Webb, R. & Ayers, S. (2015). Cognitive biases in processing infant emotion by women with depression, anxiety and post-traumatic stress disorder in pregnancy or after birth: A systematic review. Cognition and Emotion, 29(7), pp. 1278-1294. doi: 10.1080/02699931.2014.977849

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Original citation: Webb, R. & Ayers, S. (2015). Cognitive biases in processing infant emotion by women with depression, anxiety and post-traumatic stress disorder in pregnancy or after birth: A systematic review. Cognition and Emotion, 29(7), pp. 1278-1294. doi: 10.1080/02699931.2014.977849

Permanent City Research Online URL: http://openaccess.city.ac.uk/5120/

Cognitive Biases in Processing Infant Emotion by Women with Depression, Anxiety and PTSD in Pregnancy or after Birth: A Systematic Review
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Abstract

Perinatal psychological problems such as postnatal depression are associated with poor mother-baby interaction but the reason for this is not clear. One explanation is that mothers with negative mood have biased processing of infant emotion. This review aimed to synthesise research on processing of infant emotion by pregnant or postnatal women with anxiety, depression or PTSD. Systematic searches were carried out on 11 electronic databases using terms related to negative affect, childbirth, and perception of emotion. Fourteen studies were identified which looked at the effect of depression, anxiety and PTSD on interpretation of infant emotional expressions ($k=10$), or reaction times when asked to ignore emotional expressions ($k=4$). Results suggest mothers with depression and anxiety are more likely to identify negative emotions (i.e. sadness) and less accurate at identifying positive emotions (i.e. happiness) in infant faces. Additionally, women with depression may disengage faster from positive and negative infant emotional expressions. Very few studies examined PTSD ($k=2$) but results suggest biases towards specific infant emotions may be influenced by characteristics of the traumatic event. The implications of this research for mother-infant interaction are explored.

Keywords: Anxiety, Major Depression, Perinatal Period, Cognitive Bias, Face Percept

Cognitive Biases in Processing Infant Emotion by Women with Depression, Anxiety and PTSD in Pregnancy or after Birth: A Systematic Review

Pregnancy and birth are significant life events that are predominantly positive experiences for the majority of women. However, a proportion of women suffer from psychological problems during this time. Reviews and meta-analyses suggest 10 to 15% of women report depression (Gavin et al., 2005) and 3% develop PTSD after birth (Grekin & O'Hara, 2014). Population studies of anxiety in pregnancy and after birth suggest up to 16% of women report severe anxiety in the postnatal period (Woolhouse, Brown, Krastev, Perlen, & Gunn, 2009) .

These psychological problems can have negative consequences for women and their infants. For example, Murray, Fiori-Cowley, Hooper, and Cooper (1996) investigated mother-infant interactions in women with and without depression, and found that mothers with depression were more likely to respond in a rejecting or an emotionally discordant way to their infant. Mothers with co-morbid anxiety and depression are more likely to have an infant with an insecure attachment (Carter, Garrity-Rokous, Chazan-Cohen, Little, & Briggs-Gowan, 2001). Furthermore, women with PTSD after birth are more likely to report their infant as being less warm, more invasive and more difficult in temperament (Davies, Slade, Wright, & Stewart, 2008).

