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Eye-tracking the own-race bias in face recognition: Revealing the perceptual and socio-cognitive mechanisms

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ABSTRACT

Own-race faces are recognised more accurately than other-race faces and may even be viewed differently as measured by an eye-tracker (Goldinger, Papesh, & He, 2009). Alternatively, observer race might direct eye-movements (Blais, Jack, Scheepers, Fiset, & Caldara, 2008). Observer differences in eye-movements are likely to be based on experience of the physiognomic characteristics that are differentially discriminating for Black and White faces. Two experiments are reported that employed standard old/new recognition paradigms in which Black and White observers viewed Black and White faces with their eye-movements recorded. Experiment 1 showed that there were observer race differences in terms of the features scanned but observers employed the same strategy across different types of faces. Experiment 2 demonstrated that other-race faces could be recognised more accurately if participants had their first fixation directed to more diagnostic features using fixation crosses. These results are entirely consistent with those presented by Blais et al. (2008) and with the perceptual interpretation that the own-race bias is due to inappropriate attention allocated to the facial features (Hills & Lewis, 2006, 2011).

1. Introduction

Own-race faces are recognised more accurately than other-race faces: this is the own-race bias (ORB) in face recognition (e.g., Meissner & Brigham, 2001). It is a highly reliable effect (Chance & Goldstein, 1996) across various races (Ng & Lindsay, 1994) and has implications in eye-witness recognition (Leippe, 1995). There are many theories of the ORB but these can be broadly separated into socio-cultural accounts and perceptual models. Levin (1996, 2000) proposed that the ORB is due to the depth of encoding. Specifically, when presented with an own-race face, effortful and deep processing is engaged in leading to individuation. However, when presented with other-race faces, shallower processing is employed involving categorisation processes (Meissner, Brigham, & Butz, 2005): participants process race as a visual feature (Levin, 2000). Similarly, Sporer (2001) proposed the in-group/out-group model, in which own-race faces are automatically processed deeply, whereas other-race faces are processed to a shallow level. That is, people have the motivation to process own-race faces deeply, but not other-race faces.

Perceptual accounts of the ORB, however, are based on the idea that we employ some form of expert perceptual or cognitive mechanisms to encode and store own-race faces. Expert face processing has been suggested to be based on relational (distances between features) or holistic (analysing the face as a whole) processing (e.g., Tanaka & Farah, 1993). This is in contrast with the inexpert featural processing (where each feature is processed independently; for a review, see Maurer, Le Grand, & Mondloch, 2002). Holistic processing is based on our visual experience (Carey, de Schonen, & Ellis, 1992; Le Grand, Mondloch, Maurer, & Brent, 2001). Hancock and Rhodes (2008) have suggested that own-race faces are processed more holistically than other-race faces, and this leads to the ORB

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(Hugenberg & Corneille, 2009; Michel, Rossion, Han, Chung, & Caldara, 2006).

Another perceptual model of the ORB is based upon Valentine's (1991) face-space model of face memory. In this model, all faces are stored in some form of multidimensional space in which the dimensions represent physiognomic features. The dimensions are diagnostic for the most frequently encountered faces (Lewis, 2004) as a result of development (Hills, Holland, & Lewis, 2010). This means that physiognomic differences across races (McClelland & Chappell, 1998) are implicitly represented in the face-space: the dimensions used for encoding and recognition of own-race faces will be more diagnostic and appropriate, but are unlikely to be as diagnostic for the processing of other-race faces (Hills & Lewis, 2006, 2011). Thus, other-race faces are stored closer together in face-space making them more confusable (Valentine & Endo, 1992). Furthermore, the dimensions of face-space guide how well faces are encoded (Hills & Lewis, 2006).

Hills and Lewis (2006) used this face-space metaphor to train White participants to use the features typically described by Black participants when recognising faces. Ellis, Deregowski, and Shepherd (1975) found that Black and White participants describe faces using different features: White participants describe faces using the hair colour, texture, and iris colour more so than Black participants, whereas Black participants tend to use the hair position, eye size, eyebrows, chin, ears, nose, and lips more so than White participants (see also, Shepherd & Deregowski, 1981). Hills and Lewis' (2006) training removed the ORB in White participants. This was interpreted as the training altered the dimensions of the face-space that were used to encode the faces. Hills and Lewis (2011) devised a related method for reducing the ORB in White participants. They presented faces preceded by a fixation cross that either drew White participants' attention to the eyes or to the tip of the nose. Recognition of White faces was better when the fixation cross preceded the eyes, but the recognition of Black faces was better when the fixation cross preceded the nose.

