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COMMENTARY

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Visual attention to own- versus other-race faces: Perspectives from learning mechanisms and task demands

Janet H. Hsiao[1,2,3] | Antoni B. Chan[4]

[1]Department of Psychology, University of Hong Kong, Hong Kong, China

[2]Institute of Data Science, University of Hong Kong, Hong Kong, China

[3]The State Key Laboratory of Brain and Cognitive Sciences, University of Hong Kong, Hong Kong, China

[4]Department of Computer Science, City University of Hong Kong, Hong Kong, China

Correspondence
Janet H. Hsiao, Department of Psychology, University of Hong Kong, Pokfulam Road, Hong Kong SAR, China.
Email: jhsiao@hku.hk

Abstract

Multiple factors have been proposed to contribute to the other-race effect in face recognition, including perceptual expertise and social-cognitive accounts. Here, we propose to understand the effect and its contributing factors from the perspectives of learning mechanisms that involve joint learning of visual attention strategies and internal representations for faces, which can be modulated by quality of contact with other-race individuals including emotional and motivational factors. Computational simulations of this process will enhance our understanding of interactions among factors and help resolve inconsistent results in the literature. In particular, since learning is driven by task demands, visual attention effects observed in different face-processing tasks, such as passive viewing or recognition, are likely to be task specific (although may be associated) and should be examined and compared separately. When examining visual attention strategies, the use of more data-driven and comprehensive eye movement measures, taking both spatial–temporal pattern and consistency of eye movements into account, can lead to novel discoveries in other-race face processing. The proposed framework and analysis methods may be applied to other tasks of real-life significance such as face emotion recognition, further enhancing our understanding of the relationship between learning and visual cognition.

KEYWORDS

eye movement, face recognition, other-race effect, visual attention

The controversy over factors accounting for the other-race effect in face recognition has focused on perceptual expertise versus social-cognitive accounts (Stelter & Schweinberger, 2023). These two accounts could be jointly understood in terms of quality of contact (Brunet et al., 2023), including not only perceptual and social interaction contact, but also acquisition of semantic information and social context (Simon et al., 2023), and potential intergroup anxiety and motivation (Kawakami et al., 2022; Schwartz et al., 2023). Individuals learn to recognize faces by searching for and extracting relevant information for recognition and integrating the information to develop appropriate internal representations for efficient processing, which can be modulated by emotional and motivational factors. This learning mechanism can be simulated using a computational model that is designed to optimize recognition performance through joint learning of information extraction strategy (such as learning an effective visual routine) and efficient internal representations (such as developing both holistic and feature-based face representations; see Hsiao et al. (2022) for simulations using Deep Neural Network + Hidden Markov Model, or DNN + HMM, for face recognition). In this framework, both the perceptual expertise and social-cognitive mechanisms can be understood as factors that modulate other-race face processing given the relevant task demands. Simulations through computational modelling can help us tease apart confounding factors and enhance our understanding of interactions among different factors.

From the perspective of learning mechanisms, task demand plays an important role in understanding why a particular visual attention strategy as reflected in eye movement behaviour is adopted. Indeed, eye movements for viewing faces have been shown to be task-specific (e.g. Hsiao et al., 2021). Several previous findings demonstrating more eye-looking behaviour for other-race faces than own-race faces were from the encoding/learning/study phase of a face recognition task where participants passively viewed faces for later recognition (e.g. Goldinger et al., 2009; Hu et al., 2014). In passive viewing, task demands are ill-defined and subject to individual differences in perceptual style (Zheng et al., 2022), social motivation and social intention. This may lead to inconsistent results across studies. Indeed, the effect of a more eyes-focused visual attention strategy in viewing other-race than own-race faces was not always well replicated (e.g. Brunet et al., 2023). In contrast, some studies examined eye movements during the recognition/test phase of a face recognition task. In this case, eye movement strategy differences between recognizing own- versus other-race faces were not typically observed (e.g. Chuk et al., 2017; Hills & Pake, 2013). This phenomenon may be because, without prior experience with other-race faces, participants may initially adopt a default strategy developed through their existing experience, such as individuating own-race faces but only performing race categorization on other-race faces without individuation. Since the learned attention strategy may depend on personal experience with both own- and other-race faces and faces of different races may differ in information distribution for recognition, inconsistent results may sometimes be observed. For example, Wong et al. (2022) reported that when performing a face recognition task (with data from the learning and recognition phases combined), Malaysian participants adopted different visual attention strategies when viewing faces of different races (Malay vs. Chinese vs. Indian faces); also, participants from different race groups (Malay, Chinese and Indian) in Malaysia adopted different visual attention strategies. In Brunet et al. (2023), White European participants attended to the upper region of Black faces more often than White faces during face recognition, in contrast to Hills and Pake (2013) where no significant difference was observed.

