

Interpreting infant emotional expressions: Parenthood has differential effects on men and women

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ABSTRACT

Interpreting and responding to an infant's emotional cues is a fundamental parenting skill. Responsivity to infant cues is frequently disrupted in depression, impacting negatively on child outcomes, which underscores its importance. It is widely assumed that women, and in particular mothers, show greater attunement to infants than do men. However, empirical evidence for sex and parental status effects, particularly in relation to perception of infant emotion, has been lacking. In this study, men and women with and without young infants were asked to rate valence in a range of infant facial expressions, on a scale of very positive to very negative. Results suggested complex interaction effects between parental status, sex, and the facial expression being rated. Mothers provided more positive ratings of the happy expressions and more extreme ratings of the intense emotion expressions than fathers, but non-mothers and non-fathers did not. Low-level depressive symptoms were also found to correlate with more negative ratings of negative infant facial expressions across the entire sample. Overall, these results suggest that parental status might have differential effects on men and women's appraisal of infant cues. Differences between fathers' and mothers' perceptions of infant emotion might be of interest in understanding variance in interaction styles, such as proportion of time spent in play.

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Females undertake the principal rearing of offspring in the vast majority of mammalian species (95%; Geary, 2000). One unique aspect of human rearing is the relatively high, and indeed increasing, involvement of fathers (Saturn, 2014). This observed cross-species difference and the societal shifts that have promoted male roles in infant care have spurred an increased interest in fathers' roles in their infants' development (e.g., Ramchandani et al., 2013). Much of this work has demonstrated that fathers can have a unique contribution to their children's early behaviour and development (DeKlyen, Biernbaum, Speltz, & Greenberg, 1998; M. Lamb & Tamis-LeMonda, 2004; M. E. Lamb, 1982; Lewis &

Lamb, 2003; Ramchandani, Stein, Evans, & O'Connor, 2005).

This interest in fathers' roles has grown alongside a body of literature examining sex differences in responding to infants. Much of this work has been motivated by questions about men's capacity and interest in providing care. One line of work has largely focused on sensitivity to cuteness and the physical features of the face (Glocker et al., 2009; Lobmaier, Sprengelmeyer, Wiffen, & Perrett, 2010; Parsons et al., 2011; Sprengelmeyer, Lewis, Hahn, & Perrett, 2013; Sprengelmeyer et al., 2009). This is important because infant features are thought to orient adult attention to the infant, thereby eliciting care (Lorenz,

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1943). As with many studies of sex differences, findings suggest a complex picture. One of the most striking findings to emerge is that women are better at infant cuteness discrimination than men (Lobmaier et al., 2010; Sprengelmeyer et al., 2009) and give higher explicit ratings of cuteness (“liking”, e.g., Charles, Alexander, & Saenz, 2013; Parsons, Young, Murray, Stein, & Kringelbach, 2010). Other work has reported that women evaluated infant images more positively than did men (Lehmann, Huis in’t Veld, & Vingerhoets, 2013).

However, a number of studies have found that men and women do not differ on their willingness to work to view an infant face (“motivational salience”, Parsons et al., 2011; Sprengelmeyer et al., 2013; Yamamoto, Ariely, Chi, Langleben, & Elman, 2009; however see Charles et al., 2013; Hahn, Xiao, Sprengelmeyer, & Perrett, 2013). Two studies examining eye movements in response to infant face presentations also reported no differences between the sexes (Borgi, Cogliati-Dezza, Brelsford, Meints, & Cirulli, 2014; Charles et al., 2013). One study, however, reported no main effect for viewer sex, but an interaction between sex of viewer and experimental viewing condition (pairing the infant image with another male or female adult image) on eye movements (Cárdenas, Harris, & Becker, 2013). Men had a positive infant viewing bias only when the infant was presented with a male face, but women showed a positive infant viewing bias for both conditions. This study highlights the complexity and subtle nature of sex differences. In addition, Brosch, Sander, and Scherer (2007) reported no sex differences in attentional bias to infant faces using a dot probe task. Results from neuroimaging studies have also been similarly mixed. Some neuroimaging studies have found that females are more responsive than males when viewing unfamiliar infant faces (e.g., Proverbio, Zani, & Adorni, 2008), other work has found effects in the opposite direction (e.g., Weisman, Feldman, & Goldstein, 2012), and some has reported no difference (e.g., Kringelbach et al., 2008).

