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Relationship status and sex differences in emotion lateralisation: An examination contrasting the processing of emotional infant and adult faces

Victoria J. Bourne *, Domicele Jonauskaite

Department of Psychology, Royal Holloway, University of London, UK

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ABSTRACT

When processing facial emotion, most individuals are right hemisphere dominant; however there is variability in this pattern with males typically being more strongly lateralised than females. Relationship status has been found to influence the processing of facial stimuli in women, and therefore, in this research the lateralised processing of facial emotion is considered whilst taking into account the participant's relationship status and sex. Using the chimeric faces test, with both infant and adult facial stimuli, it was shown that partnered participants, but not single participants, were more strongly lateralised for the processing of adult stimuli than infant stimuli, and that partnered women did not show any hemispheric bias. These findings suggest that the neuropsychological processing of emotion may change dependent on an individual's relationship status, and are discussed in terms of the possible evolutionary significance of infant faces for individuals who are in a relationship and who wish to have children.

1. Introduction

Emotional face processing is typically lateralised, with the right hemisphere being dominant (Gazzaniga, 2000). However, there is some variation in this pattern. There is evidence for a sex difference with males being more lateralised than females (Bourne, 2005). However, this sex difference is not consistently reported in previous research. For example, it has been found that males are more lateralised to the right hemisphere only when emotions are displayed on male faces (Rahman & Anchassi, 2012). Psychological gender identity has also been linked to hemispheric specialisations for processing emotive faces, with masculinity being associated with stronger patterns of lateralisation, for males but not females (Bourne & Maxwell, 2010). Whilst there is accumulating evidence for males being more strongly lateralised than females, there are clearly other variables that may mediate this effect. In this study we consider whether relationship status might influence the magnitude of the sex difference.

Current relationship status may influence the processing of facial stimuli, particularly in women at certain phases across the menstrual cycle. Little, Jones, and DeBruine (2008) presented pairs of male faces, one of which was manipulated to look more masculine than the other, and asked partnered and single women to choose the face that they perceived to be more attractive. Although all women found more masculine male faces more attractive, women without a partner chose a similar percentage of masculine male faces during high and low fertility phases, whereas partnered women chose significantly more masculine male faces during the high fertility phase compared to the low fertility phase. Little et al. suggested that, during the follicular phase, partnered women are at a higher risk of conception than single women, and therefore favour masculine features, which may be passed onto their offspring.

Conway, Jones, DeBruine, and Little (2010) examined the influence of direct and indirect gaze in facial stimuli. They found that women preferred faces with a direct gaze, indicating social interest, but the results were more apparent for women who were not in a relationship when examining feminised male faces and judging them as a possible long-term partner. Such findings indicate that the way in which women process facial stimuli is influenced by their own relationship status. Additionally, Watkins (2012) found that the preference for masculine male faces was stronger for partnered women who had a greater desire to become pregnant, suggesting that being in a romantic relationship and thinking about future offspring modulates a woman's processing of facial stimuli. Whilst it is clear that a woman's relationship status can influence their processing of facial stimuli, it is unknown whether there is a neural basis to these effects, such as variability in brain lateralisation. One previous

* Corresponding author at: Department of Psychology, Royal Holloway, University of London, Egham, Surrey TW20 0EX, UK. Tel.: +44 (0) 1784 414019.

E-mail address: victoria.bourne@rhul.ac.uk (V.J. Bourne).

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study has examined lateralisation for processing word stimuli in middle aged participants who were either married or not, and found no laterality effects (Fussell, Rowe, & Mohr, 2012). However, to date there is no evidence for variability in lateralisation for processing emotive faces according to relationship status.

There are two main hypotheses regarding emotion lateralisation. According to the right hemisphere hypothesis, the processing of all emotions is lateralised to the right hemisphere (Borod, 1992). According to the valence hypothesis, negative emotions are processed in the right hemisphere while positive emotions are processed in the left hemisphere (Davidson, 1992). Emotion lateralisation is frequently measured with the chimeric faces test (Bourne, 2010; Levy, Heller, Banich, & Burton, 1983). Participants are shown vertically split chimeric faces, with one half face expressing an emotion (e.g. anger) and the other half being neutral. Two chimeras are presented on top of each other. One of the chimeras expresses an emotion on the left side of the face and the other one expresses an emotion on the right side of the face. Participants have to decide which chimera looks more emotive. Typically participants show a bias towards faces expressing emotion in the left half face, reflecting the right hemisphere superiority for the processing of facial emotion (Bourne, 2010).

