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# Aging affects sex categorization of male and female faces in opposite ways

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ABSTRACT

Faces are rich in social information; they easily give away a person's sex, approximate age, feelings, or focus of attention. Past research has mostly focused on investigating the distinct facial signals and perceptual mechanisms that allow us to categorize faces on these individual dimensions. It is less well understood how the different kinds of facial information interact. Here we investigated how the age of a face affects the ease with which young and older adults categorize its sex. Disconfirming everyday intuition, we showed that sex categorization is not generally hampered for older faces. Although categorization of female faces took progressively more time with increasing age, the opposite was found for male faces (Experiment 1). Differential effects of stimulus blurring and inversion for male and female faces of different ages (Experiment 2) strongly suggest one feature as a crucial mediator of the interdependence of age and sex perception — skin texture.



## 1. Introduction

We can tell whether a face is male or female within fractions of a second (Bruce et al., 1993; O'Toole, Peterson, & Deffenbacher, 1996). Various sources of information within the face allow us to make this decision with such efficiency. These include single facial features such as the eyes, nose, mouth, and chin (Brown & Perrett, 1993; Bruce et al., 1993; Roberts & Bruce, 1988) as well as the eyebrows and face outline (Yamaguchi, Hirukawa, & Kanazawa, 1995). We also base sex categorizations on configural information, i.e., relational information between facial features, such as the distance between the eyelids and the brows (Campbell, Wallace, & Benson, 1996). The importance of such configural information for sex decisions is reflected in the fact that face inversion, a manipulation that is thought to disturb configural processing, substantially impairs sex classification (Bruce et al., 1993; Wiese, Kloth, Güllmar, Reichenbach, & Schweinberger, 2012).

Here we ask whether other social signals, specifically the age of a face, also affect our perception of its sex. To date there is a remarkable lack of research on the effect of variations in facial age on the perception of sex in faces, with only very few exceptions (Johnston, Kanazawa, Kato, & Oda, 1997; Quinn & Macrae, 2005). The virtual absence of such research perhaps relates to the common assumption that invariant facial signals are processed rather independently, and that different facial categorizations rely on distinct visual features (Bruce & Young, 1986). However, some facial characteristics might be informative for multiple categorizations of faces, and the change of one facial aspect might therefore also affect the perception of the face on a different dimension (e.g., Adams & Kleck, 2003; Schweinberger & Soukup, 1998).

There is indeed evidence to support the idea that the perception of sex at least partly relies on information that also allows for age categorization. Wiese, Schweinberger, and Neumann (2008) found that participants were faster to categorize the age of faces that had earlier been categorized according to their sex, compared to new faces. This finding suggests that visual information underlying the perception of facial age had already been accessed during prior exposure, even when the task required a sex categorization.

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Considering that sex and age categorizations of faces seem to at least partly rely on shared information, it is possible that variations in age also affect the perception of sex from faces. However, the specific nature of such a relationship is as yet unspecified. A common everyday intuition seems to be that sex categorization becomes increasingly difficult as faces grow older. Strikingly, there is only very little empirical support for this assumption, with the exception of a single study. Quinn and Macrae (2005) investigated whether perceivers simultaneously attend to a person's various "identities" (e.g., as a woman or a senior citizen). They asked participants to categorize faces according to their sex, while either presenting young and old faces within each experimental block or keeping age constant. In blocks in which faces varied in both age and sex, Quinn and Macrae found that participants were faster to categorize the sex of young faces (20 to 30 years old) than of older faces (>60 years old). The authors concluded that this age-dependent sex categorization "may reflect the fact that facial changes during aging tend to minimize apparent sex differences between female and male faces" (p. 473).

Quinn and Macrae's (2005) interpretation is intuitively convincing, and it is also concordant with changes in sex hormone levels during adulthood. Both testosterone and estrogen reach peak levels in adolescence and early adulthood, causing sexual dimorphism in face and body appearance. As the levels of these hormones start to decrease in a person's forties to fifties (Feldman et al., 2002; Lamberts, van den Beld, & van der Lely, 1997), sexual dimorphism in faces might also be expected to decrease in older age.

However, data from another study raise the interesting possibility that face age might affect the perception of sex from male and female faces differently. Johnston et al. (1997) measured participants' reaction times when categorizing male and female child and adult faces according to sex and age (in separate blocks). During sex categorizations, participants responded faster to adult than child faces, a finding that is unsurprising, given that sexual dimorphism in the face is more pronounced after puberty than before. More importantly, however, when categorizing the faces for age (young vs. old), participants responded more slowly to female adult faces than to any other face condition, i.e., male adult and children's faces. This finding suggests that female adult faces are more difficult to distinguish from children's faces than male adult faces.

