Acta Psychologica 130 (2009) 168–173

Contents lists available at ScienceDirect

Acta Psychologica

journal homepage: www.elsevier.com/locate/actpsy

Females excel at basic face perception

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ARTICLE INFO

Article history:
Received 6 August 2008
Received in revised form 5 December 2008
Accepted 9 December 2008

PsycINFO Classification:
2323

Keywords:
Gender difference
Face recognition
Face detection
Identity discrimination
Visual processing

ABSTRACT

Females are generally better than males at recognizing facial emotions. However, it is not entirely clear whether and in what way females may also excel at non-affective face recognition. Here, we tested males and females on two perceptual face recognition tasks that involved only neutral expressions: detection and identity discrimination. On face detection (Experiment 1), females were significantly more accurate than males in detecting upright faces. This gender difference was reduced during inverted face detection, and not present during tree detection, suggesting that the magnitude of the gender difference for performance co-varies with the extent to which face processing mechanisms are involved. On facial identity discrimination (Experiment 2), females again outperformed males, particularly when face images were masked by visual noise, or the delay between comparison face images was extended from 0.5 to 3 s. These results reveal a female advantage in processing face-specific information and underscore the role of perceptual factors in socially relevant gender differences.

1. Introduction

Numerous studies have found that females outperform males at recognizing facial emotions (for a review, see McClure (2000)). However, it is unclear whether females excel on non-affective face perception tasks such as face detection – the recognition of a face as 'a face,' and identity discrimination – the ability to pick out one particular facial identity from others (Bruce & Young, 1986).

The relationship between affective and non-affective face recognition is nuanced. On the one hand, evidence suggests that the affective and non-affective face recognition mechanisms can function independently. For example, there are several reports of individuals with brain damage who can process non-affective facial information, but not affective facial information (Humphreys, Donnelly, & Riddoch, 1993; Young, Newcombe, de Haan, Small, & Hay, 1993), or vice versa (Duchaine, Parker, & Nakayama, 2003; Evans, Heggs, Antoun, & Hodges, 1995). On the other hand, perception in one of these domains of face recognition (e.g., affective face recognition) has the ability to influence perception in the other domain (e.g., non-affective face recognition) (Calder & Young, 2005; Schyns & Oliva, 1999). Additionally, damage to cortical mechanisms specific to affect recognition (e.g., the amygdala) has been shown to influence the activation levels of basic visual areas that process face information such as V1 (Vuilleumier, Richardson, Armony, Driver, & Dolan, 2004). This pattern of results suggests that, while affective and non-affective face recognition are dissociable, they are also related to each other.

This relationship raises a question as to whether the female advantage in processing affective information is underpinned by or related to basic (non-affective) processing of face information. Two recent studies have shown that women are better than men at the recollection of facial identity (Lewin & Herlitz, 2002; Rehnman & Herlitz, 2007). However, in both studies, it is unclear whether better performance in females was due to an advantage in perceptual processing, or due to the memory component implicitly imposed by the experimental design. This issue is particularly relevant since women have been shown to outperform men on the measures of episodic memory (Herlitz, Nilsson, & Bäckman, 1997; Yonker, Eriksson, Nilsson, & Herlitz, 2003). Additionally, it is unclear whether the gender difference in facial identity recollection is same-gender specific (i.e., females are only better at recalling female faces), since the study by Lewin and Herlitz (2002) found that females were only better at recognizing female faces, whereas the study by Rehnman and Herlitz (2007) did not find this result. Further investigation along these lines may help clarify this issue.

In order to better understand the nature of the gender differences in basic face recognition, several related factors need to be disassociated experimentally. First, employment of face images in which gender cues are minimized would allow the analysis of male

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doi:10.1016/j.actpsy.2008.12.005

and female performance independent of gender content. Second, examining face recognition according to the individual perceptual and cognitive processes involved (e.g., face detection and identity recognition/discrimination) may offer a more nuanced picture of gender-related performance discrepancies. Lastly, in order to directly analyze the perceptual dimension of face recognition, it would be prudent to utilize a paradigm which either experimentally dissociates memory and perceptual demands, or else removes significant memory demands altogether.

In the present study, we assessed male and female performance on face detection and identity discrimination tasks. For face detection, emotional and gender cues were minimized via the use of facial images that contained only neutral emotional expressions and lacked gender specific information (i.e., facial hair, eyelashes, cheek bone structure, and exterior facial contours). For this task, there was no memory component. For facial identity discrimination, gender cues were unavoidably involved since such cues are an integral component of facial identity; however, emotional cues were minimal (again, only face images with neutral expressions were used), and a memory component was assessed separately from perceptual components. We hypothesized that females would be more accurate than males at detecting faces, although the two genders may have similar reaction times. Similarly, we hypothesized that females would be able to discriminate more subtle differences in facial identity, whether or not a memory component was involved.

