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Sex differences in unfamiliar face identification: Evidence from matching tasks

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ABSTRACT

Research on sex differences in face recognition has reported mixed results, on balance suggesting an advantage for female observers. However, it is not clear whether this advantage is specific to face processing or reflects a more general superiority effect in episodic memory. The current study therefore examined sex differences with a face-matching task that eliminates memory demands. Across two experiments, female but not male observers showed an own-sex advantage on match trials, in which two pictures have to be identified as the same person. This advantage was present for whole faces and when only the internal or external facial features were shown. Female observers were also more accurate in these three conditions on mismatch encounters, in which two photographs have to be identified as different people, but this reflects a more general effect that is present for male and female faces. These findings converge with claims of a female advantage in face recognition and demonstrate that this effect persists when memory demands are eliminated.

1. Introduction

Sex differences in cognition have been a topic of intense interest for many years (for reviews see, e.g., Caplan, Crawford, Hyde, & Richardson, 1997; Halpern, 2000; Kimura, 1999; Maccoby & Jacklin, 1974). Regardless of the debate concerning the basis of any sex differences—the nature (i.e., sex hormones and genetic factors, Broverman et al., 1981; Dawson, 1972) or nurture (i.e., socio-cultural and personality factors, Burr, 1998)—these differences do exist. There is, for example, considerable evidence that males outperform females in visuo-spatial working memory tasks (for a review, see Cornoldi & Vecchi, 2003). By contrast, many studies have found that females outperform males in a variety of verbal episodic memory tasks (for a review, see Ullman, Miranda, & Travers, 2008). Females also excel in some episodic memory tasks involving non-verbal stimuli, such as unfamiliar faces (see Shapiro & Penrod, 1986). Consequently, it has been suggested that these sex differences in language and memory rely on a general superiority of females in storing and retrieving information in the declarative memory system, which underlies the learning and use of knowledge across both verbal and spatial domains (Hartshorne & Ullman, 2006; Ullman, 2004; Ullman et al., 2002, 2008).

The experiments reported here focus on one aspect of these sex differences, namely the ability to process human faces. While previous studies suggest a face recognition advantage for female observers, the effects of sex on face recognition memory have, in fact, yielded largely inconsistent findings. For example, while some studies report a general advantage for female observers regardless of face sex (e.g., McBain, Norton, & Chen, 2009; Rehnman & Herlitz, 2007), others have found a selective female advantage for female faces only (Cross, Cross, & Daly, 1971; Lewin & Herlitz, 2002; McKelvie, 1981; Rehnman & Herlitz, 2006). This issue is complicated further as an own-sex bias has also been reported for males (Ellis, Shepherd, & Bruce, 1973; Wright & Sladden, 2003), though it has not been widely replicated (Lewin & Herlitz, 2002; Rehnman & Herlitz, 2006, 2007). In addition, no sex differences have also been found in some studies for recognising male faces (Lewin & Herlitz, 2002; Vokey & Read, 1988), but some research also reports a female face advantage (Bengner et al., 2006; Ellis et al., 1973; Rehnman & Herlitz, 2007). Taken together, these studies suggest that, if sex differences in face recognition exist at all, then these differences are manifested in a recognition advantage in female observers and especially for viewing female faces (see Herlitz & Rehnman, 2009).

All of these studies, however, have examined face processing using recognition memory tasks, in which observers were asked to discriminate previously seen faces from unseen ones. As a consequence, these studies cannot resolve whether any sex differences result from the memory demands of these tasks, in line with a general memory advantage in females (see, e.g., Ullman, 2004; Ullman et al., 2002, 2008), or reflect face encoding *per se*. The superiority of female observers at episodic and declarative memory suggests that any sex differences in face recognition may occur during storage or retrieval

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rather than encoding (Herlitz, Nilsson, & Bäckman, 1997; Maitland, Herlitz, Nyberg, Bäckman, & Nilsson, 2004; Yonker, Eriksson, Nilsson, & Herlitz, 2003). However, there is no direct evidence as yet to support this suggestion. The aim of this paper, therefore, was to examine whether these sex differences persist with a task that eliminates memory demands.

For this purpose, the experiments reported here employed two different face-matching tasks. In the first task, which was used in Experiment 1, participants were shown pairs of photographs depicting two different images of the same person or images of two different people, and match/mismatch decisions to these facial identities were required (see, e.g., Megreya & Bindemann, 2009; Megreya & Burton, 2007, 2008). Matching performance in this pure face perception tasks is error-prone (e.g., Megreya & Bindemann, 2009; Megreya & Burton, 2007, 2008) and yields a range of responses across individual observers (Burton, White, & McNeill, 2010; Megreya & Burton, 2006). We therefore used this matching task to examine whether sex differences in face *perception* exist. If sex differences in face processing reflect memory mechanisms rather than differences in face perception abilities, then performance should be equivalent across males and females in this experiment. Alternatively, if this task reveals sex differences, then this would provide evidence that these differences exists also in face processing tasks that minimize memory demands.