While these studies have focused on general preference for, and attention to, infant faces, far less is known about sex differences in responding to infant emotional expressions, particularly in parents. This is important because caregiving interactions depend on the adult’s ability to respond appropriately to an infant’s communicative signals, which are largely non-verbal. Sex differences in cuteness perception, for instance, might mean that men and women

orient to an infant in different ways. However, facial expressions are important communicative signals (Frith, 2009) that can shape the trajectory of social interactions (Fridlund, 1994). Indeed, Darwin (1872) argued that the interpretation of facial expressions is an essential component of human interaction, and the way an adult perceives an expression will shape their subsequent responses. If men and women appraise facial expressions in different ways, this might have consequences for caregiving interactions. There has been some work suggesting greater accuracy for women over men in the recognition of specific face expressions (e.g., surprise and anger) but not others (joy, sadness; in university students, Babchuk, Hames, & Thompson, 1985; see also Proverbio, Matarazzo, Brignone, Del Zotto, & Zani, 2007). Furthermore, Proverbio, Brignone, Matarazzo, Del Zotto, and Zani (2006) reported an advantage for mothers over fathers in categorizing infant faces as either positive or negative, but not non-mothers over non-fathers.

Studies comparing caregiving interactions in fathers and mothers have consistently reported differences in their typical interaction styles. For instance, fathers spend a higher proportion of their interacting time in play than mothers. Their style of interaction tends to be more physically stimulating and unpredictable than mothers’ (Lewis & Lamb, 2003). In addition, fathers have been shown to use more tactile stimulation, whereas mothers use more social and object play (Parke & Tinsley, 1987). Fathers make more comments related to infant problem solving, while mothers make more comments taking the infant’s perspective (Lundy, 2003). In a recent study, Abraham et al. (2014) reported that primary caregiving fathers engaged in all of the caregiving roles more so than secondary caregiving fathers, with the exception of playing and holding. As with mothers, higher paternal sensitivity to the infant predicts better behavioural and psychological outcomes for children later in development (Grossmann et al., 2002; Trautmann-Vilalba, Gschwendt, Schmidt, & Laucht, 2006).

While there has been limited direct evidence comparing perception of infant emotion in men and women, there is a substantial body of literature regarding perception of emotion in the adult face. In general, findings suggest that there are sex differences in emotion identification (Hall, 1978; Kirouac & Dore, 1985; Nowicki & Hartigan, 1988). A recent meta-analysis demonstrated that, overall, females have a small advantage in emotion recognition (Thompson & Voyer, 2014). However, this review showed that the size of the sex

difference was moderated by several factors, including the specific emotion examined and the emotion type (negative, positive). Of potential relevance to the study of infant emotion is the finding that women have a greater advantage in processing negative emotion than positive emotion.

The impact of parenthood

In addition to sex differences, few studies have addressed whether parenthood has differential effects on men and women's responses to infant faces. This is of particular interest because of the endocrine changes accompanying birth in women, the differences in interaction style, and the importance of these interactions for infant outcomes. Furthermore, humans differ substantially from other species in their response to infants prior to parenthood. In other species, infant-directed aggression and aversion are prevalent in virgin animals (see Rilling and Young, 2014 for review). By contrast, the human response, parent or not, towards infants is near universally positive.

A number of neuroimaging studies have highlighted the similarities in response to infant stimuli (typically faces) across parents and non-parents. For example, one of the most consistent findings from functional magnetic resonance imaging (fMRI) studies is activity in the reward-related mesolimbic dopamine system (i.e., ventral tegmental area, VTA; nucleus accumbens; and medial orbitofrontal cortex) in parents in response to images or videos of infants (for review, see Parsons, Stark, Young, Stein, & Kringelbach, 2013; Parsons et al., 2010). This activity has been positively correlated with sensitive parenting behaviours (Glocker et al., 2009; Mascaro, Hackett, & Rilling, 2013; Michalska et al., 2014; Rilling, 2013). Nevertheless, hormones, pregnancy-related changes, and social learning, together with caregiving experience, may act to intensify or heighten responses to infants. The question of whether parental status affects processing of emotional cues from the infant is of importance, because it may have implications for caregiving interactions.