The evidence demonstrates that maternal mental illness can have a negative impact on the mother-baby relationship. Research on postnatal depression suggests that this may be due to women with depression being less able to perceive and respond appropriately to their infant's emotional state (Field, 2010). This ability is key to maternal sensitivity (Eisenberg, Cumberland, & Spinrad, 1998; van Doesum, Hosman, Riksen-Walraven, & Hoefnagels, 2007), however, it is unclear why women with perinatal psychological problems are less able to achieve this. One reason may be due to information processing biases in mothers with mental illness. There is evidence to support this from research in non-pregnant or postnatal samples. For example, a recent meta-analysis concluded that people with mental illness display biased attention towards material that matches the concerns of the individual, such as threat-related stimuli for people with anxiety (Yiend, 2010). Research on perception of emotions also supports this idea, showing that people with depression are more likely to have their attention captured by negative faces (Gotlib, Krasnoperova, Yue, & Joormann, 2004; Joormann & Gotlib, 2007), and are less likely to recognise happiness in ambiguous faces (Bourke, Douglas, & Porter, 2010; Joormann & Gotlib, 2006). People with anxiety have been found to display attentional biases towards threatening or fearful faces (Fox, 2002; Georgiou et al., 2005; Gilboa-Schechtman, Foa, & Amir, 1999; Pishyar, Harris, & Menzies, 2004), are better at recognising fear (Surcinelli, Codispoti, Montebarocci, Rossi, & Baldaro, 2006) and have difficulty recognising positive emotions such as happiness (Silvia, Allan, Beauchamp, Maschauer, & Workman, 2006). Furthermore, people with PTSD have been found to be worse at recognising fear and sadness compared to controls (Poljac, Montagne, & de Haan, 2011).

Biases when processing emotions in others are likely to impact on relationships. Correlational research has found that the ability to accurately identify a facial emotion is associated with being more likely to see oneself as having warm and satisfying relationships with others (Carton, Kessler, & Pape, 1999). Therefore, it could be speculated that women with antenatal and postnatal psychological problems may have difficulty interpreting their infant's emotion because of mood-related cognitive biases, leading them to be less sensitive to their infant's needs. If a mother does experience difficulty in interpreting her infant's emotions, a secure attachment may be threatened (Cassidy, 1994), and could lead to negative consequences, such as poor developmental outcomes (Carter et al., 2001; Glasheen, Richardson, & Fabio, 2010;

Murray et al., 1996; Parfitt, Pike, & Ayers, 2014).

A number of research paradigms can be used to investigate cognitive biases when interpreting infant emotions for women in the perinatal period. These include biases interpreting infant emotion and reaction time (RT) paradigms. Paradigms which investigate interpretation of emotion require participants to label the emotion of a given face, and RT paradigms require participants to ignore a distracting image. By understanding whether women have any unconscious biases when processing infant emotion, and seeing whether these differences still occur when processing adult emotion, we can begin to understand the relationship between women's interpretation of their infant's emotional expressions, and its impact on their relationship with their infant. It is also important that cognitive biases in both pregnancy and the postnatal period are investigated. A woman's relationship with her baby is already forming in pregnancy and research has found that women who show greater attentional bias towards infant distress during late pregnancy report more successful mother-infant relationships after birth (Pearson, Lightman, & Evans, 2011).

However, research using the above paradigms with perinatal women, to understand cognitive biases is disparate and there are no reviews summarising available evidence. The aim of this paper is therefore to synthesise the evidence on the cognitive biases that pregnant and postnatal women with mental health difficulties exhibit when processing emotion in infant and/or adult faces.

Method

Eligibility Criteria

Inclusion criteria were that: 1) The sample was a group of either (or both) pregnant or postnatal (up to one year, to ensure inclusion of as many studies as possible) women with naturally occurring (i.e. not induced) depression, anxiety, or PTSD symptoms or diagnosis; 2) used a procedure in which the interpretation or processing of emotion in human adult or infant faces was measured behaviourally; 3) the main language of the article was English. Exclusion criteria were: 1) Animal studies.

Identification of Relevant Papers

Studies were identified by searching electronic databases, forward and backward searching, and searching through the grey literature. Limits of language (English only) and human research only were applied when databases allowed for this. The search was applied to the following databases: Academic Search Complete (1887 – Present), CINAHL Plus (1937 – Present); E – Journals (1885- Present), EMBASE (1974 – Present), Gender Studies Database (1972 – Present); Health and Psychosocial Instruments Database (1985 – Present), MEDLINE (1946 – Present); PubMed (1996 – Present), PsychARTICLES (1894 – Present);, PsycINFO (1597 – Present), SCOPUS (1823 – Present) and Web of Science (1900 – Present). Boolean search terms included, but were not limited to: *bias* or *emotion** or *express** and *depress** or *dysphor** and *"generali?ed anxiety disorder"* or *GAD* and *post-traumatic stress disorder* or *PTSD* . Please see supplemental materials for full list of search terms. The searches were carried out in July 2014.

