A randomised trial of cognitive therapy for antenatal depression

Trial Registration number: ISRCTN44902048

Chief Investigator: [REDACTED]

PART 1: To be completed by ALL participants

- | | Please initial | |
|--|--------------------------|--------------------------|
| | ONE box | |
| | Yes | No |
| 1. I have read and understood the information sheet dated 28.05.10 (Version 1.3) for the above study, and been given a copy to keep | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. I have had the opportunity to consider the information, and ask any questions. I have had satisfactory answers to all of my questions | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. I have received enough information about the study | <input type="checkbox"/> | <input type="checkbox"/> |

Maternal Responsiveness and Women's Self Report to Infant Stimuli in Pregnancy

4. I understand that I may not be eligible to take part in the study
5. I understand that details of my participation will be stored anonymously on file and may be used in the final analysis of data
6. I agree to complete the screening assessments
7. I understand that my GP/midwife will be informed of my participation in the study
8. I agree for my contact details being given to members of the qualitative team so that they may contact me to arrange an interview about my expectations and experiences of the study and my booking appointment.

Name of Participant **Date** **Signature**
(BLOCK CAPITALS)

I have explained the study to the above participant and she has indicated her willingness to take part in the screening assessments.

Name of Researcher

Date

Signature

(BLOCK CAPITALS)

2 copies: 1 for participant; 1 for researcher site file (photocopy for medical records)

PART 2: To be completed by ELIGIBLE participants only

		Please initial ONE	
		box	
		Yes	No
7.	I give my permission for responsible individuals from the research team (researchers based at the University ██████████), to have access to any medical records for myself and my baby	<input type="checkbox"/>	<input type="checkbox"/>
8.	I understand that data collected during the study (including information from my medical records) may be looked at by responsible individuals from the research team, from regulatory authorities or from the NHS Trust, where it is relevant to my taking part in this research	<input type="checkbox"/>	
9.	I understand that my participation is voluntary, and that I am free to withdraw at any time, without giving any reason, and without my or my baby's medical care or legal rights being affected	<input type="checkbox"/>	
10.	I agree to take part in this study	<input type="checkbox"/>	<input type="checkbox"/>

To be completed by those receiving CBT

Maternal Responsiveness and Women's Self Report to Infant Stimuli in Pregnancy

11. I give my permission for any CBT treatment sessions to be audio-recorded for research purposes, including use in future research studies on CBT for depression. Audio files will be destroyed 5 years after the close of the study.
12. I give my permission for any CBT treatment sessions to be audio-recorded for teaching purposes. I understand that audio clips from these recordings may be used in presentations and that this might mean I am not completely anonymous if someone recognises my voice.

Name of Participant **Date** **Signature**
(BLOCK CAPITALS)

I have explained the study to the above participant and she has indicated her willingness to take part in the study.

Name of Researcher **Date** **Signature**
(BLOCK CAPITALS)

2 copies: 1 for participant; 1 for researcher site file (photocopy for medical records)



Trial Patient Information Sheet

ANTICIPATE

A randomised trial of cognitive therapy for antenatal depression

We would like to invite you to take part in a research study. Before you decide you need to understand why the research is being done and what it would involve for you. Please take time to read the following information carefully. Please ask us if there is anything that is not clear or if you would like more information.

What is the purpose of the study?

Many women experience low mood when they are pregnant. Little is known about the treatment of low mood during pregnancy. However, it is important to treat low mood as symptoms could affect the mother and baby. There is some evidence to suggest that a type of “talking therapy” called cognitive behavioural therapy (or CBT) may be helpful. To test this, we need to compare two approaches to treating depression by carrying out what is called a randomised controlled trial.

Why have I been asked to take part?

We are asking all pregnant women over 16 years of age who have stated at their first appointment with their midwife that they might like help with their low mood and asked to consider taking part in the study.

What will happen now?