Effects of depressive symptoms on facial emotion appraisal

There has been much interest in understanding how caregiving behaviour can be adversely affected by depression, because of long-term implications for child development (Bakermans-Kranenburg, Van

Ijzendoorn, & Juffer, 2003; Murray, Hipwell, Hooper, Stein, & Cooper, 1996). There is some emerging evidence that mothers with postnatal depression have difficulties interpreting negative infant facial expressions (Stein et al., 2010). This is consistent with studies on appraisal of adult facial expressions, which have tended to show that there is a bias in interpreting faces with negative valence in depression (Bouhuys, Bloem, & Groothuis, 1995; George et al., 1998). One other study examining infant faces reported that while non-depressed pregnant women showed an engagement bias towards distressed infant faces, depressed women tended to disengage more quickly from the images (Pearson, Cooper, Penton-Voak, Lightman, & Evans, 2010). To date, there has been little exploration of the effects of depressive symptoms in fathers, or men who are not yet fathers, on responses to infant facial emotion. Furthermore, these studies have typically examined participants with clinical levels of depressive symptoms. It remains to be seen if subclinical or low levels of depressive symptoms might also have an impact on the perception of emotion in infant faces.

The present study aimed to examine the effects of a number of inter-related factors (sex, parenthood, and symptoms of depression) on appraisal of emotion in the infant face. While previous studies have focused on appraisal of physical features of the infant face, we focus here on emotional expressions. This is because parental sensitivity to infant communicative cues has been identified as an important determinant of the quality of caregiving (for review, see Murray, Halligan, & Cooper, 2010). There is evidence that interpretation of infant facial expressions is specifically disrupted in conditions shown to adversely affect the quality of parent–infant interactions (Arteche et al., 2011; Stein et al., 2010). Finally, we examined adults' appraisal of universal infant facial emotions (negative/sad, neutral, positive/happy) at different intensities (muted negative, most negative, muted positive, most positive). This is important because it extends beyond previous work examining more basic categorization accuracy (e.g., two-alternative forced-choice tasks, Proverbio et al., 2006) and allows for examination of more subtle differences in evaluation. We hypothesized that there would be differences in the perception of emotion in infant faces, dependent on the sex of the rater and their parental status. Furthermore, we hypothesized that depression symptoms in a community sample would be associated with more negative ratings of negative

infant facial expressions (muted negative and most negative).

Experimental study

Method

Ethical approval for the study was granted by the Ethics Committee of Central Region Denmark.

Participants

Participants were recruited from the general community in Aarhus using posters, online advertisements, and social media. All provided written informed consent for participation. Inclusion criteria for participation were: not currently experiencing any psychological or physical conditions, not taking medication affecting the brain, no problems with hearing, normal vision or vision corrected to normal. Participants were aged between 21 and 39 years ($M = 28.76$, $SD = 3.69$). All of the fathers and mothers had infants aged less than 18 months ($M = 8.1$ months, $SD = 4.43$), to ensure current infant caregiving experience. The majority were first-time parents (23 mothers, 19 fathers), but 6 fathers and 6 mothers had two children, and one father had three. A total of 110 men and women participated (see Table 1 for further demographic information).

Beck Depression Inventory

The Beck Depression Inventory (BDI) is a frequently used measure of depressive symptoms with high internal consistency and clinical sensitivity (Beck, Steer, & Carbin, 1988).

Stimuli and procedure

The experimental task was presented on a standard desktop monitor via Presentation software (Version 14.4 Neurobehavioral Systems, Inc.). The task was to rate the emotional expression of each face, from very positive/happy, to very negative/sad (see Figure 1; as reported Stein et al., 2010; Stein et al., 2012). Images were taken from a database of videos of infants filmed at home, with an average age of 7.8 months ($SD = 2.7$) making different facial expressions (rated by a large sample of adults, Kringelbach et al., 2008). From the videos, muted positive faces were chosen to be midway in expression between neutral and most positive, and muted negative faces were chosen to be midway between neutral and most

negative. Faces were shown as greyscale images and were matched for size and luminosity.

Participants were presented with a face image on the centre of a screen and a vertical visual analogue scale (VAS) to the right. Fifty infant face stimuli were used in the study, 10 different infants presenting an expression for each of five target emotions (positive, muted positive, neutral, muted negative, negative). The ratings bar started at the midpoint on the scale (at “neutral”, halfway between “very positive” and “very negative”), and participants adjusted the height of this bar using the “up” and “down” arrows on a standard keyboard. One keypress started the bar moving, and one key press stopped it. Scores ranged from a maximum of +4 (very positive) to a minimum of -4 (very negative), with intervals of .0025. Participants had a maximum of 5 s to rate each stimulus.