Hills and Lewis (2006, 2011) interpreted these results within the face-space metaphor: faces of different races are processed more accurately using different physiognomic features. Black faces are easier to distinguish based on the nose, whereas White faces are more distinguishable from the eyes (Ellis, 1975). The ORB is due to participants not attending to these most diagnostic visual features. This interpretation is only based on behavioural data however it is consistent with the differential feature hierarchy for Black and White observers (whereby the eyes are the most diagnostic visual feature for White participants processing faces and other features are less diagnostic, e.g., Haig, 1985, 1986; Hills, Ross, & Lewis, 2011). Eye-tracking evidence is required to confirm this conclusion.

The socio-cognitive theories (e.g., Levin, 2000; Sporer, 2001) of the ORB and the holistic/featural processing (Hancock & Rhodes, 2008) perceptual theory make the assumption that we view own- and other-race faces differently. If these theories are correct, then you would expect to find that there are eye-tracking differences when viewing own- and other-race faces. However, these theories do not predict that there would be any eye-movement differences across participants of different races.

There is a problem with the suggestion above: eye-movements are relatively slow and face perception is fast. The face-sensitive Event-Related-Potential occurs 170 ms after the stimulus has been presented (e.g., Joyce & Rossion, 2005) and ERPs as early as N250 show familiarity effects (e.g., Tanaka, Curran, Porterfield, & Collins, 2006) implying face recognition occurs within 200 ms. The first fixation typically lasts about 200–300 ms (e.g., Guzman-Martinez, Leung, Franconeri, Grabowecky, & Suzulo, 2009; Sæther, van Belle, Laeng, Brennen, & Øvervoll, 2009), suggesting that only one fixation is required to accurately recognise faces. Indeed, Hsiao and Cottrell (2008) have shown that face recognition is accurately performed with only one central fixation and is not much improved with three or more fixations beyond the level obtained with two fixations. This would suggest that any processing differences observed for own- and other-race faces are not likely to be due to eye-movement differences, rather they will be due to coding differences subsequently. However, there is evidence that with longer exposure durations to faces, recognition accuracy is increased (e.g., Bruce, 1982; Ellis, 1981; Laughery, Alexander, & Lane, 1971; Shepherd, Gibling, & Ellis, 1991), though this is not due to more features being sampled (Coin & Tiberghien, 1997). Potentially, therefore, coding differences may be revealed through eye-movements following these first two fixations.

The other perceptual theories of the ORB (based on the face-space, Valentine, 1991), however, make a contrasting prediction to the socio-cultural and holistic/featural processing accounts: namely that there would be observer differences in eye-movements based on cultural exposure and experience. Given the physiognomic differences of faces of different races, and the experience of looking at these faces, the features explored by one race will be different than the features explored by a different race. However, there would be no effect of race of face, because the observer would simply use their native scan-path for all faces and the deficits to recognition are caused by the fact it is not expert enough because it does not focus on the most diagnostic features.

Given the clear predictions made by these theories, we should explore what the experimental data shows us. There have not been many studies employing eye-tracking and the ORB. One of the first was conducted by Blais et al. (2008) who found that Western Caucasian observers fixated upon each eye more so than East Asian observers. Conversely, East Asian observers fixated upon the nose more than Western Caucasian observers. This pattern of results was observed when the observers were viewing both own- and other-race faces in both a race categorisation task and an old/new recognition paradigm. Thus, this suggests that culture affects the way people view faces and that people use the same eye-movements when viewing all faces. Similar results were obtained by Caldara, Zhou, and Miellet (2010) using an old/new recognition paradigm.

Contrasting with the findings of Blais et al. (2008), Caldara et al. (2010), Goldinger et al. (2009) reported a recogni-