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RESEARCH REPORT

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Sex differences in the perception of affective facial expressions: Do men really lack emotional sensitivity?

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Abstract There is evidence that men and women display differences in both cognitive and affective functions. Recent studies have examined the processing of emotions in males and females. However, the findings are inconclusive, possibly the result of methodological differences. The aim of this study was to investigate the perception of emotional facial expressions in men and women. Video clips of neutral faces, gradually morphing into full-blown expressions were used. By doing this, we were able to examine both the accuracy and the sensitivity in labelling emotional facial expressions. Furthermore, all participants completed an anxiety and a depression rating scale. Research participants were 40 female students and 28 male students. Results revealed that men were less accurate, as well as less sensitive in labelling facial expressions. Thus, men show an overall worse performance compared to women on a task measuring the processing of emotional faces. This result is discussed in relation to recent findings.

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Introduction

Cognitive differences between men and women have been the topic of interest for years. Several studies have addressed this issue and found sex differences on specific cognitive domains. Females are generally reported to perform better on verbal tasks, such as word recall and recognition (Berenbaum et al. 1997), as well as on visual recognition memory (McGivern et al. 1997). In turn, males perform better on certain tasks of spatial memory (Postma et al. 2004). With respect to behavioural differences, a common believe is that women and men show differences in emotional processing.

Differences in emotional processing can be the result of the distinct social roles of men and women. Grossman and Wood (1993) found that the intensity of reported emotions correlated with the belief one has in stereotypic role patterns of men and women. Women who believed more in stereotypic role patterns reported more intense emotions. In turn, men who believed more in stereotypic role patterns reported less intense emotions. Furthermore, women generally fulfil more care-taking roles and would hence show more intensity in the emotions involved in this role, such as happiness, fear and sadness. In line with this theory, it is suggested that men more intensely feel and express anger, because this emotion is associated with their protective social role.

Additionally, sex differences in emotional behaviour could also be related to neuro-anatomical differences in structures responsible for affective processing. For example, women have more grey-matter volume in specific parts of the limbic system involved in emotion processing (Good et al. 2003), and activate a significantly wider portion of their limbic system than men during transient sadness (George et al. 1996). Also, women have a larger orbital frontal lobe (Gur et al.

2002), a brain area important for input to the amygdala and for inhibition of aggressive behaviour.

Furthermore, studies focusing on memory for emotional stimuli have reported gender differences in performance. Canli et al. (2002) reported better memory for highly emotional events in women compared to men. In addition, Burton et al. (2004) studied the effects of explicit and implicit memory for affective stories and demonstrated that affective content had a more positive effect on memory in male participants, both explicit and implicit, compared to females. Differences in physiological processes have also been demonstrated, Cahill et al. (2001) found that enhanced memory for emotional video clips was associated with activity in the right amygdala in men, but with the left amygdala in women. In addition, an fMRI study by Royet et al. (2003) found more activation in the left orbitofrontal cortex in women compared to men during explicit decision-making related to odours. On the other hand, Robin et al. (2003) found no differences between men and women in their autonomic reaction to different tastes, or for the distribution of the associated basic emotions obtained for sweet, bitter and control solutions.

Looking at gender differences concerning the processing of emotional facial expressions only a few studies have been reported. Natale et al. (1983) found an overall negative rating bias for facial expressions in women, while men showed a positive bias. Furthermore, Thayer and Johnson (2000) found females to be more accurate in recognizing facial expression compared to men. Here, the sex of the displayed face had no effect on accuracy for the female subjects. Male subjects, however, were especially less accurate for negative facial expression of women. A recent investigation of Campbell et al. (2002) confirms these results and demonstrated specific sex differences for the recognition of ''disgust'' and ''anger'', with women being more accurate.

The lack of conclusive findings on sex differences in emotional processing is even more interesting given the fact that gender differences occur in the behavioural manifestation of psychiatric disorders. For example, well-described differences in the symptoms between men and women have been reported in schizophrenia. Self-neglect, social withdrawal, social inattentiveness and social maladjustment are more frequently reported in males with schizophrenia, whereas social adaptation and affective symptoms are more common in female patients. Related to this, a higher incidence of clinical depression is found in women compared to men (Hartung and Widiger 1998). Although several possible reasons have been suggested, there is no consensus yet (Piccinelli and Wilkinson 2000; Kessler et al. 1994). Still, deficits in emotion perception might possibly underlie behavioural symptoms in neuropsychiatric disorders, such as schizophrenia and depression (Goldstein and Link 1988; Häfner et al. 1994; Hambrecht et al. 1992).