Results

Data analysis

Distributions of mean ratings for each facial expression were examined for each participant category (fathers, non-fathers, mothers, non-mothers). Removal of data from three participants, which fell more than 3 standard deviations from the mean, resulted in distributions meeting the criteria for normality, as confirmed by Kolmogorov–Smirnov tests. Parametric tests are therefore used throughout.

Parental status, gender, and facial expression interaction

Ratings were analysed using mixed analyses of variance (ANOVAs) with gender and parental status as between-subjects variables and facial expression (most positive/happy, muted positive/happy, neutral, muted negative/sad, most negative/sad) as a within-subjects variable. There was a significant three-way interaction effect between facial expression, gender, and parental status, $F(4, 408) = 2.43$, $p = .04$, $\eta_p^2 = .02$. There was also an interaction effect between facial expression and gender, $F(4, 408) = 2.57$, $p = .038$, $\eta_p^2 = .02$. The interaction between parental status and facial expression was not significant, $F(4, 408) = 0.75$, $p = .56$, $\eta_p^2 = .007$. The main effect of facial expression was significant, $F(4, 408) = 2031$, $p < .0001$, $\eta_p^2 = .95$, indicating that mean ratings were different across the five facial expression categories (more positive for happy expressions, more negative for sad expressions).

Table 1. Participants by parental status and gender

Measure	Mothers	Non-mothers	Fathers	Non-fathers
Number	29	29	26	26
Age (years)	29.41 (3.37)	26.45 (2.37)	27.84 (8.2)	28.07 (3.34)
Beck Depression Inventory	4.28 (3.58)	3.36 (2.97)	3.27 (3)	2.3 (2.42)
Age of infants (months)	8.41 (3.36)	—	7.81 (5.38)	—

Means are shown, with standard deviations in parentheses.

To investigate further the three-way interaction effect, the data were divided by parental status. This was done to determine whether the sex by face expression interaction effect was significant in both the parent and non-parent groups. The interaction between sex and face expression was significant in the parent group, $F(4, 200) = 3.41$, $p = .01$, $\eta_p^2 = .06$, but not in the non-parent group, $F(4, 200) = 1.35$, $p = .25$, $\eta_p^2 = .03$. This suggests that mothers and fathers differed in their ratings of different infant facial expressions, but non-mothers and non-fathers did not. A clear difference between mothers and fathers occurred in response to the happy faces. Mothers rated the most positive/happy faces more positively than did fathers, $t(52) = 2.3$, $p = .02$, $d = 0.64$, and also a combined category of “muted happy and most happy” faces more positively than did fathers, $t(52) = 2.26$, $p = .03$, $d = 0.62$. Furthermore, examining ratings of the most intense emotion faces (most negative, most positive), mothers provided more extreme ratings than fathers, $t(52) = 2.1$, $p = .04$, $d = 0.6$. This difference was not apparent for non-mothers and non-fathers. There were no other significant differences for the facial expressions [muted positive/happy, $t(53) = 1.55$, $p = .12$; neutral, $t(53) = 0.7$, $p = .48$; muted negative/sad, $t(53) = 1.6$, $p = .11$; most negative/sad, $t(53) = 1.22$, $p = .22$] between mothers and fathers.

As can be seen in Figure 2, participants rated the five facial expression categories differently. Ratings of each of the five facial expressions were examined using univariate ANOVAs, with two between-subjects variables (sex, parent). For the most positive/happy faces, there was a significant effect of sex, $F(1, 103) = 5.12$, $p = .02$, $\eta_p^2 = .05$, with women giving higher ratings than men for the most positive faces. There was no main effect of parental status, $F(1, 103) = 0.05$, $p = .83$, $\eta_p^2 = .0001$, and no interaction between sex and parental status, $F(1, 103) = 1.14$, $p = .29$, $\eta_p^2 = .01$. For the neutral faces, there was a significant main effect of parental status, $F(1, 103) = 9.22$, $p = .003$, $\eta_p^2 = .08$, but no main effect of gender, $F(1, 103) = 0.39$, $p = .53$, $\eta_p^2 = .004$, and no interaction effect, $F(1, 103) = 3$, $p = .09$, $\eta_p^2 = .03$. Parents gave

less negative ratings of the neutral faces (closer to neutral) than did non-parents. For the most negative faces, there was a significant interaction between sex and parental status, $F(1, 103) = 4.51$, $p = .03$, $\eta_p^2 = .04$, but no significant main effects of sex, $F(1, 103) = 11$, $p = .74$, $\eta_p^2 = .001$, or parental status, $F(1, 103) = 48$, $p = .49$, $\eta_p^2 = .005$. Of the four participant groups, non-fathers gave the most negative ratings for the infant “most negative/sad” faces. There were no significant differences for the “muted positive/happy” or the “muted negative/sad” faces ($p > .05$).