Study Selection and Data Extraction

Duplicates were removed and studies were screened by abstract and title by one researcher for eligibility. Studies that were not eligible were excluded (see Figure 1). Full text of studies that appeared to meet criteria or where it was not clear was then examined by two researchers to determine whether they should be included in the review. Data extraction sheets were designed and piloted for the purposes of this systematic review. One review author extracted the following

data from the full text of the fourteen studies: 1) participant demographics; 2) the country in which the research took place; 3) recruitment procedure; 4) sample characteristics; 5) inclusion/ exclusion criteria of the study; 6) measure used for diagnosis; 7) whether a diagnosis was made; 8) experimental methods used; 9) results; 10) study limitations; and 11) any funding relevant to the aims of the study. This was then checked by a second author and any disagreements resolved through discussion.

Results

(Figure 1 about here)

Study selection and characteristics

The literature search provided a total of 152,581 citations. After screening through the abstracts, titles and full text fourteen studies remained for inclusion. Literature identified and reasons for exclusions are shown in Figure 1. Papers included in the review examined anxiety symptoms ($k=1$), depression ($k=5$), PTSD ($k=2$), anxiety and depression ($k=3$), or general distress symptoms ($k=3$). Sample sizes ranged from 45 to 195 with a total sample size of $N=1,255$. Studies were conducted in the United Kingdom ($k=6$), the United States ($k=4$), Croatia ($k=1$) France ($k=1$), Netherlands ($k=1$) and South Africa ($k=1$). A broad range of methodologies were used that could be categorised into two groups: (i) studies that looked at women's interpretation of facial emotion; (ii) studies that looked at women's reaction times when asked to ignore emotional faces.

(Table 1 about here)

Interpretation of emotion

Ten studies included a task designed to measure women's interpretation of facial emotion. These studies suggest women with depressive or anxious symptoms show differential accuracy in identifying emotions compared to controls. In both cases, women with anxiety or depressive symptoms appear to be biased towards identifying negative emotional expressions in infant faces, and may possibly be quicker at identifying negative emotions. For example, Stein et al. (2010) found that women with diagnosed depression rated negative and muted negative faces as more negative than controls. Additionally, Gil, Teissèdre, Chambres, and Droit-Volet (2011) found that mothers with high state anxiety were more likely to rate sad infant faces as being sadder, and mothers high in trait anxiety were more likely to rate neutral infant faces as being sad. There was also a trend for those with both anxiety and depression to be able to identify sadness in infant faces, when it was morphed with a happy face, before controls (Arteche et al., 2011). These biases appear to be specific to infant faces and are not observed when studies use stimuli with adult faces with depressed women (Flanagan, White, & Carter, 2011; Gil et al., 2011) or anxious women (Pearson, Lightman & Evans, 2009).

Three studies used the Infant Facial Expressions of Emotion from Looking at Pictures (IFEEL Pictures; Butterfield, Emde, & Osofsky, 1987) to look at perceptual biases when interpreting infant emotions in mothers with depression or a high level of negative affect. The IFEEL pictures is made up of 30 pictures of infants taken in a naturalistic setting. Participants are asked to label the emotions displayed using free response format. These responses are then encoded using a lexicon of emotion-related words (Butterfield & Ridgeway, 1993). Each word is placed into one of 12 categories: surprise-interest-joy-content-passive-sad-cautious/shy-disgust-dislike/anger-distress-fear-other. These results are then either compared to a reference sample (Applebaum, Butterfield, & Culp, 1993) or control groups.

