



OPEN Individuating experience moderates the effect of implicit racial bias on eye movements to other race faces: a cross-cultural study

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The present cross-cultural study investigated gaze behaviour in the context of assessing the aesthetic value of figurative paintings depicting White and East Asian individuals in social scenes. Across three experiments, we examined how implicit racial attitudes and self-reported individuating experiences influenced gaze patterns when participants evaluated their liking of these paintings. Despite no requirement to inspect faces in the paintings, the results revealed that participants with negative implicit attitudes toward other-race individuals and limited individuating experience with those groups, spent more time fixating on other-race faces. This relationship between implicit attitudes and individuating experience in guiding gaze behaviour was consistent across both British and Chinese participants, despite differing definitions of same- and other-race faces between the groups. Our findings suggest that gaze behaviour during the aesthetic evaluation of figurative paintings is shaped by an interaction between attitudinal and experiential factors, which operates across cultural contexts.

Keywords Gaze behaviour, Implicit racial attitudes, Individuating experience, Cross-cultural influence

Multiple factors influence where gaze is focussed in visual scenes. For example, gaze is attracted by salient visual features^{1,2} the presence of specific semantic categories such as people and faces^{3–7} and task-related requirements during viewing^{8,9}. Recent evidence also suggests that individual differences in anxiety, curiosity, openness-to-experience, and need for cognitive closure can affect the temporal and spatial extent of fixations when free viewing scenes^{10–14}. The influence of individual differences on gaze has been shown in tasks using natural scenes¹⁵ pictorial artworks^{16,17} and scenes showing pairs of individuals expressing emotions^{18,19}.

Research on social cognition has demonstrated that group membership can also impact gaze. First, men look more at bodies than do women, an effect known as body-biased gaze²⁰. Second, arbitrary group membership (determined through random allocation) influences the number of fixations made when seeking to support decisions about the allocation of donations in a money allocation task²¹. Third, same-race faces tend to attract shorter but more frequent fixations than other-race faces^{22–24}. Fourth, the effect of race on gaze to faces is modulated by prejudicial and stereotypical attitudes toward individuals from other racial groups^{25–29} that can operate outside our conscious awareness^{30,31}. We extend this research on the impact of attitudes on gaze to same- and other-race faces in the present study by considering eye movements to faces appearing in figurative paintings. Previous studies exploring the visual processes underpinning decisions about liking paintings show that these decisions are usually reached quickly and following incomplete image inspection^{32,33}. Despite the fact that faces do not need to be inspected to assess a paintings liking, faces appearing in paintings are known to attract them^{17,34–36}. In the present study, we asked participants to evaluate the liking of paintings that contain same- and other-race faces. The first hypothesis tested is that racial attitudes influence fixations to other race faces.

The value of using a task that requires judging the liking of figurative paintings to explore this hypothesis lies in the fact that participants can meaningfully perform the task without considering the race of the faces appearing in the paintings. The appearance of faces (of whatever race) in the paintings has no particular status. Moreover, participants are free to make their judgements based on any other aspect of its visual details or composition, or indeed any other aspect of the interpretative lens of the artist or their artistic style that might

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affect their aesthetic experience. This is important because several studies have demonstrated gaze to social scenes can change depending on participants' beliefs about the task being performed. For instance, Milani et al.³⁷, asked participants to view sexual images on a computer screen. Observers exhibited some control of fixations when they knew that their eyes were being monitored such that they avoided looking at sexualised content in videos. This control of fixations was relaxed when they believed that their eyes were not being monitored. In the present study, while participants were aware that their eye movements were being monitored and fixations could be made to faces, the task of evaluating the aesthetic merit of paintings neither required, needed nor primed fixations to be made to faces. If we observe effect of racial attitudes on viewing other race faces in paintings it means that these attitudes are strikingly pervasive.

Participants' experience of same- and other-race faces are likely to vary in frequency and this may have negative consequences for face processing³⁸. Moreover, evidence from studies exploring gaze to predictable versus novel stimuli shows that novel items attract and hold fixations more than predictable items (in paintings³⁹; in face perception^{40,41}; in natural scenes⁴²). In the case of faces, there is some evidence that low levels of contact with members of the out-group is associated with high racial prejudice, however, this association is reduced when the quality of contact is high⁴³. For this reason, the second hypothesis we explore is whether the impact of racial attitudes on gaze is moderated by the quality of the contact with the out-group. We tested this hypothesis while accounting for individual differences in participants' level of social contact with the out-group and their ability to process faces²⁶.