Effects of symptoms of depression

Participants reported only low, minimal depressive symptoms (see Table 1), well within the healthy non-depressed range. It was hypothesized that depressive symptoms would be associated with more negative ratings of negative facial expressions. To test this, a negative/sad face rating value was calculated by combining participants' ratings of the muted negative and most negative faces. There were no significant effects of parental status or sex on depression scores (see Table 1), so effects were examined across the entire sample ($N = 109$) using Spearman's rank correlation (given the non-normality of the BDI scores). There was a significant positive correlation between BDI score and ratings of the negative/sad faces ($r_s = .16$, $p = .04$). Controlling for the effect of parental status and sex, this effect remained ($r_s = .17$, $p = .04$).

General discussion

The present study examined how parental status and sex affect adults' interpretation of infant emotional expressions. The ability to interpret emotional expressions is of clear importance for how parents interact with their infants and may be a determinant of the quality of parental care. The major finding was that sex, parental status, and the nature of expression showed significant interaction effects in relation to the appraisal of infant emotion. Mothers provided more positive ratings of the happy infant faces than did fathers. Looking at the most intense facial

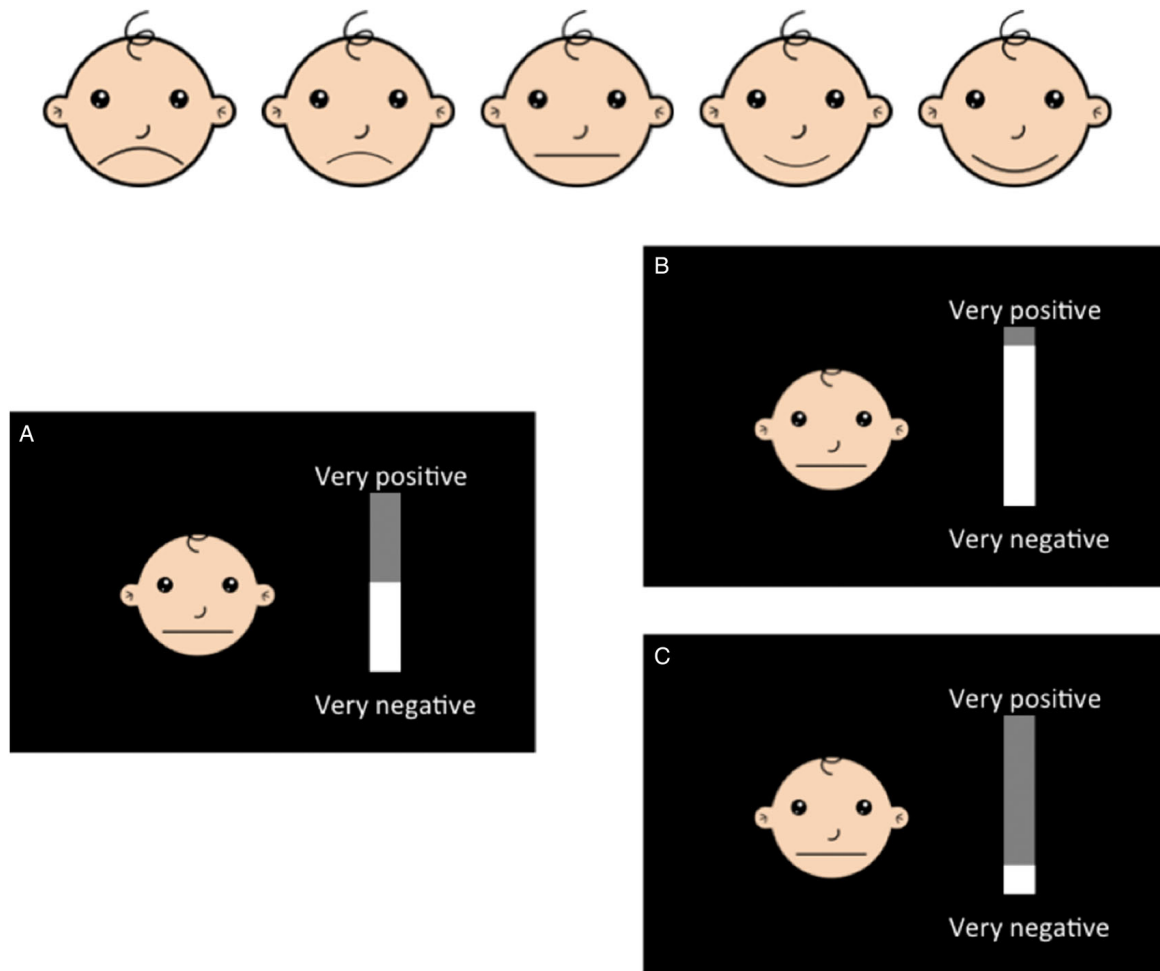


Figure 1. The experimental paradigm (Cartoons are for illustrative purposes only). Participants rated five categories of infant faces, from very positive/happy to very negative/sad. (A) Images were presented onscreen, with a vertical visual analogue scale (VAS) bar to the right; (B) participants could raise the height of the VAS to provide a positive rating; (C) participants could lower the height of the VAS to provide a negative rating.

expressions (most positive, most negative), mothers also provided more extreme ratings than did fathers. These differences were not apparent in the non-mothers and non-fathers. This suggests that parenthood has differential effects on men and women. These effects were subtle in nature, and overall the fathers', mothers', non-fathers', and non-mothers' appraisal of infant emotional expressions were more similar than different. In addition, subclinical depressive symptoms were found to be associated with more negative ratings of negative facial expressions.

Parents rated the "neutral" infant faces more positively, or closer to "neutral", than non-parents, but no other differences across the facial expression categories were apparent. It is possible that experience of parenthood brings attunement to facial expressions at low emotional intensity. Adult

neutral faces have been referred to as "affectively ambiguous" and are often interpreted as slightly positive or slightly negative (Ekman & Friesen, 1976; Lee, Ng, Tang, & Chan, 2008; Lehmann et al., 2013; Said, Sebe, & Todorov, 2009; Somerville, Kim, Johnstone, Alexander, & Whalen, 2004; Thompson, Gupta, Miller, Mills, & Orr, 2004; Yoon & Zinbarg, 2008). This may be the case for infant neutral facial expressions too. Given that parents rated the faces as closer to "neutral", this could be interpreted as more accurate performance. It seems fair to suggest that experience of caring for an infant would confer an advantage in perceiving low-intensity or ambiguous facial expressions. It may be that for more extreme and obvious facial expression differences, there is little difference between men and women or parents and non-parents.

