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Sex differences in face cognition ☆,☆☆

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ABSTRACT

Although there is abundant evidence for female superiority in Face Cognition (FC), a number of questions regarding sex differences remain to be addressed. Here we report a reanalysis of data on the level of latent factors, modeled on the basis of an extensive test battery applied to three samples of over 800 adults in all. In independent samples the measurement structure of FC was invariant for both sexes, indicating that the measurement of the construct does not depend on the context variable sex, and investigating mean performance differences will not be biased by measurement issues — a neglected aspect in previous studies. We confirmed female superiority for face perception (FP) and face memory (FM). For the first time we could show that these sex differences prevailed after accounting for sex differences in broadly measured general cognitive functioning and in object perception. Across adult age, sex differences in FM increased due to the rapid decline of this ability in men, whereas performance in women remained stable across adult age. Self-reported social involvement and things-oriented activities moderated sex-differences in FM. Results show that sex differences are salient at the level of specific FC constructs and that they can be partially explained by social involvement.

1. Introduction

Faces convey important social information such as age, gender, emotional expressions, social attractiveness, and lip speech. They are a primary gateway to biographical knowledge about familiar people, such as a person's occupation or social status, and to their names. Faces are crucial for successful interpersonal interaction since it is important to correctly perceive, learn, understand, and recognize the information that faces provide. Face cognition (FC) abilities are therefore important facets of social intelligence (e.g. Herzmann, Danthiir, Wilhelm, Sommer, & Schacht, 2007). This paper focuses on sex differences in FC and expends previous research by considering a variety of tasks assessing different aspects of FC as well as the aspect of its development through the adult lifespan.

Research on sex differences in general and specific cognitive abilities has a long tradition (Neisser et al., 1996). There is consensus about the absence of notable sex differences in general cognitive abilities (Halpern, 1992; Halpern & LaMay, 2000; Neisser et al., 1996). However, women perform at a somewhat higher level than men in episodic memory tasks (Herlitz, Airaksinen, & Nordström, 1999; Herlitz, Nilsson, & Bäckman, 1997) and verbal production tasks (e.g. Halpern & LaMay, 2000; Hedges & Nowell, 1995; Hyde & Linn, 1988; Schaie & Willis, 1993) whereas men outperform women in visuo-spatial tasks (Halpern & LaMay, 2000; Hedges & Nowell, 1995, Levine, Huttenlocher, Taylor, & Langrock, 1999; Voyer, Voyer, & Bryden, 1995) and at technical and scientific (Hedges & Nowell, 1995) as well as mathematical problem solving (Hyde, Fennema, & Lamon, 1990). Several studies also reported sex differences in perceptual speed favoring women (Hedges & Nowell, 1995; Schaie & Willis, 1993).

1.1. Previous research on sex differences in face cognition

Sex differences have frequently been reported also for processing faces. As noted above, faces contain many different aspects of socially relevant information as captured in the model of Bruce and Young (1986). The two most important aspects are the processing of facially expressed emotions and the recognition of others by identifying their

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face. Although we will be concerned only with the latter, we point out that sex differences in favor of females have been reported for perceiving emotional expressions (e.g. Fujita, Diener, & Sandvik, 1991; Hall & Matsumoto, 2004; Seidlitz & Diener, 1998; Thayer & Johnsen, 2000; for a meta-analysis see McClure, 2000) but there are also reports of inconsistent results within the same study (McKelvie, Standing, St. Jean, & Law, 1993) and no effects (Grimshaw, Bulman-Fleming, & Ngo, 2004) even in large samples (Hoheisel & Kryspin-Exner, 2005).

Considerably more consistent are findings about sex differences in face recognition (memory). Already in their review from 1986, Shapiro and Penrod concluded that women show better face recognition than men. Lewin, Wolgers, and Herlitz (2001) also reported that in a face recognition task women were superior to men. The authors suggested that this might relate to more pronounced verbalization strategies. Recently, Weirich and coworkers (Weirich, Hoffmann, Meißner, Heinz, & Bengner, 2011) showed a female superiority in face recognition, only when faces were presented for a long duration (10 sec) and mainly after a 24 hr delay. Lewin and Herlitz (2002) found women to be more accurate in recognizing previously seen unknown female faces than men, whereas there were no sex differences for male faces. The face superiority was not related to sex differences in verbal abilities because the differences prevailed after controlling for these abilities and were also present when presentation was too short to allow for verbal coding of the faces. These results of female superiority in recognizing female faces (female own-sex bias) were essentially confirmed in a large sample of 9-year old Swedish and Bangladeshi boys and girls (Rehnman & Herlitz, 2006) as well as in adults ($d = .72$) as reported by Rehnman and Herlitz (2007); however, in the latter study women were also better than men in recognizing male faces ($d = 0.36$). A recent study by Lovén, Herlitz, and Rehnman (2011) replicated the own-sex bias for women in face recognition and concluded from the effects of a concurrent task during face encoding that the own-sex bias emerges only when full attention is given during encoding.