The results of these studies are consistent with the previous studies in that women with depression were more likely to label faces as negative compared to controls and reference samples (Broth, Goodman, Hall & Rayner, 2004; Zahn-Waxler & Wagner, 1993). Higher levels of

negative affect were also associated with mothers labelling more infant faces as negative (van Bakel et al. (2013).

With regards to identifying positive emotions the results are inconsistent. For example, Stein et al. (2010) and Gil et al. (2011) found no effect of depressive symptoms on identifying positive emotions. However, Arteche et al. (2011) found that women with depression were less accurate at identifying happiness in infant faces. Similar results are found for anxiety with Arteche et al. (2011) and Stein et al. (2010) finding a trend for mothers with diagnosed anxiety to be less accurate at identifying happy infant faces than controls. However, Gil et al. (2011) and Pearson, Lightman, and Evans (2009) found that anxiety symptoms had no influence on the identification of happiness in either adult or infant faces.

Two studies looked at the effect PTSD has when interpreting infant emotions. Both studies use the IFEEL pictures and results suggest characteristics of the trauma may affect women's processing of emotion. Bernstein, Tenedios, Laurent, Measelle, and Ablow (2014) found women who experienced traumatic events involving betrayal in adulthood and had PTSD symptoms rated less infant faces as being sad when using the IFEEL pictures. On the other hand, Kne?eviá and Jovan?evi? (2004) found that women who had experienced interrogations or had witnessed violence were less likely to perceive infant faces as being passive. Conversely women who had been wounded or who had a war related illness were more likely to perceive fear in infant faces. These results suggest the type of trauma exposure influences emotional perception.

Reaction Time Paradigms

Four studies investigated women's reaction time when asked to ignore emotional faces (Pearson, Cooper, Penton-Voak, Lightman, & Evans, 2010; Pearson et al., 2013; Roos et al., 2012; Thompson-Booth et al., 2014). Two studies (Pearson et al., 2010; Pearson et al., 2013) used a Go/No-go paradigm, which required participants to look at a distracting image on the centre of the screen and disengage from this to identify a vertical line elsewhere on the screen. The remaining two studies used a measure to assess how distracted participants were by the emotional stimuli. For example, Roos et al. (2012) used a Stroop paradigm, where adult faces were displayed using different colours, and participants were required to ignore the face and label the colour it was presented in. Thompson-Booth et al. (2014) used a visual search task, in which participants were required to identify the target blue-eyed face, out of an array of three faces, and state which way round the face was rotated.

Both disengagement paradigms recruited pregnant women with depressive symptoms and found that these women were faster at identifying the vertical line when the distracting image was a distressed (i.e. actively crying) infant face (Pearson et al., 2010; Pearson et al., 2013). This was interpreted as reflecting the fact that women with depressive symptoms during pregnancy have a diminished attentional bias towards distressed infant faces

The remaining studies recruited women with symptoms of distress in pregnancy or in the postnatal period. Roos et al. (2012) found that distressed pregnant women reacted faster to fearful adult faces than controls. On the other hand, Thompson-Booth et al. (2014) found no differences in terms of parenting distress when suppressing attention from adult faces compared to controls. However they did find women with high level of parenting distress were faster to label the rotation of an emotional infant face.

Antenatal and Postnatal Differences in Cognitive Biases

Identifying patterns across the antenatal and postnatal period is difficult due to the small number of studies available. However, when comparing across emotions some interesting patterns emerge. For example, pregnant anxious women are more accurate at labelling anger in adult faces

(Pearson et al., 2009) and react faster to angry adult faces (Pearson et al., 2099) than postnatal women (Gil et al., 2011).

Additionally, a pattern was found for women with negative affect to be less easily distracted by infant emotion in both the antenatal and postnatal period, with three studies finding that pregnant and postnatal women with symptoms of distress were faster to disengage attention from infant emotional expressions than controls (Pearson et al. (2010) Pearson et al. (2013) Thompson-Booth et al. (2014). This suggests that women with depression and negative affect in both pregnancy and the postnatal period are less distracted by infant emotion.