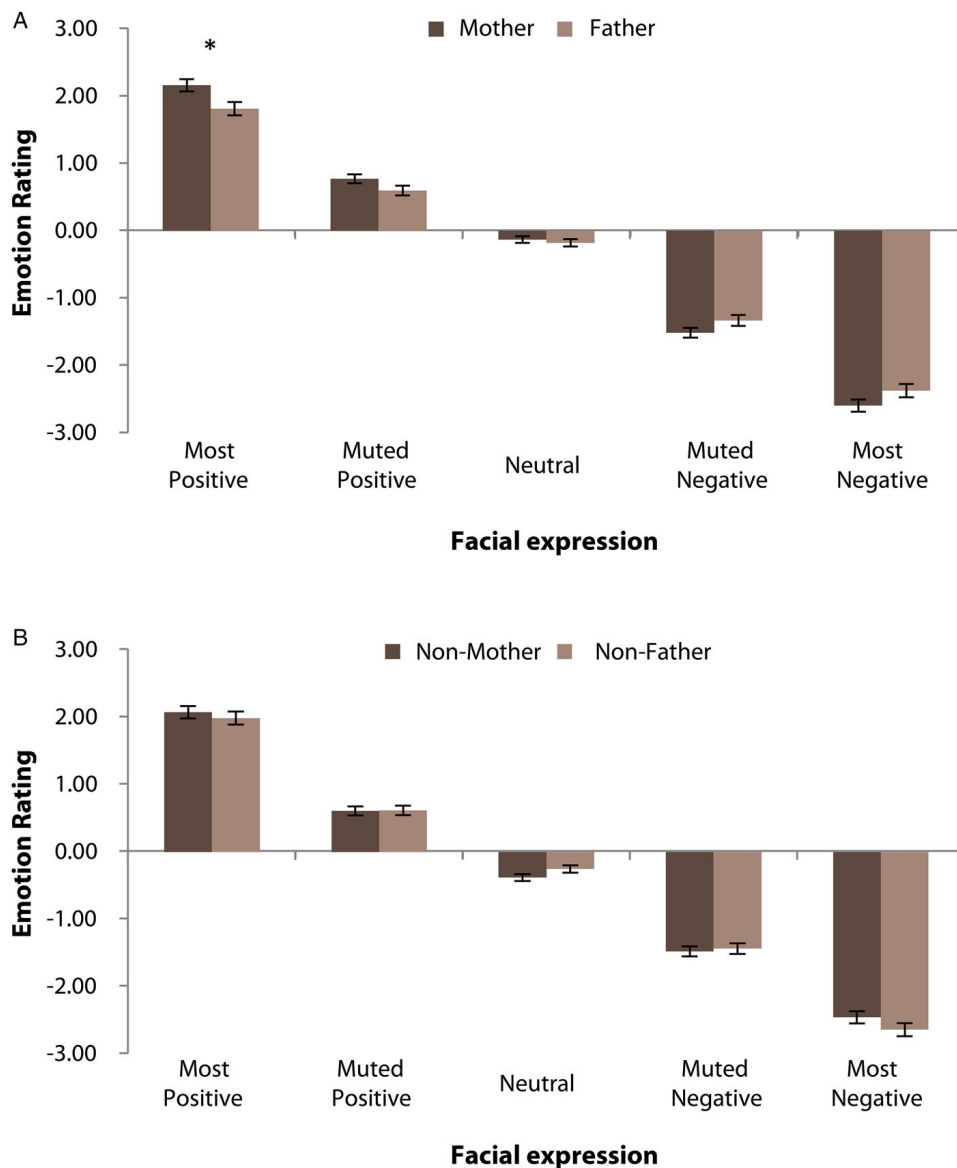


Figure 2. Parental status, gender, and facial expression interaction effects: (a) a comparison of mothers and fathers; (b) a comparison of non-mothers and non-fathers. *Denotes significant difference, SE bars.

Parents and non-parents were similar in their ratings of the negative infant facial expressions. This finding is consistent with a previous study that found no difference in parents' and non-parents' ratings of distress in infant faces, as presented in videoclips (with other visual and audio information removed; Irwin, 2003). In addition, another study reported no difference between parents and non-parents in performance on an implicit association test measuring positive affective responses to infant faces (Senese et al., 2013). On the other hand, a recent comparison of attentional capture in mothers and non-mothers found that mothers had slower

responses times overall to all faces, but especially to infant faces (Thompson-Booth et al., 2014).

Our finding showing parental status affecting responses only to neutral faces suggests that parenthood may be associated with subtle perceptual changes. This is consistent with current findings in the neuroimaging literature. While fMRI studies have reported generally similar overall activation patterns in parents and non-parents, event-related potential (ERP) studies with greater sensitivity to the timing of neural activity have reported some differences related to parental status (Peltola et al., 2014; Proverbio et al., 2006; Proverbio et al., 2007; Weisman et al.,

2012). For instance, one study showed that mothers, and carriers of G allele carriers of the OXTR gene, had differential early ERPs in frontal areas at around 100 ms to high-intensity infant facial expressions, whereas non-mothers and non-carriers did not (Peltola et al., 2014). This study, however, failed to find an overall effect of motherhood on the