Your midwife will pass on your contact details to the research team. A researcher will then contact you to arrange a visit to explain more about the study. If you are willing to take part you will be asked to complete a consent form. The researcher will then ask you to complete some questionnaires. These questionnaires will ask about your background, any history of depression and any physical and psychological symptoms you may be experiencing. You will also be asked to provide some additional information about yourself, your health and well-being. Finally, you will be asked to complete a simple task on the researcher's computer. This will involve reacting quickly to short displays of emotional baby faces and target lines in different locations on the computer screen and will take 5-10 minutes. You will also be asked to look at a series of faces and write down your response to them.

You will be given a copy of this information sheet and your consent form to keep. Whether or not you decide to take part you will continue to receive care as usual from your midwife or GP. If you agree to take part, you will then be randomly – that is, by chance - allocated to one of two groups to receive (1) CBT in addition to usual care or (2) usual care. The appointment will normally take no longer than 60 minutes. If you are not eligible for the study, or you do not want to take part, you will continue your usual care with your midwife.

What is cognitive behavioural therapy?

CBT is a type of talking therapy that has been shown to be helpful in treating low mood. It focuses on the difficulties you may be experiencing presently. CBT is based on the idea that people's thoughts and behaviours affect their mood. During CBT sessions, the patient and therapist discuss difficulties the patient

is experiencing and how thoughts and behaviours affect the problem. The patient and therapist then work together to find ways of helping the person cope with symptoms of depression. As part of this process, you may be asked to think about some of the issues discussed between sessions. We hope that CBT will help you develop ways of managing depression better. Please refer to the enclosed leaflet (Document 4, 'Cognitive Behavioural Therapy and Depression') explaining more about CBT for you to read.

Do I have to take part?

You do not have to take part in this study. If you have agreed to meet with the researcher, this will not commit you to taking part in the study. Similarly, if you complete the screening questionnaires during the appointment, this does not mean you are committed to taking part in the study. We hope that as many people as possible will take part, but it is up to you to decide. If you decide to take part you are still free to withdraw at any time, without giving a reason and this will not affect your medical care in any way.

What will happen to me if I take part?

You will meet with a researcher and complete some questionnaires, as described above, to see if the study is suitable for you. You will be put into one of two groups. As we need to be able to compare the two treatments it will not be possible for you or for the researcher to choose the treatment that you receive. The group that you will be part of will be determined by computer at random, in other words, by chance. Both groups will continue to receive usual care by their midwife/GP.

If you are included in Group 1: Your involvement in the study will last 33 weeks. You will be invited to:

- attend up to 12 once weekly one-to-one CBT sessions
- 60 minutes per sessions
- to take place at home or at your GP surgery or other NHS premises – at your choice
- During these sessions you will work with your therapist to develop ways of managing your low mood.

If you are included in Group 2: Your involvement in the study will last 33 weeks. You will be invited to:

- continue to be under the normal care of your midwife/ GP for the management of your low mood
- there will be no restrictions on the treatments that you can receive.

We will contact you by telephone 15 and 33 weeks after entering the study to arrange follow up meetings to ask you about your symptoms and to find out whether your low mood has improved or not. These meetings will normally last about 40-45 minutes.

At some point in the study, you may be invited to attend a face to face interview with a researcher to find out your views about the study and your views on the CBT. You can decide not to take part in this aspect of the research. If you agree to be interviewed, the interview will be held at a time and place that suits you.

The interview will normally last about an hour and will be recorded on a digital voice recorder so that we have an accurate record of the conversation. The sound file will be stored on a secure university computer and typed up by a secretary. Your personal information will be deleted from the written version so that you cannot be identified. Only members of the research team will have access to the recorded interview and typed transcript. What you say in the interview will not affect the care you receive from your midwife or GP in any way. You will not need to do anything to prepare for the interview. We simply want to find out your views.

Will you ask anything of me?

As part of the consent process, we will ask you for permission to access to your medical records held at your GP's surgery and any hospital records. If you agree, any information that we record from your medical records will have your name and address removed so that you cannot be recognised from it.

If you are in the group receiving CBT sessions, we will ask for your consent to record a session using a digital voice recorder. This will enable us to monitor the quality of the treatment that you are receiving. Your therapist will discuss the details of this with you. You do not have to take part this aspect of the research.