The current study set out to replicate and extend the findings of Campbell et al. (2002) using a more sensitive task to examine whether differences in the labelling of facial affect between men and women can be found. Furthermore, since several studies have shown effects of depressed mood (Cooley and Nowicki 1989; George et al. 1998; Hale et al. 1998) and anxiety (Richards et al. 2002) on the identification of emotional faces, both groups will be carefully matched on these variables using self-report scales.

Methods

Research Participants

Participants were 68 students from the psychology department, University of St. Andrews, Scotland. 28 Males and 40 females participated. Groups were matched on age and an independent t-test revealed no significant difference between both groups ($t(66) = 1.83$, $p = 0.07$). Furthermore, Beck's Depression Inventory (BDI) was used as an exclusion criterion with a cut-off score of 10 (Beck et al. 1988). The state and trait versions of the State and Trait Anxiety Inventory (STAI) were also administered (Spielberger 1970). There were no significant differences on the BDI or the STAI between both groups (see Table 1).

Materials and Tests

A computer-generated program, developed from algorithms designed by Benson and Perrett (Benson and Perrett 1991) was used to develop the stimuli. This program was devised to enable a real-time interactive morphing (gradual change) between two endpoint facial expressions of the same identity, from 0% emotion (neutral face) to 100% emotion. Each morphing sequence entailed was made of 20 image steps. Stimuli for this test were based on coloured pictures from actors mimicking emotional expressions. These faces were manually delineated by 179 feature-points that define the shape of the important facial features (Rowland and Perrett 1995). The continuous morph was generated by the calculation of the difference in spatial position between two corresponding feature points on the two

Table 1 Mean age (+ SD) and mean scores (+ SD) on the Beck Depression Inventory (BDI) and the State and Trait Anxiety Inventory, state (STAI-S) and trait (STAI-T) versions, for the male and female participants

	Men (n = 28)		Women (n = 40)		Statistical analyses
	M	SD	M	SD	
Age	23.4	5.0	21.5	3.9	$t(66) = 1.83$, n.s.
BDI	3.4	2.9	3.9	2.6	$t(66) = 0.74$, n.s.
STAI-S	32.7	8.4	34.0	7.7	$t(66) = 0.65$, n.s.
STAI-T	35.4	8.4	38.5	1.0	$t(66) = 1.74$, n.s.

end-points images. Both dimensions of shape and texture undergo the 0–100% transition (see Figure 1 of an example of a face morphing from neutral to full-blown expression). The task was constructed of morphs from four actors (two male, two female) and six emotions (anger, disgust, fear, happiness, sadness and surprise), each emotion was shown both in frontal view and in side view (Frigerio et al. 2002). All trials were randomly assigned.

Procedure

Each subject started with the emotional expression-morphing task. Following four practice trials, the 48 randomly ordered trials of the test were presented. Each trial started with the neutral face that morphed into a full expressive face. Subjects had to label the emotion they perceived (i.e., accuracy). Next, the same face returned to a neutral face and subjects were requested to indicate the point at which they could first perceive the emotion appear in the face (sensitivity) by using the cursor keys to move back and forwards through the animation sequence.

Analyses

Two different indices were used, that is accuracy and sensitivity. Accuracy is the percentage of correct answers for each expression shown for all intensities taken together. Sensitivity is the average amount of expression needed to first be able to correctly label the specific emotion.

Results

Figure 2 and 3 show the accuracy and sensitivity for the separate emotions for both groups. To investigate the effect of sex, view and emotion on both indices a 2×2×6 multivariate analysis for repeated measurements (GLM) was conducted with two Measures (accuracy and sensitivity), and Sex (male, female) as between-subject variable and Viewing Direction (2 levels: frontal view, side view) and Expression (6 levels: Anger, Disgust, Fear, Happiness, Sadness, Surprise) as within-subject factors. The multivariate tests, combining the two measures, revealed main effects of Sex ($F(2,49) = 5.8$, $p < 0.01$), Viewing Direction ($F(2,49) = 16.3$, $p < .001$), and Expression ($F(10,41) = 52.3$, $p < 0.001$). Also, an Expression × Sex interaction ($F(10,41) = 2.4$, $p < 0.05$) and a Viewing Direction × Expression interaction ($F(10,41) = 3.0$, $p < 0.01$) were found (all other F-values < 2.5). This analysis shows that men perform overall worse compared to women, and that this sex difference is not equal for all emotions. Furthermore, facial expressions in frontal view are generally recognised better compared to faces presented in side view for the group as a whole, but this advantage is not equal for all emotions. Subsequent univariate testing for the measure sensitivity revealed main effects of Viewing Direction ($F(1, 250) = 30.9$, $p < 0.001$), Expression ($F(5,250) = 52.5$, $p < .001$) and Sex ($F(1,50) = 5.2$, $P < .05$). Also, an interaction between Viewing Direction and Expression ($F(5,250) = 3.6$, $p < .005$) was found. Univariate testing for the measure accuracy showed main effects of Expression ($F(5,250) = 46.8$, $p < 0.001$) and Sex ($F(1,50) = 5.6$, $p < .05$), as well as interactions between Expression and Sex ($F(5,250) = 3.7$, $p < .005$) and between Viewing Direction and Expression ($F(2,250) = 3.8$, $p < .005$) All other interactions were not significant (F-values < 3.8).

