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# Looking at faces from different angles: Europeans fixate different features in Asian and Caucasian faces

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ABSTRACT

Race categorization of faces is a fast and automatic process and is known to affect further face processing profoundly and at earliest stages. Whether processing of own- and other-race faces might rely on different facial cues, as indicated by diverging viewing behavior, is much under debate. We therefore aimed to investigate two open questions in our study: (1) Do observers consider information from distinct facial features informative for race categorization or do they prefer to gain global face information by fixating the geometrical center of the face? (2) Does the fixation pattern, or, if facial features are considered relevant, do these features differ between own- and other-race faces? We used eye tracking to test where European observers look when viewing Asian and Caucasian faces in a race categorization task. Importantly, in order to disentangle centrally located fixations from those towards individual facial features, we presented faces in frontal, half-profile and profile views. We found that observers showed no general bias towards looking at the geometrical center of faces, but rather directed their first fixations towards distinct facial features, regardless of face race. However, participants looked at the eyes more often in Caucasian faces than in Asian faces, and there were significantly more fixations to the nose for Asian compared to Caucasian faces. Thus, observers rely on information from distinct facial features rather than facial information gained by centrally fixating the face. To what extent specific features are looked at is determined by the face's race.


## 1. Introduction

There is considerable evidence that race categorization occurs early and mostly automatically for faces (e.g. Levin, 1996; Taylor et al., 1978), despite the fact that there are no human races in the biological sense (Cosmides, Tooby, & Kurzban, 2003; Tishkoff & Kidd, 2004). Nonetheless, perceived race affects subsequent face encoding profoundly: The "other-race effect" (ORE) for example is a robust psychological phenomenon (for a meta-analysis see Meissner & Brigham, 2001), describing the fact that other-race faces are more difficult to recognize compared to own-race faces.

Behavioral and electrophysiological findings suggest that differences in own- vs. other-race face perception appear at early stages of visual processing (Caharel et al., 2011; Ito & Urland, 2003). Assessing where observers initially direct their gaze during face categorization could therefore help investigating whether differences in visual input could be at the basis of such differences in face processing. Precise visual input is only available within the visual field of the fovea. Thus, specific parts of a visual scene are fixated foveally one after another to bring crucial visual information into focus (Loftus & Mackworth, 1978; Yarbus, 1967), and eye tracking techniques serve as a useful tool for assessing which parts of a face a viewer considers most informative for the task at hand.

In contrast to many recent studies on eye movements in face perception tasks, here, we are not investigating the ideal strategy to optimize performance (as e.g., Peterson & Eckstein, 2012), or the ability of the visual system to efficiently use the information provided by natural or manipulated face stimuli (e.g., Schyns, Bonnar, & Gosselin, 2002). What we are studying here is what information human observers *consider* diagnostic by recording where they look in a face while judging its race. We concentrated on the first fixation in our analyses, because it probably provides the visual input most crucial for face race categorization for three reasons: First, many face categorization tasks can be completed, if necessary, after one or two fixations only (Hsiao & Cottrell, 2009).

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Second, face race categorization is considered to be an especially fast and automatic process (e.g. Levin, 1996; Taylor et al., 1978) generally occurring before and faster than other judgments, e.g. sex categorization (Ito & Urland, 2003). Third, differences in brain activity for own- and other-race faces strongly suggest that face race affects the earliest stages of face perception (Caharel et al., 2011; Ito & Urland, 2003).

Eye tracking has recently been used in a range of studies investigating race- and culture-specific fixation strategies: Generally, it has been reported that Western Caucasian observers use rather analytical viewing strategies, fixating the most prominent features of a scene or object, whereas East Asian observers look at stimuli more holistically, i.e. they pay more attention to the background and/or central regions than Westerners (Chua, Boland, & Nisbett, 2005; Kelly, Miellet, & Caldara, 2010). The same differences between observers of European and Asian backgrounds have also been found for face perception (Blais et al., 2008; Kelly, Miellet, & Caldara, 2010; Kelly et al., 2011; Miellet et al., 2013). Some of these studies report that observers employ the same culture-specific fixation strategies regardless of whether they look at own- or other-race faces (Kelly, Miellet, & Caldara, 2010; Kelly et al., 2011). Contrary to that, however, there are also studies reporting diverging fixation patterns for own- and other-race faces in Asian (Fu et al., 2012) as well as European (Goldinger, He, & Papesh, 2009) observers. The authors of these latter studies propose that such differences might arise due to the enculturation of particular visual strategies (Fu et al., 2012; Liu et al., 2011; Wheeler et al., 2011): As these culturally shaped strategies develop predominantly in interaction with own-race faces, they might not be used for other-race faces, resulting in differing viewing patterns for both face categories. Yet another line of evidence for differing scanning strategies argues that observers directly access the individuation level, i.e. they process information about idiosyncratic features, only when viewing own-race faces (Levin, 1996, 2000; MacLin & Malpass, 2001). According to this theory, the presence of a "racial marker" in other-race faces directs the observer's attention away from the identity of the face and towards the feature that serves as this marker.

