



Do individuals with autism spectrum disorder process own- and other-race faces differently?



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ABSTRACT

Individuals with autism spectrum disorder (ASD) process human faces in atypical ways according to previous literature. We investigated whether individuals with ASD can process face race information and respond to own- and other-race faces differentially. Chinese individuals with ASD ($n = 24$), typically developing (TD) individuals ($n = 28$), and individuals with intellectual disabilities (ID, $n = 26$) were asked to recognize Chinese and Caucasian faces in an old-new face paradigm using eye tracking. In terms of recognition, the ASD and ID groups did not perform differently and displayed superior own-race recognition compared with other-race faces; TD participants displayed similar recognition of the two types of faces. In terms of eye tracking, the TD, ASD, and ID groups displayed more looking on the eyes and less looking on the nose and mouth of Caucasian faces relative to Chinese faces. Overall, individuals with ASD manifested a behavioral other-race effect and displayed the same type of cross-racial differentiation in face scanning observed in TD individuals. The findings suggest that as is the case with TD individuals, face processing of individuals with ASD is influenced by differences in visual experience with different face categories.

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1. Introduction

Individuals with autism spectrum disorder (ASD) have difficulty in recognizing and discriminating human faces, compared to typical populations in previous studies (e.g., Gepner, de Gelder, & de Schonen, 1996; Klin et al., 1999). However, these prior studies on face processing in ASD mostly used human faces from the same racial group as the participants. In particular, Caucasian facial stimuli were used for Caucasian participants. Using eye-tracking methodology, we investigated whether individuals with ASD process faces of other racial groups differently from faces of their own racial group so as to elucidate the role of visual experience in face processing of individuals with ASD.

In addition to the study of behavioral performance of face processing by those with ASD, eye-tracking techniques have allowed researchers to examine eye movement patterns of individuals with ASD when they view faces. However, controversies exist with regard to previous findings on face scanning patterns in ASD. A number of prior eye-tracking studies have reported that compared to typically developing (TD) people, individuals with ASD attended less to human faces and core facial features, especially the eye region (e.g., Klin & Jones, 2008; Klin et al., 2002a; Klin et al., 2002b; Pelphrey et al., 2002; Shimojo, Wu, & Shimojo, 2013; Trepagnier, Sebrechts, & Peterson, 2002; Yi et al., 2013). However, other studies reported similar face scanning patterns in TD individuals and those with ASD (Falck-Ytter et al., 2010; Rutherford & Towns, 2008). As was the case with behavioral recognition and discrimination, all the eye-tracking studies mentioned above focused only on human faces of the same race as the participants.

Examining how individuals with ASD process faces of other racial groups would deepen our knowledge of the nature of face processing abnormalities in ASD. The current study investigated whether individuals with ASD process faces of other racial groups

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differently from faces of their own racial group with the specific goal of elucidating the role of visual experience with human faces in ASD. One hypothesis proposed fundamental deficits that are specific to processing faces in ASD (e.g., see, for example, discussion in [Chawarska & Volkmar, 2007](#)). If there is a pervasive face processing deficit associated with ASD, then it should mute individuals with ASD to all aspects of visual experience. However, if some aspects of face processing are spared and are normal in ASD (e.g., [Cleary et al., 2014](#)), then ASD individuals should be sensitive to those aspects. Race is a salient social category attribute of faces, and there is compelling evidence that typically developing individuals display differences in processing same- vs. other-race faces based on differential experience ([Anzures et al., 2013a](#); [Anzures et al., 2013b](#)). If there is an all-encompassing face processing deficit in ASD, then ASD individuals would be expected to process same- and other-race faces similarly. However, if processing of race information is spared in ASD, then we would expect that ASD individuals are sufficiently sensitive to experiential differences between same- and other-race faces to display cross-racial face processing differences.

It is well established that typically developing individuals display an advantage in recognizing and discriminating own-race faces over other-race ones (e.g., [Walker & Tanaka, 2003](#); see [Meissner & Brigham, 2001](#), for a review). This other-race effect (ORE), consistently found in the typical population across ages and races ([Lee et al., 2011](#)), could be due to a number of not mutually exclusive factors, such as one's extensive experience with own-race faces and relatively limited experience with other-race faces, incorporation of culture-specific cognitive processes (e.g., [Fu et al., 2012](#); [Hu et al., 2014](#); [Liu et al., 2011](#)), and even explicit or implicit racial prejudice ([Lebrecht et al., 2009](#); [Zebrowitz, White, & Wieneke, 2008](#)).