2. Experiment 1: face detection

2.1. Method

2.1.1. Subjects

Sixty-two individuals (35 females) participated in the main task – upright face detection. Thirty-eight (22 females) also completed two comparison tasks – inverted face detection and tree detection. Participants were recruited via posted advertisement flyers within the local community. Inclusion criteria were defined as (1) aged between 21 and 80 years, (2) verbal IQ greater than 70, as measured by the WAIS-R (Wechsler, 1981), (3) visual acuity of at least 20/30, as measured by the Rosenbaum pocket vision screener, (4) no drug or alcohol abuse within the past six months, (5) no history of organic brain disease, and (6) no history of psychiatric illness. Criteria 4–6 were assessed during a screening interview with prospective participants, which was based on the SCID-NC (First, Spitzer, Gibbon, & Williams, 2002). Males and females did not differ significantly in terms of age, verbal IQ, and years of education ($p > 0.05$). Table 1 provides an overview of the demographic information of the sample.

Table 1
Demographic information of the sample. Number of participants is listed in parentheses after gender. Standard deviations are reported in parentheses. Education and age are measured in years. Verbal IQ was measured with the WAIS-R.

	Age	Verbal IQ	Education
Participants			
Females (35)	39.5 (14.2)	110.3 (10.9)	16.4 (2.3)
Males (27)	45.4 (13.7)	110.5 (10.5)	15.5 (2.2)

2.1.2. Stimuli

The target for face detection was a line-drawn face (or tree) embedded within a larger line-drawing, located on the right or left side of the image (Fig. 1). Orientation of faces could be upright or inverted, whereas trees were always upright. Stimuli were displayed for 13, 26, 52, or 104 ms on a PowerMac G4 with a 17-in. Studio monitor. In total, 62 line-drawn images (subtending 8.3° (width)/12.2° (height) of visual angle) were created, and each of these stimuli was presented four times for a total of 248 trials. Subjects performed tasks in a darkened room, seated at a distance of 63 cm from the monitor.

2.1.3. Procedure

Using a two-alternative forced choice method, subjects judged whether the face (or tree) was located on the left or right side of the line-drawing, and pressed one of two buttons on a keyboard to indicate their response (Fig. 1). Trials were grouped into blocks according to presentation time (13, 26, 52, and 104 ms), stimulus type (face and tree), and, in face detection, orientation (upright and inverted). The presentation order of the blocks that were completed was randomized across subjects. The protocol was approved by the Institutional Review Board of McLean Hospital, and an informed consent was obtained from each participant.

2.2. Results and discussion

2.2.1. Accuracy

A three-way ANOVA (condition × gender × presentation time) was used to compare male and female accuracy on upright face

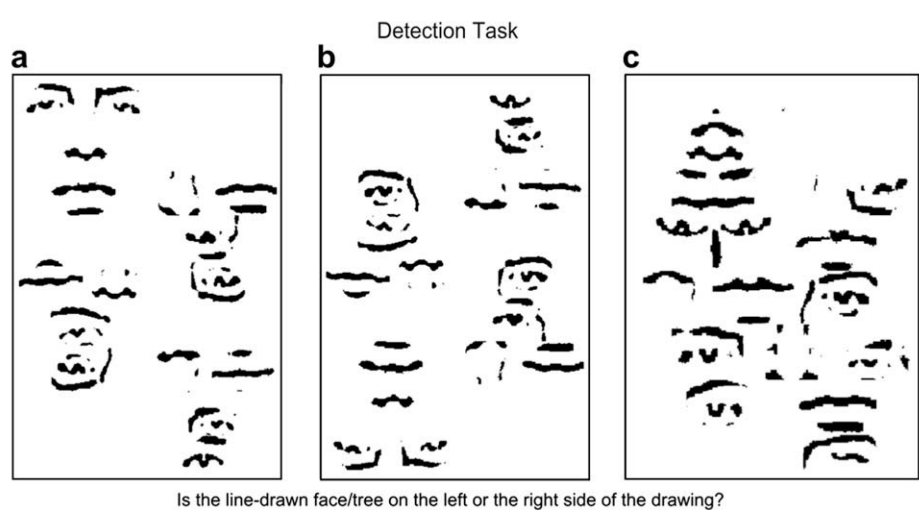

Fig. 1. (a) Illustration of a stimulus used in the upright face detection condition. (b) Illustration of a stimulus used in the inverted face detection condition. (c) Illustration of a stimulus used in the tree detection condition.