To ensure the robustness of our findings, we used a cross-cultural experimental design. Racial attitudes were measured alongside the gaze behaviour of British and Chinese participants as they evaluated their liking of paintings depicting individuals of White and East Asian origin. Importantly, we presented all participants with figurative paintings from both Western and East Asian traditions. Paintings in the Western and East Asian traditions employ distinct artistic techniques and structures⁴⁴. Given that participants from the UK and China likely have varying levels of familiarity with these artistic styles, it is important to draw images for the stimulus set from both traditions. Most important, the combination of British and Chinese participants viewing paintings drawn from Western and East Asian traditions means that the categories of same and other-race faces are orthogonally combined. In orthogonally manipulating participants and painting style, the categories of same and other-race faces are controlled such that any effects we report cannot be explained by virtue of some other factor.

In sum, here we tested the influence of racial attitudes and contact with members of the out-group on fixations to same and other-race faces, while accounting for participants' ability to process faces. We hypothesise that racial attitudes towards, and the quality of experience with out-group members, will modulate gaze behaviour toward other race faces. The study seeks to provide evidence from eye gaze measures for two theoretically relevant effects⁴⁵. First that racial attitudes influence attentional engagement with other race faces presented in visual scenes. Second, that quality of contact with other races moderates the effect of racial attitudes on attentional engagement with other race faces presented in visual scenes.

We pre-registered the first two studies (DOI: <https://doi.org/10.17605/OSF.IO/69K7X>). Study 1 was conducted in the UK and Study 2 was conducted in China. To address the issue of lack of social contact and individuating experience with White people in Study 2, we conducted Study 3 in China but target Chinese participants who had also spent at least 6 months in Western country.

Results

The result of each study consists of analyses of liking ratings and gaze behaviour for three studies. With respect to liking rating, we explored the effect of racial attitudes towards (evaluated using Implicit Association Test [IAT]⁴⁶, quality of experience with out-group members (measured by individuating experience), and painting style (East Asian vs. Western) on liking judgement. In addition, our models accounted for participants' interest in art (measured using the Art Interest Questionnaire⁴⁷), amount of social contact with members of the out-group (measured by social contact scale), and their ability to process faces (assessed using the Cambridge Face Memory Test [CMFT]⁴⁸), as research has shown that a high level of social contact and strong face recognition ability enhance the efficiency of processing other-race faces²⁶. As well testing for main effects, the models tested also included four sets of interactions testing the extent to which the influence of racial attitudes may be modulated by painting tradition, face recognition ability, social contact, and quality of experience with White or East Asian people. If a significant interaction was found between fixed factors, we explored it further by testing whether the slopes at 1 SD above or 1 SD below the means of the racial attitude measures influenced the dependent variable. The descriptive statistics for the individual differences measures are reported in Table 1, and the main outputs of the model are presented in Table 2.

With respect to analysis of gaze behaviour, difference scores were calculated for each participant with respect to total fixation duration made to other- and own-race faces (as well as number of fixations and mean fixation duration). Positive difference scores indicate greater total fixation duration (or more fixations/longer fixation duration) to other-race faces. The models were conducted with the same set of effects and interactions as for the preference ratings, and the results are reported in Table 3. We also applied the same analytical strategy to explore significant interactions.

As the paintings used in the Studies 1–3 varied in terms of the number, size and position of faces present across identities, our interest is not in the main effect of gaze behaviour to White and East Asian faces. Rather, it is in how overall gaze behaviour is associated with racial attitudes and individuating experience with out-group members while controlling for the effects of face recognition ability, social contact, and art interest. As such, we are interested in interactions between gaze behaviour and racial attitudes and individuating experience with other races.

	Mean	Median	SD	Min	Max
Study 1					
Art interest	1.95	2	0.73	0.38	3.63
IAT	0.15	0.15	0.43	−0.94	1.03
CFMT	78.54	77.78	12.33	51.39	100
Social contact: Asian people	1.95	1.70	0.96	1	4.60
Social contact: White people	4.47	4.60	0.64	2.40	5
Individuating experience: Asian people	2.86	3	1.13	1	5
Individuating experience: White people	4.27	4.2	0.64	3	5
Study 2					
Art interest	1.81	1.94	0.80	0.5	3.48
IAT	−0.16	−0.16	0.33	−0.73	0.59
CFMT	67.95	66.67	10.66	48.61	90.28
Social contact: Asian people	4.53	4.8	0.65	2.2	5
Individuating experience: Asian people	4.4	4.3	0.57	3	5
Study 3					
Art interest	2.07	2	0.87	0.5	4
IAT	−0.08	−0.03	0.39	−0.82	0.87
CFMT	69.34	70.83	11.77	36.11	93.06
Social contact: Asian people	4.55	4.80	0.58	2	5
Social contact: White people	1.42	1.20	0.64	1	3.4
Individuating experience: Asian people	4.42	4.6	0.66	2	5
Individuating experience: White people	2.17	2	1.07	1	5

Table 1. The descriptive statistics for the measures of art interest, implicit racial bias (IAT), Cambridge Face Memory Test (CFMT), social contact, and individuating experience with East Asian and White people.