Discussion

The results from this review suggest perinatal symptoms of anxiety, depression and PTSD are associated with cognitive biases in recognising emotional expressions. Postnatal women with depressive and anxiety symptoms appear to be more sensitive towards sad infant faces (Arteche et al., 2011; Gil et al., 2011; Stein et al., 2010) compared to happy infant faces (Arteche et al., 2011; Steine et al., 2011). This sensitivity is less apparent when adult faces are used as stimuli (Flanagan, White, & Carter, 2011; Gil et al., 2011; Pearson et al., 2009; Stein et al., 2010). In terms of perceptual biases, mothers with symptoms of depression or negative affect are more likely to interpret infant faces as being negative compared to controls (Broth et al., 2004; van Bakel et al., 2013; Zahn-Waxler & Wagner, 1993). Additionally, both pregnant and postnatal women seem to be less easily distracted by infant emotional expressions (Pearson et al., 2010; Pearson et al., 2013; Thompson-Booth et al., 2014), and differential patterns emerge when processing angry adult faces across the antenatal (Pearson et al., 2009; Roos et al., 2012) and postnatal period (Gil et al., 2011).

The results can inform our understanding of the poor sensitivity displayed by mothers with postnatal mental health difficulties (Carter et al., 2001; Davies et al., 2008; Murray et al., 1996). For example, maternal sensitivity is dependent on a mother's ability to perceive and respond appropriately to her infant's emotional displays (Eisenberg et al., 1998; Shin, Park, Ryu, & Seomun, 2008; van Doesum et al., 2007). This review suggests that mothers with depression are more likely to perceive negativity in infant faces, and those with depression and anxiety symptoms have a heightened sensitivity towards negative emotions, as well as have difficulty identifying positive emotions. Women may be more likely to recognise and respond to their baby's negative emotions leading them to act in an emotionally concordant way. Therefore, it could be speculated that the infant is more likely to display sadness, as their mother is more responsive to this, reinforcing expression of sadness by the infant. Therefore, these cognitive biases may be influential in problems in the mother-infant interaction.

Two findings from this review have important implications; however with limited findings only tentative conclusions can be drawn. Firstly, the results suggest that biases found in the perinatal period in women with psychological problems are specific to infant emotion (Arteche et al., 2011; Gil et al., 2011; Pearson et al., 2010; Pearson et al., 2013; Stein et al., 2010). These findings imply that biases when interpreting infant emotion could lead to difficulty in forming or maintaining relationships with infants but not adults. However, very few studies examined biases on adult faces in the perinatal period (Flanagan et al., 2011; Gil et al., 2011; Pearson et al., 2010; Pearson et al., 2009; Thompson-Booth et al., 2014) therefore more research is needed before conclusions can be drawn. The findings with regards to the impact of PTSD in interpreting infant emotion also have important implications. These results suggest that biases for women with PTSD are different to those observed in anxiety and depression, but also may be dependent on the

trauma type or characteristics (Bernstein et al., 2014; Kne?eviá & Jovan?evi?, 2004). The results suggest that mother's may be more biased towards perceiving certain emotional expressions which may then play out when a mother is interacting with her infant, again leading to less sensitivity towards her infants needs. However, more research is needed to confirm any patterns.

Before drawing conclusions some general limitations need to be considered. Firstly, only 14 relevant studies were identified and included in this review, and they differ widely in the methodology and sampling. For example, some studies used structured clinical interviews to diagnose psychological problems, whereas others used questionnaire designs to assess symptoms. Additionally, only two studies controlled for differences between anxiety and depression (Arteche et al., 2011; Stein et al., 2010) and only one drew a distinction between major depressive disorder with and without a postnatal onset (Flanagan et al., 2011) Furthermore, the stimuli used in each study differed both in terms of the photos and the emotion displayed. For example, all but one study used happy faces, whereas only two studies used surprise. Finally, even though the studies could be categorised into accuracy and disengagement tasks, different cognitive tasks were used within these categories. For example, two accuracy tasks used morphing paradigms, whereas the others did not. These differences in methodology are likely to have influenced the findings in some way.