The second task, in Experiment 2, then required observers to match a whole face image to another photograph in which only the internal or external features of a face were preserved (see, e.g., Megreya & Bindemann, 2009; Young, Hay, McWeeney, Flude, & Ellis, 1985). External features capture some salient gender cues, such as hairstyle. However, these features can be changed (e.g., by restyling your hair) and, as a consequence, can provide misleading identity information (see, e.g., Sinha & Poggio, 1996). Despite this, identity matching of unfamiliar faces tends to rely more on these external cues than internal features (see, e.g., Bruce et al., 1999; Ellis, Shepherd, & Davies, 1979; Young et al., 1985). Moreover, in studies of recognition memory, external features also appear to be a major contributing factor to sex biases (Wright & Sladden, 2003). By manipulating the presence of these features in Experiment 2, we therefore sought to dissociate if any sex differences in face matching are driven by the external or internal features of a face.

2. Experiment 1

In Experiment 1, face perception was assessed using a two-alternative forced-choice matching task, in which participants were shown unfamiliar face pairs and had to decide whether each pair depicts one person or two different people. While this scenario appears seemingly trivial, previous research shows that performance on this task is highly error-prone (e.g., Bruce, Henderson, Newman, & Burton, 2001; Burton et al., 2010; Henderson, Bruce, & Burton, 2001; Megreya & Bindemann, 2009; Megreya & Burton, 2006, 2007, 2008) and therefore provides an appropriately sensitive method for probing sex differences in face matching.

2.1. Method

2.1.1. Participants

Ninety undergraduate students (45 males) from the University of Essex, with a mean age of 22.9 years ($SD = 6.9$), volunteered to participate in this experiment. All had normal or corrected-to-normal vision.

2.1.2. Stimuli

A total of 120 face-matching pairs were taken from the standard version of the Glasgow Face Matching Test (GFMT; see Burton et al., 2010). Each pair consisted of a video still of a target face and a digital photograph showing either the same person, on match trials, or the target face and a visually similar-looking distractor, on mismatch trials. These video images and digital photographs were taken on the same day and under the same lighting conditions, and with a very similar full-face viewpoint (for full details, see Burton et al., 2010). All mismatch pairs in the GFMT database are constructed on the basis of pairwise similarity measures, to ensure that the perceived similarity of the distractors to the target faces is optimized (for further details, see Burton et al., 2010). The size of each face image was approximately 5×7 cm, and all faces were presented in grayscale. Example stimuli are depicted in Fig. 1.

2.1.3. Procedure

Participants were tested individually using an Apple computer. Each subject completed a total of 60 trials, consisting of 15 match and 15 mismatch pairs each of male and female faces. These trials were presented in a random order using experimental software. In each trial, a central fixation cross was displayed for 1 s, followed by a stimulus pair, which was shown onscreen until a response was registered. Participants were randomly assigned to two sets of stimuli in order to counterbalance match and mismatch items for each sex. Therefore, across the experiment, each male and female face was seen equally often in the match and mismatch conditions. The participants were instructed to decide whether each pair of faces consisted of the same person or two different people by pressing one of two labeled keys on a standard computer keyboard. The task was self-paced and participants were instructed to respond as accurately as possible.

2.2. Results

Performance on match and mismatch trials reflects dissociable face processing abilities (see, e.g., Megreya & Burton, 2007), so these conditions were analyzed separately (see Fig. 2). For match trials, *Hits* are reported here, which reflect correct positive decisions, whereas *Correct Rejections (CR)* refer to the correct negative responses to mismatch pairs.

To analyze these data, two mixed-factor 2 (participant sex) × 2 (face sex) ANOVAs were conducted for the match and mismatch conditions.[1] For match trials, ANOVA showed no main effects of face sex, $F(1,88) < 1$, and of participant sex, $F(1,88) < 1$, but an interaction between both factors, $F(1,88) = 6.13$, $p = 0.01$, $\eta_p^2 = .06$. Analysis of simple main effects indicates that this interaction reflects an own-sex face advantage in female observers for detecting identity matches, $F(1,88) = 5.76$, $p = 0.02$, $\eta_p^2 = .06$, whereas the matching performance of male observers was similar for male and female face pairs, $F(1,88) = 1.21$, $p = 0.27$. The analogous analysis for mismatch trials showed no main effect of face sex, $F(1,88) = 2.17$, $p = 0.14$, and no interaction between face and participant sex, $F(1,88) < 1$. However, a main effect of participant sex was found, $F(1,88) = 3.99$, $p = 0.03$, $\eta_p^2 = .12$, reflecting generally higher mismatch accuracy in female observers.

2.3. Discussion

The results of Experiment 1 indicate that female observers are more accurate than their male counterparts in detecting identity mismatches, both with male and female face pairs, in line with suggestions

[1] It is noteworthy that this data was negatively skewed, with skew ranging from −0.207 to −0.253 across conditions (One-Sample Kolmogorov–Smirnov Test, all $Zs \geq 1.39$ and ≤ 1.70, all $ps < 0.05$). This reflects the fact that performance is generally closer to ceiling than chance in face matching. Parametric tests, such as ANOVA, often assume that data must be normally distributed, but this is mitigated if data are skewed by roughly the same degree and in the same direction across conditions (Roberts & Russo, 1999), as is the case in the present study. ANOVA generally also appears remarkably robust against violations of the normality assumption (see, e.g., Harwell, Rubinstein, Hayes, & Olds, 1992). In line with other research in this field, ANOVA was therefore used for analysis.