These analyses show that men performed worse compared to women, both with respect to accuracy and sensitivity. Furthermore, no interaction between sex and viewing direction was found. For this reason we performed independent-sample t-tests on all six emotions separately on the combined score of the frontal-view and the side-view facial expressions. Men were significantly less accurate than women for the emotions Sadness ($t(66) = 3.3$, $p < .005$) and Surprise ($t(66) = 2.2$, $p < .05$). Also, men were significantly less sensitive than women for the emotions Anger ($t(66) = 2.6$, $p < .05$) and Disgust ($t(66) = 2.0$, $p < .05$), indicating that men needed more

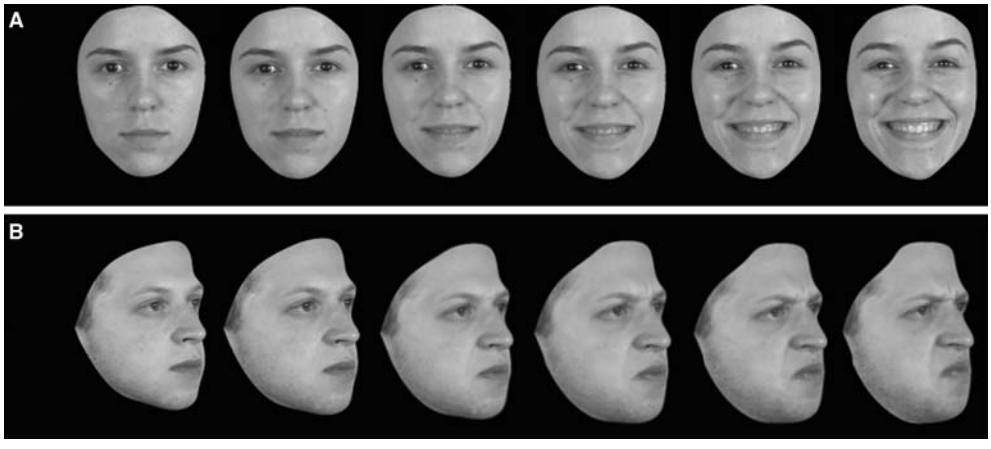

Fig. 1 Example of a neutral face morphing into a full-blown happy expression in frontal view and a neutral face morphing into a full-blown disgusted face in side view

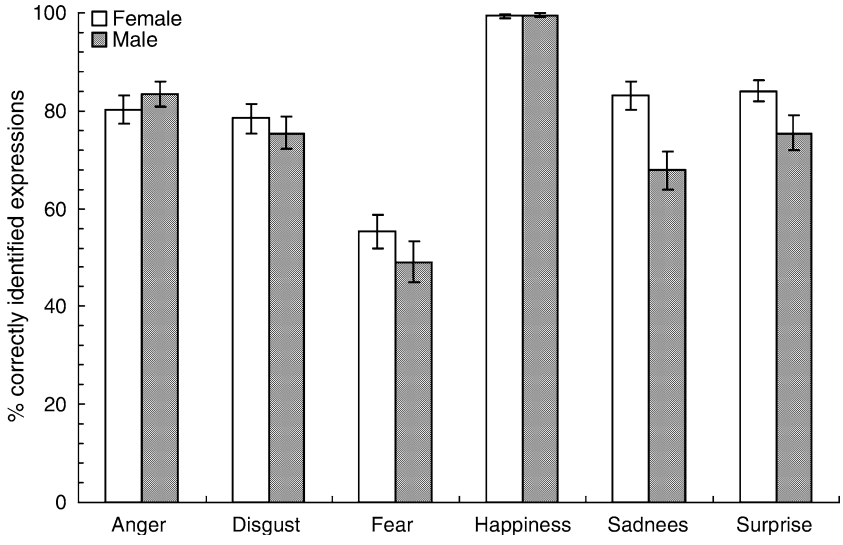

Fig. 2 The mean accuracy (+ S.E.M.) for the facial emotional expressions for female (n = 40) and male (n = 28) participants

emotion in the face in order to label it correctly for these emotions.