We sought to investigate whether those with ASD are sensitive to the cross-racial difference in visual experience with faces. To date, how individuals with ASD process own- and other-race faces has only been explored in two studies. Wilson and colleagues (2011) asked children with ASD and TD children to choose from two alternative faces to match the identity of a target face, and found that both ASD and TD groups displayed a typical own-race advantage in this task. The [Wilson et al. \(2011\)](#) results are consistent with the findings that 6-year-old children with ASD display the same type of gender and racial stereotyping as unimpaired controls ([Hirschfeld et al., 2007](#)). Given that the children with ASD failed a false-belief task, the combination of findings has been used to argue that while those with ASD display theory-of-mind deficits (e.g., [Baron-Cohen, Leslie, & Frith, 1985](#)), they may process observable social category attributes such as gender and race in ways comparable to typically developing individuals ([Hirschfeld, 2013](#)). However, in a more recent study by [Chien et al. \(2014\)](#), only TD children, but not children with ASD, displayed an own-race advantage over other-race faces. This latter result thus suggests that children with ASD are not sensitive to race information in faces.

Considering the inconsistency in the existing evidence regarding the behavioral ORE in individuals with ASD, we investigated their face scanning patterns to provide a different measure of processing race information from faces. That is, by using eye tracking, we examined whether individuals with ASD, as well as their age-matched TD peers and IQ-matched peers with intellectual disabilities (ID), display different cross-racial face scanning patterns. We also tested face recognition of these three groups. It is noteworthy that a majority of the participants in the [Wilson et al. \(2011\)](#) study were Caucasian, whereas the participants in the current study are Chinese. The involvement of Chinese participants with ASD thus allows us to assess whether the perception of face race in individuals with ASD is impacted by racial identities different from Caucasian.

We used an old-new face recognition paradigm to ask Chinese participants to remember several face identities (half of the faces were Chinese and the other half were Caucasian) and then tested whether participants perceived the faces as “old” or “new”. In addition, we provided a longer viewing time than what is typical in a face recognition study in order to obtain sufficient eye-tracking data. Due to these procedural changes, we anticipated that TD individuals would reach ceiling in their recognition performance for both races of faces because the task would be rather easy for them. Thus, we did not expect to find the own-race face superiority effect seen among the TD individuals in a typical face recognition paradigm. However, the current task might not be too easy for individuals with ASD such that their recognition performance might be above the chance level, but below ceiling. If that were the case, based on the findings of Wilson and colleagues (2011), we expected a recognition advantage for own-race faces over other-race ones in individuals with ASD.

We also used area of interest (AOI) and data-driven data analytic methods to examine whether individuals with ASD display different cross-racial face scanning patterns when compared with TD and ID groups. We expected that participants with ASD would fixate on core facial features (e.g., eye region, nose, and mouth) differently from TD and ID groups, based on previous evidence regarding ASD-related face processing abnormalities.

With regard to own- and other-race face scanning differences, cultural differences in eye gaze patterns when processing faces have been found in the prior literature with typical populations (e.g., [Fu et al., 2012](#); [Wheeler et al., 2011](#)). More specifically, it has been suggested that Chinese individuals have been socialized to focus on the central regions of faces (e.g., the nose region) whereas Westerners have been socialized to focus on the eye regions ([Fu et al., 2012](#)). This nose-centric strategy seen among Chinese individuals has been further suggested to be due to the fact that Chinese cultural norms of face-to-face interaction discourage excessive eye contact. There is, however, controversy as to whether Chinese observers show the nose-centric scanning pattern for Chinese faces only ([Fu et al., 2012](#); [Hu et al., 2014](#)) or for both own- and other-race faces (e.g., [Blais et al., 2008](#); [Kelly et al., 2011](#)). Regardless of this controversy, it is agreed that socialization of cultural norms regulating interpersonal interaction drives the scanning of faces by TD individuals. Although no study has examined whether individuals with ASD would show different eye movement patterns when processing own- and other-race faces, based on the existing findings with Chinese adults and infants ([Fu et al., 2012](#); [Hu et al., 2014](#); [Wheeler et al., 2011](#)), we expected that our Chinese TD individuals would scan the eye regions of Caucasian faces longer than those of Chinese faces, but scan the nasal and oral regions of Chinese faces longer than those of Caucasian faces. We also hypothesized a similar cross-racial differentiation of face scanning patterns in individuals with ASD. However, given impairments in social communicative skills in ASD, we speculated that the influence of socialization of cultural norms, if any existed, would have a lesser impact on individuals with ASD than TD individuals, and thus cross-racial differences of face scanning patterns in ASD individuals might be smaller relative to TD individuals.

2. Material and methods

2.1. Participants

We recruited three groups of participants: 24 adolescents and young adults with ASD and 26 individuals with ID as IQ-matched peers recruited from special training centers for the disabled in Guangzhou, China, and 28 age-matched TD individuals in the same city also participated (see [Table 1](#) for detailed information on the

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