Are there any disadvantages of taking part in this study?

This is a randomised controlled trial therefore you cannot choose which group you wish to join. This will be determined by chance. Some of the questions that you will be asked during the assessment are personal and sometimes people can find it upsetting to discuss these issues. However, you don't have to answer anything you don't want to. The researcher will be able to offer support during the appointment if you are upset, but would also contact the midwives or GPs who normally provide care for you, if further support was necessary. There are no other disadvantages or risks associated with taking part in the study.

What are the possible benefits of taking part?

The results of the study will help midwives and GPs in the future to decide on the best treatment for women who experience low mood during their pregnancy. If you are put into the group receiving CBT, we hope that you find these sessions helpful. However, this cannot be guaranteed.

What happens when the study stops?

After the study is complete, we hope that your low mood will have improved. If not, your GP will continue to manage your treatment. Unfortunately, it will not be possible for us to offer everyone CBT at the end of the study. Your GP may be able to refer you for CBT or some other form of 'talking therapy' as part of your normal care.

What if there is a problem?

If you wish to complain about any aspect of the study, the way you have been approached or treated during the course of the study, please contact the Chief Investigator, [REDACTED] (on 0117 9546635) or your local research team (on 0117 3310748) who will try and resolve your issues or advise you on the

official complaints mechanisms available to you. CBT is a treatment that is already used within the NHS and so there are no special compensation arrangements. However, in the event that something did go wrong and you were harmed during the research, and this was due to someone's negligence, then you may have grounds for a legal action but you may have to pay your legal costs.

Alternatively contact your Patient Advisory and Liaison Service:

Phone:

website:

Phone:

Website:

Phone:

Website:

Who will know I am taking part in this study?

Your GP and midwife will be notified that you are taking part in the study.

Will my taking part in the study be kept confidential?

All the information you give as part of the study will be treated as confidential and will not be disclosed to anyone outside the research team. However, in exceptional circumstances, if we are concerned that you may harm yourself (or others), we may inform your GP or midwife because of possible risk to yourself (or to others). Where possible the research team would consult you before contacting your GP or midwife.

Procedures for handling, processing, storage and destruction of your data will be compliant with the Data Protection Act 1998.

What will happen to the results of the research study?

The results of the study will be published in health research journals. If you are interested in obtaining a copy of any publication, please feel free to contact us. We would like to assure you that you, as an individual, would not be identified in any study report or publication.

Who is organising and funding the research?

The study is organised by the Department of Community Based Medicine at the [REDACTED]. It is funded by a grant from the Research for Patient Benefit (RfPB) Programme, National Institute for Health Research. The study is also supported by the Mental Health Research Network (MHRN) for England, and the Primary Care Research Networks in England (PCRN).

Who has reviewed the study?

This study has been reviewed and approved by Southmead Research Ethics Committee.

Who do I contact for further information?

For further information about the study, please contact the ANTICIPATE Team at the [REDACTED] on [REDACTED].

Thank you for considering taking part in this research

Appendix C. Correlation analysis ABI and MRS

Rationale for Analysis

This analysis aimed to investigate the relationship between the more conscious MRS scales developed for this study, and women's less conscious attention bias index (ABI) (see Pearson et al. 2010 for a review of this methodology). Both measures were strongly independently related to depression.

Analysis

Scatter plots were used to examine the correlation between attention bias index scores (ABI) and maternal responses of turning away and comforting (MRS)

Results

There was no correlation between ABI and MRS responses. ABI showed a strong 'dose response' effect, with women with subthreshold symptomatology showing different ABI scores to non depressed women. This effect was not observed in the MRS data (see Figures 5-7).