later positive component ERP, as reported in the smaller study by Proverbio et al. (2006). In the Weisman et al. (2012) study, both fathers and mothers showed greater activity to neutral infant faces than did non-fathers and non-mothers at around 300 ms. In line with the Weisman study, findings presented here suggest parental effects in response to neutral facial expressions.

Considering the interaction between sex and parenthood, non-fathers and non-mothers rated expressions similarly, but there were clear differences between fathers and mothers. Mothers interpreted the positive faces significantly more positively than fathers, but no such differences arose between the non-fathers and non-mothers. This is broadly consistent with the findings of Proverbio et al. (2006), who reported differences only between fathers' and mothers' ERPs in response to infant faces, but not in non-fathers and non-mothers. The Proverbio study also required participants to categorize infant faces as either positive ("comfortable") or negative (distressed), in a forced-choice task. In the present study, participants were asked to evaluate the infant facial expressions on a continuous scale and were presented with both high-intensity (most positive/negative) and low-intensity (muted positive/negative, neutral) expressions. As suggested by Joormann and Gotlib (2006), evaluation of low-intensity facial expressions may be helpful in understanding interpersonal functioning more fully than examining extreme expressions alone. This is because we are typically confronted with information comprising a wide range of emotional intensity, not only with full-intensity information. In the current study, while mothers appeared to rate the positive faces more positively and the negative faces more negatively than non-mothers, fathers appeared to rate the positive faces less positively and the negative faces less negatively than non-fathers.