One's visual attention strategy for processing other-race faces can be modulated by increasing experience with information distribution of other-race faces through contact. If the experience involves performing tasks that demand individuating other-race faces, it may lead to the acquisition of race-specific information processing strategies, such as increased looking to the lower part of a Black face (Brunet et al., 2023; Hills & Pake, 2013). This learning process can be modulated by social-motivational factors, such as needs arising from different social interaction requirements. Interestingly, Brunet et al.'s (2023) findings suggested that in-person and virtual contact with other-race faces may result in different visual attention effects during face viewing, perhaps due to differences in task demands involved. Brunet et al.'s (2023) results also suggested that the length of contact time may be an important factor to consider. In short, both quality and length of other-race contact may play an important role in understanding visual attention strategy development in other-race face processing.

Another factor to consider is the eye movement data analysis methods used for measuring visual attention (Brunet et al., 2023; Wong et al., 2022). Many previous studies used summary statistics of eye movement measures such as number of fixations and predefined areas of interest (AOIs) such as upper versus lower part of the face, without considering temporal scan-path information or individual differences in AOIs among participants (e.g. Brunet et al., 2023; Wong et al., 2022). Alternatively, data-driven approaches such as Eye Movement analysis with Hidden Markov Models (EMHMM; Chuk et al., 2014), which accounts for both spatial (where one looks) and temporal (the *order* of where one looks) aspects of eye movements, may be used to quantify participants' eye movement patterns along dimensions of contrasting representative patterns obtained through bottom-up clustering of participants. Clustering helps discover data representations that better reflect the individual difference, which in turn may lead to findings undiscoverable using predefined AOIs (e.g. Zheng & Hsiao, 2022). Using EMHMM, it has been reported that during passive viewing of faces, Asian participants adopted a more eyes-focused pattern when viewing White (other-race) faces than Asian (own-race) faces (Zheng et al., 2022), whereas during face recognition, Asian nor White Australian participants did not differ significantly in eye movement patterns when recognizing own- and other-race faces (Chuk et al., 2017). Another eye movement measure that should be considered in future research on the other-race effect is eye movement consistency, that is, how consistent one's eye movement strategy is across trials. Eye movement consistency reflects visual routine development: Eye movement consistency for own-race face recognition decreases gradually from early childhood into adulthood as a result of learning. Also, high eye movement consistency predicts better face recognition performance in children, whereas low eye movement consistency in face processing is associated with an autism diagnosis (Hsiao et al., 2022). As individuals may differ in their preference in adopting eyes-focused or nose-focused eye movement patterns for face processing (Chuk et al., 2014), eye movement consistency (i.e. the *consistency* of where one looks and the order of where one looks) during learning to recognize other-race faces may reflect quality of contact with other-race individuals better than eye movement pattern (i.e. where one looks and the order of where one looks). EMHMM provides quantitative measures of eye movement pattern and consistency (as measured in entropy: lower entropy indicates higher consistency/predictability). Future work may use these measures in addition to summary statistics of eye movements to better understand the changes in eye movement behaviour across conditions in other-race face recognition as results of contact and social interaction under different scenarios.

In summary, here we posit that the other-race effect in face recognition can be better understood from the perspectives of learning mechanisms that involve joint learning of visual attention strategies and internal representations for faces, which can be modulated by quality of contact with other-race individuals. We argue that computational modelling of this learning mechanism will enhance our understanding of the interactions among contributing factors. Since learning is driven by task demands, visual attention strategies and internal representations as results of learning can be task specific. Thus, effects in different face processing tasks, such as learning versus recognition phase of a face recognition task, should be examined and compared separately, although they may be associated with one another. Adopting more data-driven and comprehensive measures of eye movements using machine learning methods, considering both spatial–temporal pattern and consistency of eye movement behaviour, may shed new light in the research on visual attention during other-race face processing. Our proposed framework and analysis methods may help resolve some inconsistent results obtained in the literature, enhancing our understanding of not only the other-race effect in face recognition, but also learning and cognition in other tasks of real-life significance, such as face emotion recognition and object detection.

AUTHOR CONTRIBUTIONS

Janet Hsiao: Conceptualization (lead), writing – original draft, writing – review and editing (lead). **Antoni Chan:** Conceptualization (supporting), writing – review and editing (supporting).

CONFLICT OF INTEREST STATEMENT

All authors declare no conflict of interest.

ORCID

Janet H. Hsiao https://orcid.org/0000-0003-2271-8710
Antoni B. Chan https://orcid.org/0000-0002-2886-2513

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