Fixed Effects	Study 1			Study 2			Study 3		
	<i>b</i>	<i>SE</i>	<i>t-value</i>	<i>b</i>	<i>SE</i>	<i>t-value</i>	<i>b</i>	<i>SE</i>	<i>t-value</i>
(Intercept)	51.04	2.45	20.84	46.63	2.20	21.16	48.88	2.38	20.53
IAT	9.25	4.04	2.29	0.18	4.59	0.04	1.59	5.16	0.31
Style	4.37	2.81	1.56	6.22	2.41	2.58	3.10	2.45	1.27
CFMT	0.11	0.13	0.87	0.10	0.14	0.71	−0.09	0.15	−0.61
SC	−2.37	2.41	−0.99	-	-	-	−3.96	3.63	−1.09
IE	4.46	2.00	2.23	-	-	-	0.88	2.13	0.41
Art interest	1.70	2.16	0.79	−1.03	1.84	−0.56	1.37	1.89	0.73
IAT × Style	−3.27	1.92	−1.71	0.66	2.26	0.29	0.61	1.95	0.31
IAT × CMFT	0.10	0.32	0.32	−0.90	0.44	−2.05	0.17	0.50	0.33
IAT × SC	7.91	6.65	1.19	-	-	-	−15.40	12.33	−1.25
IAT × IE	−4.12	3.95	−1.04	-	-	-	4.96	7.23	0.69

Table 2. Fixed effect estimates from the LMMs for preference judgement as a function of implicit racial bias [IAT], painting style (East Asian vs. Western paintings), Cambridge Face Memory Test [CFMT]; social contact [SC] and individuating experience [IE] with other races in Study 1 - 3.

Among these four main factors, there was a positive correlation between the ratings of social contact and the individuating experience scales in Study 1 and 3 (for experience with East Asian people: $r_{Study\ 1} = 0.69, p < 0.001$; $r_{Study\ 3} = 0.72, p < 0.001$; for experience with White people: $r_{Study\ 1} = 0.39, p = 0.009$; $r_{Study\ 3} = 0.71, p < 0.001$). Nonetheless, the Variance Inflation Factor (VIF) estimates suggested that there were no concerns with respect to multicollinearity among any of those factors their interactions in Study 1 ($VIF_{SC,East\ Asian} = 2.26$; $VIF_{IE,East\ Asian} = 2.37$; $VIF_{CFMT} = 1.13$; $VIF_{IAT} = 1.28$; $VIF_{SC,East\ Asian \times IAT} = 2.21$; $VIF_{IE,East\ Asian \times IAT} = 1.98$; $VIF_{CFMT \times IAT} = 1.18$) and Study 3 ($VIF_{SC,White} = 2.28$; $VIF_{IE,White} = 2.13$; $VIF_{CFMT} = 1.32$; $VIF_{IAT} = 1.32$; $VIF_{SC,White \times IAT} = 2.52$; $VIF_{IE,White \times IAT} = 2.24$; $VIF_{CFMT \times IAT} = 1.30$). In Study 2, Chinese participants reported having no experience with White individuals; therefore, we did not perform these calculations.

Data analyses were conducted with R (version 4.2.2)⁴⁹ Data were fitted using the lmer4⁵⁰ and MASS⁵¹ packages. We used the ggeffects package⁵² to create the adjusted predictions and predicted marginal means for fixed factors of models. The random effects were structured for items and participants. The random effects were structured for items and participants including slopes for meaningful fixed effects and correlation. The

	Study 1			Study 2			Study 3		
Fixed Effects	<i>b</i>	SE	<i>t</i> -value	<i>b</i>	SE	<i>t</i> -value	<i>b</i>	SE	<i>t</i> -value
(Intercept)	181.29	53.96	3.36	-214.63	55.76	-3.85	-206.45	64.97	-3.18
IAT	-16.37	46.99	-0.35	28.60	53.49	0.53	-44.86	41.04	-1.09
Style	432.70	104.31	4.15	-403.55	108.22	-3.73	-519.16	127.57	-4.07
CFMT	0.52	1.52	0.34	-1.81	1.69	-1.07	-1.55	1.37	-1.13
SC	27.73	28.82	0.96	-	-	-	51.41	32.75	1.57
IE	-28.64	23.90	-1.20	-	-	-	-54.23	19.19	-2.83
Art interest	-8.56	25.86	-0.33	-16.27	22.13	-0.74	4.80	17.03	0.28
IAT × Style	68.51	53.70	1.28	222.37	67.71	3.28	35.23	61.16	0.58
IAT × CMFT	9.62	3.89	2.48	-3.22	5.29	-0.61	7.33	4.49	1.63
IAT × SC	-177.38	79.58	-2.23	-	-	-	-207.47	111.28	-1.86
IAT × IE	125.64	47.32	2.66	-	-	-	138.64	65.24	2.13