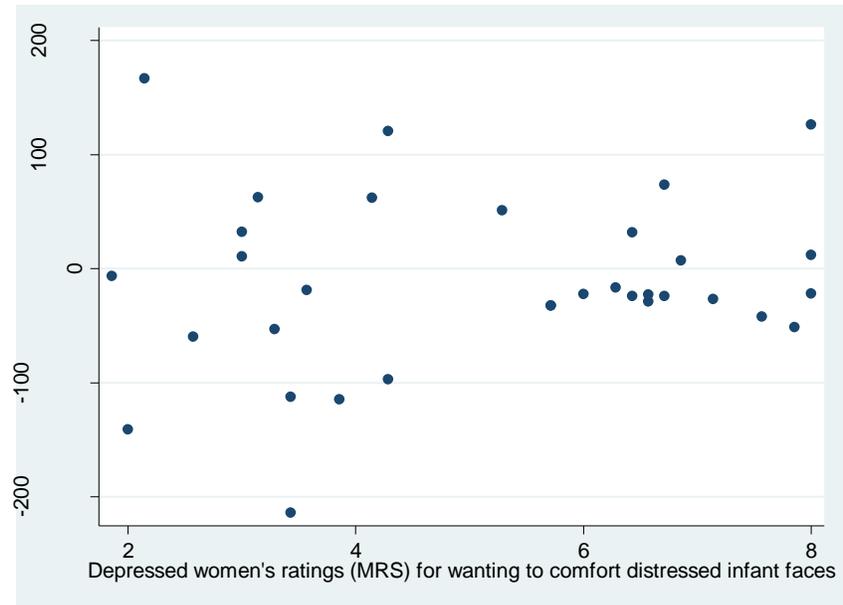


Figure 5. Scatter plot attention bias comforting distressed with depression

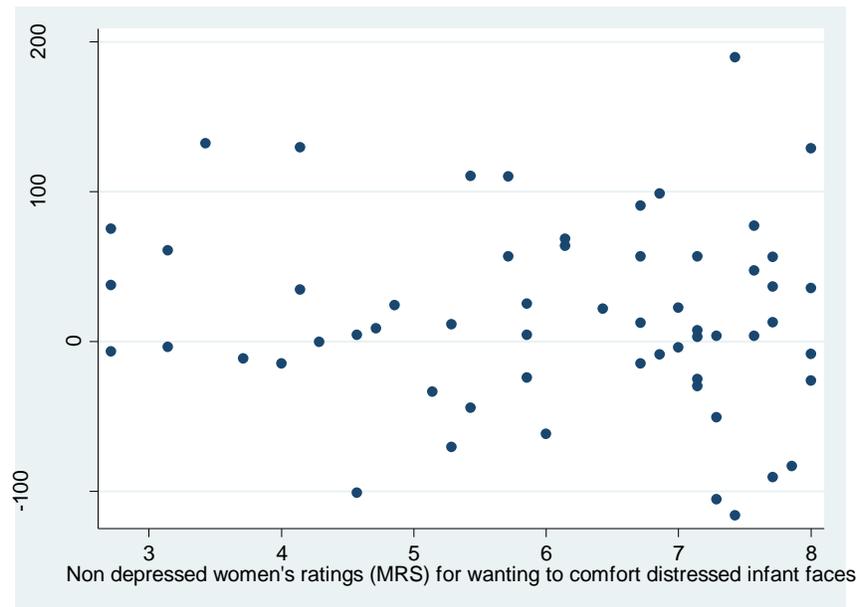


Figure 6. Scatter plot attention bias comforting distressed with non-depression

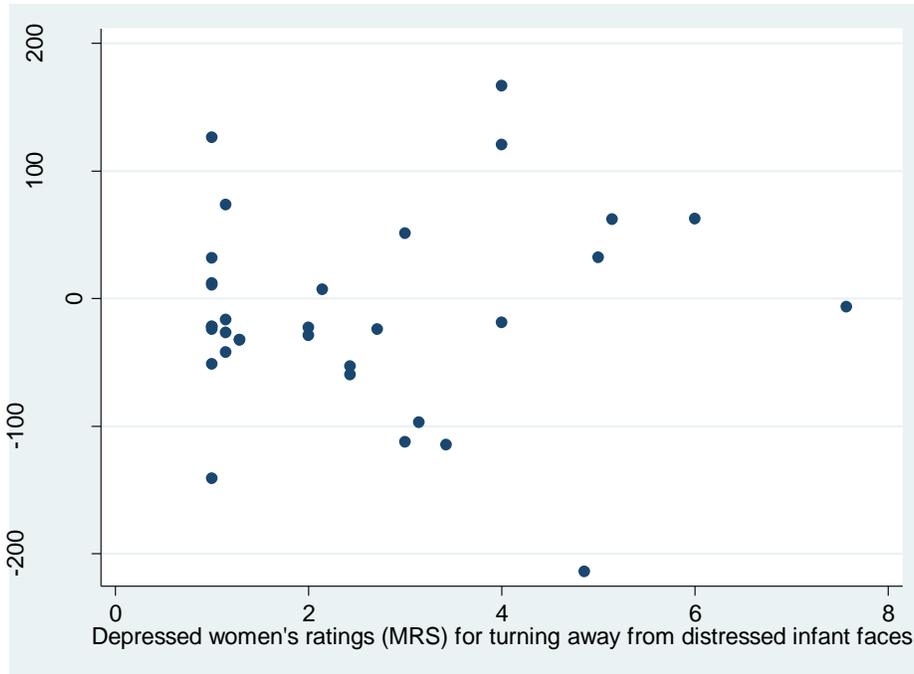


Figure 4. Scatter plot attention bias turning away distressed with depression

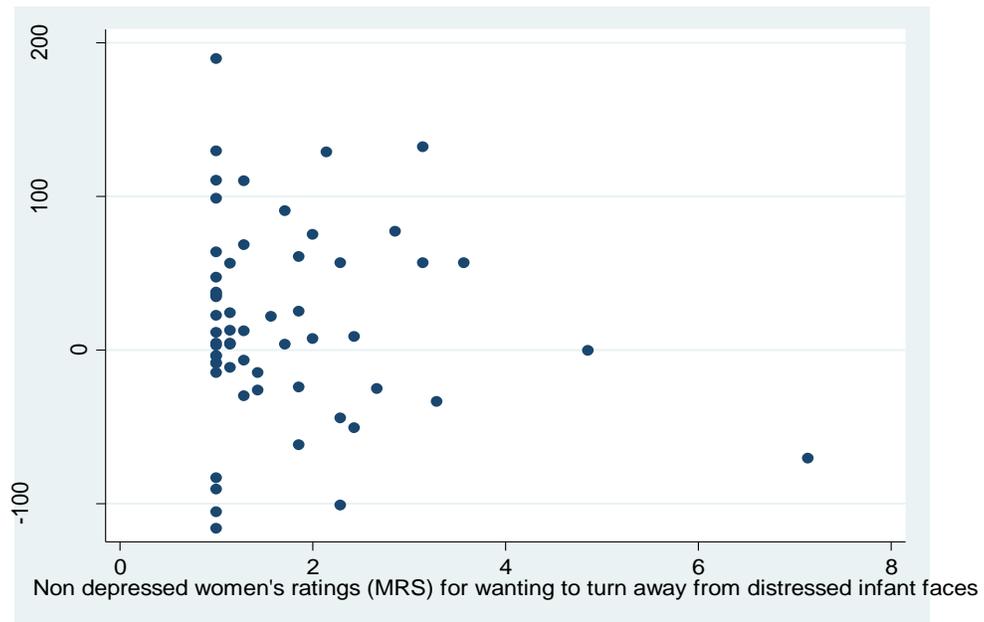


Figure 7. Scatter plot attention bias turning away distressed with non-depression

Appendix D.

Dissemination plan

Type/style of dissemination	Comments	Already completed (Time scale)	To be completed (Time scale)
Journal	To submit to the Journal of Affective Disorders		To be submitted September 2012
Community forums	Study presented at the Perinatal Mental Health Group (██████ group)	July 2011	
	Study presented at the GITCP, Exeter	November 2011	
Research summary	To be distributed to midwife and perinatal groups as appropriate		July-October 2012
Conferences/workshops	Invitation to The National Network for the Study of Infant Mental Health's conference's (Paris)		October 2012