Because these studies relied on tasks that require both perceptual and memory skills, McBain, Norton, and Chen (2009) implemented two tasks that excluded memory demands. In their first experiment, they used line-drawn faces that did not show sex specific cues for a face detection task. Women were more accurate than men. In the second task, they used pairs of morphed faces that varied in similarity for an identity discrimination task. Again, women excelled over men, especially, when the condition was more difficult because of perceptual noise or temporal delay. The authors concluded that female face processing superiority is independent of their superior memory and is not confined to female faces.

From the short review above, two key findings emerge: (a) Women are better than men in learning and recognizing faces and (b) this seems to be mainly true for female faces. A closer look to the literature on sex difference in FC, however, reveals a number of gaps and shortcomings. These shortcomings relate to the neglect of FC as part of a cognitive system in the service of social cognition (Herzmann et al., 2007). Instead, most studies have relied on isolated single face tasks and have, at best, partialled out performance in specific non-face tasks such as vocabulary (Lewin & Herlitz, 2002). It remains unclear to which degree the reported sex differences are attributed to specific task characteristics or sex differences in applying different strategies at solving the particular tasks. Here we suggest understanding FC as a specific ability within the structure of cognition. From this perspective, previous research can only be considered a first step towards a more profound understanding.

1.2. The structure of face cognition and its development through the adult lifespan

To overcome the shortcomings of previous studies outlined above we recently conducted three multivariate studies investigating the structure and nomological net of FC using a variety of established tasks assessing different aspects of FC. These studies (Wilhelm et al., 2010) showed that FC can be divided into three separate abilities, (1) the accuracy of perceiving faces (Face Perception — FP), (2) the accuracy of recognizing faces (Face Memory —FM), and (3) the speed of perceiving and learning and remembering faces (Speed of Face Cognition — SFC). The third factor supposedly captures the speed of both face perception and face memory. However, the speed factor was indistinguishable from the speed of processing facial emotional expressions and the speed of object cognition and may therefore be part of a more general system (Hildebrandt, Schacht, Sommer, & Wilhelm, 2011). This is not true, however, for the two accuracy factors, which are distinct from general cognitive functioning (Wilhelm et al., 2010). Both factors were shown to remain invariant across the adult life span from 18 to 88 years, despite substantial age-related performance declines were salient (Hildebrandt, Sommer, Herzmann, & Wilhelm, 2010; Hildebrandt, Wilhelm, Schmiedek, Herzmann, & Sommer, 2011).

1.3. Research questions

In order to locate sex differences in FC within the structure of cognition, it is necessary to test whether the measurement structure of FC and its relation to other factors of cognitive functioning is equivalent for men and women. For example, FC abilities and their relationship to general cognitive abilities and object perception might be more differentiated because of higher ability levels (e.g., Tucker-Drob, 2009) or less dependence of FC on general cognitive functioning in women than in men. To this question the literature is largely mute, except for attempts to relate the female superiority to verbal abilities (Lewin & Herlitz, 2002) or attention (Lovén et al., 2011). In order to properly address this question, several indicator tasks have to be considered in a sequence of latent variable models. Latent variable approaches explicitly account for measurement errors and allow for generalization from the performance in several specific tasks to stable individual differences in underlying hypothetical skills. There is no previous research using a latent variable approach, not least because neither the number of tests nor the number of participants has usually been sufficient to this end in prior research.

Second, if the factorial structure of FC is indeed sex-unspecific, it would be of interest, whether the reported female superiority can be replicated for latent factors and attributed to a specific face processing ability (perception or recognition, or both). The somewhat inconsistent studies by McBain et al. (2009) about FP cannot be considered as conclusive.

Third, it is of interest to know whether sex differences still hold, when differences in general cognitive abilities and object perception are taken into account. For example, women have been reported to excel over men in episodic memory (e.g., Andreano & Cahill, 2009). Could such differences in rather general cognitive abilities and object perception account for sex differences in the accuracy of FM and FP, respectively?

Fourth, it would be of special interest whether there are differential sex-specific patterns of age-related decline in FC. Previous research showed linear age-related decline of about 1 *SD* between 20 and 80 years in FM, but not for FP, after broadly measured general cognitive functioning was accounted for (Hildebrandt et al., 2011). In the light of reported female superiority in face recognition abilities (as outlined above) it is conceivable that the female superiority in FC increases across the adult age range because age-related decline in men might be stronger. As far as we know, no previous research has investigated age-related changes of sex-differences in FC.

A popular explanation of female superiority in FC is that women have greater interest in social aspects of daily life (Kaplan, 1978; Su, Rounds, & Armstrong, 2009) and thus acquire more expertise for human faces. We therefore recorded and analyzed self-reported