We find this aspect of Johnston et al.'s data particularly interesting because it might indicate an important role of skin texture in any potential interaction of face age and face sex. Here, we use the term "skin texture" to refer to the detailed pattern of the skin surface, as determined by the presence or absence of lines, wrinkles, visible pores, and stubble.[3] The skin texture of young adult female faces is smoother than that of male faces and therefore more similar to that of children, which possibly delays age discrimination of these faces when presented amongst children's faces. Critically, skin texture is not only a reliable cue to age (George & Hole, 1995, 2000; Lai, Oruç, & Barton, 2013; for a review, see Rhodes, 2009), but is also relevant for sex decisions: Bruce et al. (1993) demonstrated that sex perception is substantially impaired relative to baseline performance when participants are asked to categorize laser-scanned face stimuli, which are lacking texture information.

The idea that the age and sex of faces might be processed interactively, possibly moderated by a shared reliance on skin texture information, is also in line with the finding that feminized faces are perceived to be younger than masculinized faces (Perrett et al., 1998). Moreover, the age of adult female faces tends to be underestimated, whereas the age of male faces tends to be slightly overestimated (Voelkle, Ebner, Lindenberger, & Riediger, 2012, a pattern that appears to be reversed during adolescence when girls are perceived to be older-looking than boys of the same age, Willner & Rowe, 2001).

Importantly, if smooth skin is indicative of both youth and femininity, age-related changes in skin texture would be predicted to not only influence our perception of facial age itself, but to also hamper sex categorization of older female faces more than that of male faces. Here, we systematically investigated the effect of face age on sex perception in adult faces. Our aim was to establish whether increasing age affects the efficiency of sex classifications of male and female faces similarly, in line with previous conclusions (Quinn & Macrae, 2005), or whether the perception of sex in female and male faces is differentially affected by aging, as would be predicted based on the importance of skin texture information for both age and sex classifications (Bruce et al., 1993; Lai et al., 2013). To this end, we asked participants to categorize the sex of male and female faces from three different age groups, ranging from young adulthood to older age. Based on the fact that a reduction of collagen, elastin and subcutaneous adipose tissue makes aging skin gradually lose its smooth texture, which serves as an indicator of both youth and femininity, we predicted differential effects of age on sex categorization for male and female faces. Specifically, female faces should take longer to categorize with increasing age. In contrast, no such detrimental effects were predicted for male faces. In fact, if the absence of smooth skin texture actually serves as a signal for masculinity, male faces might even be categorized more easily with increasing age (cf., Voelkle et al., 2012).

## 2. Experiment 1

### 2.1. Materials and methods

#### 2.1.1. Participants

Twenty young adults (9 men, age range 18–30 years, $M = 24.5$, $SD = 3.5$) participated in the experiment. All participants were naïve to the purpose of the study and had normal or corrected-to-normal vision. The study was in accordance with the ethical guidelines of the Declaration of Helsinki. Written informed consent was obtained from all participants before the experiment.

#### 2.1.2. Stimuli

Color pictures of 144 unfamiliar individuals were obtained from the FACES database of the Max Planck Institute for Human Development (Ebner, Riediger, & Lindenberger, 2010). Faces were of three different age groups, each represented by 48 individuals (50% male). Young faces ranged from 19 to 28 years (male faces: 20–28 years, $M = 23.9$ years, female faces: 19–28 years, $M = 22.5$ years), middle-aged faces ranged from 43 to 55 years (male faces: 43–55 years, $M = 49.0$, female faces: 45–55 years, $M = 48.9$), and old faces ranged from 69 to 78 years (male faces: 70–78 years, $M = 72.5$, female faces: 69–78 years, $M = 73.1$). Within each age group, male and female faces did not significantly differ in age, all $ts < 1.7$, all $ps > .10$.

Pictures did not contain gender-specific features such as beards, glasses, make-up, or jewelry and were edited so that the hair was removed from the image as completely as possible.[4] Stimuli measured 8.2 cm in width and 10.1 cm in height, corresponding to 5.2° × 6.4° at a viewing distance of 90 cm, which was kept constant using a chin rest (Fig. 1).

#### 2.1.3. Design and procedure

Face age (young, middle-aged, old) and Face sex (female, male) were varied within participants, resulting in six experimental conditions. Participant sex was considered as between-participants factor.

[3] Note that this definition deviates from a less specific use of the term texture (often used interchangeably with the term reflectance), as a general measure of the reflecting properties of the skin surface.

[4] In a few cases, female faces had hairstyles that were impossible to completely edit out due to fringes covering parts of the forehead. However, this was a rare occurrence and evenly spread across all age groups.