These limitations show the need for future research to address a number of issues. Firstly, research should focus on standardising the diagnostic tool used, such as whether a clinical interview or diagnostic questionnaire is implemented. Secondly, more research should examine cognitive biases during pregnancy and after birth, including controlling for the onset of mental illness. Thirdly, stimuli and methodology should be standardised so studies are comparable and conclusions can be drawn. Finally, research on women with PTSD needs to consider the role of trauma characteristics in biases in the perception of infant emotions so this can be clarified. Addressing these limitations could provide key insights into the attentional biases displayed by mothers allowing firmer conclusions to be drawn.

In conclusion, this review provides preliminary evidence that pregnant or postnatal women with anxiety or depression have difficulty identifying positive infant emotions, yet are more accurate at recognising negative infant emotion. Additionally, mothers with depression display a perceptual bias in interpreting infant emotion, in that they perceive more negative emotions than controls. Furthermore the results provide some evidence that pregnant women with depressive symptoms are faster to disengage from infant emotional expressions. These biases may partially explain the reduced sensitivity displayed by mothers with depression, anxiety, or PTSD when interacting with their infant. The bias towards recognition of negative emotions may mean mothers reinforce these emotions in their infants. This interaction may then become circular leading to difficulties in the mother-infant interaction. Although there are many methodological issues to consider when drawing conclusions, the results suggest the need for further research in this area in order to inform treatment of perinatal depression, anxiety and PTSD and poor mother-infant interactions.

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Table 1

Overview of Studies Reviewed

Article citation	Country	n	

Search 2: anxiety

Attention*	Anxiety	Pregnan*	
Bias	Anxious	Antenatal	
"Selective	GAD	Perinatal	
attention"	Generali?ed	Birth	
Cognitive	anxiety disorder	Birth-related	
Percept*	Worry	Child-bearing	
"Negative stimuli"	Fear	Postnatal	
	Stress	Postpartum	
Emotion*	"Affective	Mother	
Infant	disorder"	Maternal	
Baby			
Babies			
Adult			
Face*			
Facial			
Processing			
Interpretation			
Expression			

Search 3: PTSD

Attention*	Anxiety	Pregnan*	
Bias	Anxious	Antenatal	
"Selective	GAD	Perinatal	
attention"	Generali?ed	Birth	
Cognitive	anxiety disorder	Birth-related	
Percept*	Worry	Child-bearing	
"Negative stimuli"	Fear	Postnatal	
	Stress	Postpartum	
Emotion*	"Affective	Mother	
Infant	disorder"	Maternal	
Baby			
Babies			
Adult			
Face*			
Facial			
Processing			
Interpretation			
Expression			

Identification

Records identified through database searching (Academic Search Complete; CINAHL; Gender Studies Database; MEDLINE; Psycharticles; Psychinfo; Scopus and Embase
(n = 152,580)

Screening

Full-text articles excluded, with reasons
(n = 3)

- Line drawings of faces used rather than human faces (n = 1)
- Mental illness measured was not a mood disorder (n = 1)
- Measured mood disorder but excluded this in the analysis (n = 1)

Records excluded with reasons
(n = 51,812)

- Not primary research (n = 16,412)
- Sample not postnatal or pregnant women (n = 11,262)
- Correct sample but no measure of psychopathology (n = 12,820)
- Correct sample and measure of psychopathology, but no measure of maternal cognitive bias (n = 11,274)
- Correct sample and measures but faces not used as the stimuli (n = 38)
- Correct sample and measures but only neural correlates of facial interpretation investigated (n = 6)

Records after duplicates removed

(n = 65,508)

Records after animal studies and

non-English articles removed
(n = 51,829)

Additional records identified through other sources (grey literature; forward and backward searching)
(n = 1)

Records screened by title
(n = 51,829)

Full-text articles assessed for eligibility
(n =17)

Studies included in the review
(n = 14)

Eligibility

Included