These findings suggest that parental status may affect men and women in different ways. It may be that motherhood increases women's perception of the intensity of emotion in infant faces (more extreme ratings), whereas fatherhood decreases men's perception. These subtle differences may be apparent in certain types of parent–infant interactions, such as propensity to engage in play or respond to

infant distress. Understanding the mechanisms underlying these emotion processing effects, such as potential overt attentional differences, would be of interest. A previous study demonstrated overt differences, as measured by eye movements, towards infants in men and women who were not parents (Cárdenas et al., 2013). Given the present findings, it would be of interest to investigate overt attention in fathers and mothers.

Depression symptom effects

The population tested here were within the healthy, non-depressed range for Beck's Depression Inventory scores. Nonetheless, there was a positive correlation between relatively low-level symptoms and more negative ratings of the negative infant facial expressions. This effect was apparent even after controlling for the effects of parental status and gender. This finding supports previous research concerning a "negativity bias" when rating faces with a negative valence in the context of depression (Bouhuys et al., 1995; George et al., 1998). This is also consistent with previous studies on the responses of depressed mothers to infant negative emotion (Field, Morrow, & Adlestein, 1993; Murray, Fiori-Cowley, Hooper, & Cooper, 1996). This finding may be of importance because a substantial proportion of mothers (8–25%) experience subclinical depressive symptomatology sometime during the first year postpartum (O'Hara & Swain, 1996).

Limitations

The cross-sectional nature of this study constrains the extent to which strong conclusions about the effect of parental status on perception of emotion in infant cues can be made. Longitudinal work, following up adults as they transition into parenthood, would be helpful in this regard. Furthermore, it remains to be shown how these differences in perception of unfamiliar infant faces might translate into actual differences in caregiving sensitivity. It would be of fundamental importance in future work to link observed parent–infant interactions with perceptions of infant expressions. This would complement some of the recent innovative work examining hormonal changes associated with parenthood and parental behaviour in both men and women (e.g., Feldman, Gordon, Influx, Gutbir, & Ebstein, 2013; Mascaro, Hackett, & Rilling, 2014; Weisman, Zagoory-Sharon, &

Feldman, 2014). Additional studies, taking into consideration the nature and extent of caregiving roles, would also be of interest in this context. There is mounting evidence to suggest that perception of infant emotional expressions is disrupted in postnatal depression (Arteche et al., 2011; Stein et al., 2010), a condition associated with difficulties in mother–infant interactions. Other variables of interest, which may be confounders here, would include socio-economic status, which has been shown to moderate the effects of postnatal depression on caregiving behaviour (Stein et al., 2008). Related to this, participants in the current study were self-selecting, and replication with larger sample sizes would be helpful. Finally, it would be interesting to examine whether the duration of stimulus presentation would alter the sex, parental status, and facial expression interaction effects presented here. There is evidence that both sex differences (e.g., Sonnby-Borgström, Jönsson, & Svensson, 2008) and depression effects (e.g., Gotlib, Krasnoperova, Yue, & Joormann, 2004; Stein et al., 2010) are more apparent at longer presentation times. Relative to these studies, our presentation time was long, and perhaps the effects might be altered or attenuated with briefer times.

Conclusion

These findings extend current knowledge by demonstrating that perception of happy and intense infant emotional expressions can differ between mothers and fathers, but not between non-mothers and non-fathers. Perception of emotion in infant faces may also be negatively affected by mild depressive symptoms. If mothers and fathers perceive the same infant emotional expressions in different ways, this may contribute to the sex differences in interaction styles that are frequently observed (see Ramchandani et al., 2013, for review). Furthermore, while numerous studies have suggested sex differences in adults' perception of infant physical features (Lobmaier et al., 2010; Parsons et al., 2011; Sprengelmeyer et al., 2013; Sprengelmeyer et al., 2009), this is the first demonstration that emotional expressions, clearly salient for interactions, might also be affected.

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