Overall, thus, the literature so far is quite inconsistent concerning differences in fixation patterns between own- and other-race faces, with recent studies reporting contradictory results. We aimed to address these inconsistencies in the task that usually precedes other face-related judgments, i.e. during race categorization. There is an advantage of studying race categorization itself, rather than identification or other face judgments in different races: In the latter tasks, the features that are most informative, e.g. for judging a face's sex, age or other not race-related properties, might differ between races, making it thus necessary to look at each race differently for optimal performance. As for face race categorization, however, the features diverging most in appearance between face races can be considered the most diagnostic ones. Hence, it would be an efficient strategy for race categorization to look at these same features preferentially across all face races. Differences in fixation distributions for own- and other-race faces are thus least likely to emerge in a face race categorization task. If such differences emerge nonetheless, these findings would strongly suggest that observers' fixation behavior changes according to face race *per se* and not only because they chose fixation strategies most efficient for the task at hand.

So far no study yet concentrated on differences in fixations across face races during race categorization. Even though Blais et al. (2008) employed such a task, alongside learning and recognition trials, they did not report whether there were differences in viewing strategies for own- compared to other-race faces during race categorization. In the current study, we thus investigated where observers look in own- and other-race faces when classifying them by race. As it has been suggested that centrally located fixations – as opposed to fixations distributed over specific facial features – are characteristic for face processing in a variety of tasks (Armann & Bülthoff, 2009; Schwarzer, Huber, & Dümmler, 2005) or at least for the first fixation on a face (Bindemann, Scheepers, & Burton, 2009), we disentangled the position of inner facial features from the center of the face stimulus by presenting the faces in different orientations. Most features are visible in all orientations, but their position changes, with for example the nose moving from center-most feature in a frontal face to the outer border on either side in profile view.

In view of the findings reviewed above, several possible outcomes could be predicted for our experiment: First, if our observers consider detailed information about specific facial features to be crucial for race categorization of own- and other-race faces, they should always direct their gaze to those features, independent of face orientation. If, in contrast, face processing and thus race categorization, too, relies mostly on fixations to the center of the visible face, a preference to look at the center of the face in all face orientations would be expected. Second, if one or a few features serve as "racial markers" for other-race faces only, these features should be more often fixated in other- compared to own-race faces. If however culture-specific fixation strategies are applied to all faces, locations of initial fixations should be similar for own- compared to other-race faces.

Thus, we aimed to answer two major questions in our study: (1) Does race categorization generally rely on sampling information from distinct facial features or rather on gaining global face information by fixating the geometrical center of the face (Blais et al., 2008)? (2) Do fixation distributions differ for own- and other-race faces when categorizing faces by race?

We tested European participants on Asian and Caucasian faces in a time-controlled race categorization task while recording their gaze position. We have not included the factor cultural background of the observer in this study; rather, we focused on first assessing the effect of different face orientations in combination with face race in one culturally homogenous sample of observers. These insights may then serve to guide further research on intercultural differences. Our results clearly indicate that information from distinct facial features is sampled for race categorization and that those features vary depending on *face race*. Specifically, our European participants clearly fixated the eyes more in Caucasian (own-race) than in Asian (other-race) faces, in which, in comparison to Caucasian faces, they looked at the nose more often.

## 2. Methods

### 2.1. Observers

Observers were 24 individuals (12 females, mean age = 27.5 yrs, *SD* = 8.5) with European cultural and ethnical background, normal or corrected-to-normal visual acuity and no known impairments of face recognition. None of the participants has reported to have lived in Asia for more than 6 months and none of the participants stated to have intense contact with Asian individuals. All participants received a remuneration of €8 per hour and participated only once. All participants gave written informed consent according to the Declaration of Helsinki.

### 2.2. Stimuli and setup

Static face images were derived from three-dimensional laser scans collected in the face database of the Max Planck Institute for Biological Cybernetics (http://faces.kyb.tuebingen.mpg.de). From these heads, 2D face images were derived in a full-frontal,