In previous research, chimeric faces stimuli are typically created using images of adult posers, such as the Ekman stimuli (Bourne, 2010; Workman, Chilvers, Yeomans, & Taylor, 2006) or the Levy stimuli (Levy et al., 1983). Little research has considered whether patterns of lateralisation might differ when processing emotional expressions of infant faces, and whether men and women might process infant and adult emotional expressions differently in the brain. A sex difference has been reported in an ERP study of the hemispheric processing of infant faces (Proverbio, Brignone, Matarazzo, Del Zotto, & Zani, 2006). Whilst the ERP response to infant faces tended to be earlier and larger for women, males had more asymmetric responses, showing the typical right hemisphere dominance (e.g., Bourne, 2005; Bourne & Maxwell, 2010). Barth, Boles, Giattina, and Penn (2012) used facial stimuli from children aged between five and twelve years old, and adult participants had a significant right hemisphere bias for the processing of these stimuli, which was significantly correlated with the adult version that was developed by Levy et al. (1983). However, both versions only used happy–neutral chimeras, and the facial stimuli were of children, not infants. Best and Queen (1989) developed a set of chimeric face stimuli from infants aged between seven and thirteen months. When asked to judge the intensity of the emotional expressions on single chimeric faces on infant faces, they found a right hemiface bias for smiling, but not for crying expressions. In a subsequent study, Best, Womer, and Queen (1994) used these stimuli to create a two face version of the chimeric faces test, where participants are asked to judge which of a pair of chimeric face stimuli is more emotive. They found a significant left hemiface (right hemisphere) bias for the infant stimuli, particularly for faces with a negative emotional expression. More recently, Proietti, Pavone, Ricciardelli, and Cassia (2015) formed chimeric faces from infants aged 3–4 days old with a neutral expression, and used these in a paradigm where individual unmanipulated target faces had to be matched for identity to one of two probe chimeric faces. In adult participants, they found a significant left visual field (right hemisphere) bias for both adult and infant faces, although the bias was significantly stronger for adult faces than for infant faces. In children, aged about five years old, these biases were reduced, and for the adult stimuli they were still significant, whereas for the infant stimuli there was no significant visual field bias.

Such findings indicate that the lateralised neuropsychological processing of infant emotive faces may differ according to the age of the poser in the stimuli and the sex of the viewer. The present study will additionally consider whether these biases vary according to relationship status. To date no research has considered whether the lateralised processing of infant faces may vary according to relationship status. However, there are sex differences in the lateralised processing of infant faces (e.g., Proverbio et al., 2006) and that partnered women process faces differently from single women (e.g., Watkins, 2012). It is therefore possible that patterns of lateralisation for the processing of emotive faces, and specifically infant faces, will differ between partnered women, single women, and men.

A sex difference is often observed in emotion lateralisation with males being more strongly lateralised to the right hemisphere than females (Bourne, 2005; Bourne & Maxwell, 2010). Females are often found to be more accurate with processing emotional faces than males (e.g., Hampson, van Anders, & Mullin, 2006; McClure, 2000), however the reason for this is unclear. These differences may result from neuropsychological differences in the lateralised processing of facial emotion between males and females (e.g., Bourne, 2005; Bourne & Maxwell, 2010). The current study aims to further examine the sex difference in emotion lateralisation by considering whether relationship status influences emotion hemispheric lateralisation. Since partnered women have been found to process faces differently to single women (Little et al., 2008; Watkins, 2012), it is predicted that relationship status will influence emotion lateralisation with the typical patterns of hemispheric asymmetry being exaggerated in individuals who are in a relationship. It is also possible that the sex difference may be influenced by whether infant or adult faces are being processed.

2. Methods

2.1. Participants

A sample of 200 people (99 males, 101 females) participated in the study. Participants were undergraduate or postgraduate students and were recruited through opportunity sampling. None had any children. Mean age was 21.5 years old ($SD = 3.1$, range 18–40). All participants reported being right-handed and this was confirmed with a handedness questionnaire (Dorthe, Blumenthal, Jason, & Lantz, 1995). The questionnaire contained 14 items about hand preference for various tasks and each item was scored on a seven-point Likert scale from −3 (always with left hand) to +3 (always with right hand), giving a total score between −42 (strongly left handed) and +42 (strongly right handed). Mean handedness score in the sample was 31.1 ($SD = 7.1$, range 11–42). None of the participants reported having any head injuries, neurological or clinical disorders, as assessed by means of a self-report questionnaire. Vision was either normal or corrected to normal. Power calculations gave a minimum total sample size of 52 with a medium effect size, power of .95 and estimated correlations of .5 between repeated measures. Ethical approval was granted by the Departmental Ethics Committee.

2.2. Adult and infant chimeric face tasks (CFT)

The adult trials in the chimeric faces test used the stimuli developed by Workman and colleagues and using the Ekman emotional face stimuli (Ekman, 1993; Workman, Peters, & Taylor, 2000). Male and female emotional faces expressing happiness (positive valence) or sadness (negative valence) were used to create adult chimeric stimuli. Infant chimeric faces were created from infant face stimuli used elsewhere (Kringelbach et al., 2008; Parsons, Young, Kumari, Stein, & Kringelbach, 2011) and had either positively or negatively valenced emotional expressions. Chimeric faces of both ages were created and presented in the same way.