Discussion

The present study examined whether a group of healthy young men and women show differences on a task measuring the perception of emotional expression. The results revealed that men were less accurate in labelling facial expressions, specifically sadness and surprise, and less sensitive in labelling facial expressions, specifically anger and disgust. These results suggest a general, rather than a specific effect of sex on the perception of facial expressions. This is in line with the findings of Campbell et al. (2004), who also found men performed worse then women on expression categorisation in general with the emotions anger and disgust showing the largest sex differences. In turn, Rahman et al. (2004) recently found only limited support for differences in emotion recognition between men and women. A direct comparison between the current study and the previous ones, however, is difficult for various reasons. A possible explanation for the differences could, for example, lie in methodological aspects, such as the fact that the present study used coloured, less dated faces instead of the black-and-white Ekman and Friesen set (1976). Furthermore, Rahman et al. (2004) also applied a different experimental design, since participants were asked to react as fast as possible. Neither in the study of Campbell et al. (2002) nor in our study was reaction time a dependent variable. Furthermore, although Rahman et al. (2004) did not show women to be more accurate overall, they found that women were faster in accurately identifying facial emotional expressions.

Support for sex differences in affective processing is also provided by recent studies using neuroimaging techniques. Kemp et al. (2004) used steady-state visual

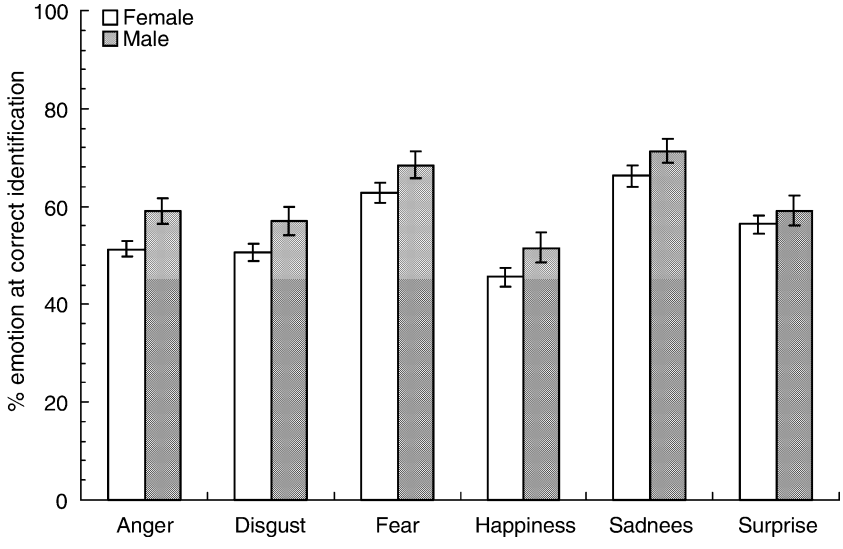

Fig. 3 The mean sensitivity (i.e., the amount of emotion in the facial expression in order to make a correct identification) and S.E.M. for the emotional facial expressions for female (n = 40) and male (n = 28) participants

evoked potentials (VEPs) and reported sex differences with respect to prefrontal latency reduction during the processing of unpleasant and pleasant images, while Schirmer et al. (2004) showed a sex difference in the processing of emotional speech with fMRI. Happy and angry words were presented in a spoken manner with either happy or angry prosody, in such a way that a condition could be either congruent or incongruent. Results showed a significant congruence effect related to left inferior frontal gyrus activation, but only in women. In addition, a combination of visual stimuli and speech perception was applied in a PET study (Hall et al. 2004). Here, a difference in the activation pattern was found during the recognition of emotion in visually presented facial expressions as well as during a task using visual stimuli together with associated auditory emotional stimuli, with women showing more bilateral and limbic activation compared to men.

Also, in contrast to Grossman and Wood's theory (1993) about the feeling and expression of emotions related to gender roles, the current results do not show a specific advantage for emotions related to either a male (anger) or female (happiness, fear, and sadness) social gender role. Furthermore, although the influence of depressive mood and anxiety on the recognition of emotional expressions has not been well established, several studies have shown a negative effect of depressed mood or anxiety on emotion perception (Cooley and Nowicki 1989; George et al. 1998; Hale et al. 1998, Richards et al 2002; Leppänen et al. 2004). Since the current groups were carefully matched on these variables, the present findings are not due to differences in the amount of depression or anxiety.

In conclusion, the present results clearly show a higher accuracy in women for sadness and surprise and a higher sensitivity in women for the labelling of facial expressions of anger and disgust, suggesting a general sex difference in the labelling of facial expressions. These results are in line with previous studies looking at the processing of emotional material in men and women. Future studies should focus more in depth on the neurocognitive basis of emotional perception in relation to more sensitive measures than just the ability to label full-blown emotional expressions.

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