Table 3. Fixed effect estimates from the LMMs for Δ total fixation duration made to faces as a function of implicit racial bias [IAT], painting style (East Asian vs. Western paintings), Cambridge Face Memory Test [CFMT]; social contact [SC] and individuating experience [IE] with other races in Study 1 - 3.

full random structure was trimmed down for those models that did not converge or had a high or equal to zero correlation⁵³. The *t* values equal to 1.96 or higher were interpreted as significant, because for high degrees of freedom the *t* statistic in LMMs approximates the *z* statistic.

Liking

Study 1

Liking ratings made by British participants were associated with racial attitudes and individuating experience with East Asian people. Paintings were liked less as participants held a more negative attitudes towards and had a lower level of individuating experience with East Asian people. No other effects were significant.

Study 2

Liking ratings made by Chinese participants with no social contact and individuating experience with White people were higher for Western than East Asian paintings (see⁵⁴ for similar findings). Moreover, an interaction between racial attitudes and face recognition ability affected preference ratings in response to viewing paintings. Specifically, while the preference rating remained unaffected by face recognition ability among participants with positive racial attitudes ($b = -0.40$, 95% [-0.90, 0.11]), those with more negative attitudes towards White people and poorer face recognition ability indicated a lower liking of paintings ($b = 0.60$, 95% [0.01, 1.18]). No other significant results were observed.

Study 3

Liking ratings made by Chinese participants with experience of White people were not affected by social and attitudinal factors, nor painting style.

To summarise, for British participants, positive racial attitudes toward East Asian people were associated with a greater liking for all paintings. In the case of Chinese participants who reported no social contact and individuating experience with White people, negative racial attitudes toward White people and poor face recognition ability were associated with a lower liking for all paintings. Increasing individuating experience with other-race people was also important in predicting liking rating though this was only shown in the British participants.

Gaze behaviour

In the main report, we focus on analysis of total fixation durations to faces (as findings from analysis of number of fixations [which are publicly available at DOI: <https://doi.org/10.17605/OSF.IO/WBZXD> together with analyses for mean fixation duration] largely paralleled these findings). The analyses were conducted on the difference scores, but we also report the descriptive statistics for the total fixation durations to own- and other-race faces in Table 4.

Study 1

The difference in total fixation duration to other- relative to own-race faces was influenced by the tradition of paintings and by interactions between racial attitudes and face recognition ability, individuating experience and social contact. The difference in total fixation duration was greater when viewing Western but not East Asian paintings and in participants holding a negative racial attitudes who also had poor face recognition ability ($b_{\text{CFMT: low}} = -175.69$, 95% [-317.35, -34.04]; $b_{\text{CFMT: high}} = 74.44$, 95% [-74.20, 223.08]), low individuating experience ($b_{\text{IE: low}} = -191.34$, 95% [-345.52, -37.17]; $b_{\text{IE: high}} = 90.09$, 95% [-52.59, 232.77]) and a high level of social contact ($b_{\text{SC: high}} = -217.36$, 95% [-424.56, -10.17]; $b_{\text{SC: low}} = 116.11$, 95% [-34.33, 266.56]).

	Study 1			Study 2			Study 3		
	<i>M (SD)</i>	<i>Median</i>	<i>Min-Max</i>	<i>M (SD)</i>	<i>Median</i>	<i>Min-Max</i>	<i>M (SD)</i>	<i>Median</i>	<i>Min-Max</i>
Western									
Own-RF	549 (159)	549	147-881	886 (217)	901	372-1566	959 (207)	932	464-1570
Other- RF	827(308)	786	277-1530	529 (148)	534	296-852	588 (122)	566	359-838
East Asian									
Own-RF	601 (254)	588	170-1258	579 (174)	563	318-1157	629 (166)	598	321-1034
Other-RF	548 (223)	502	144-1187	557 (180)	565	185-921	692 (147)	659	421-1084

Table 4. Descriptive statistics for the total fixation durations to own- and other-race faces [RF] in Western and East Asian paintings across Studies 1–3.

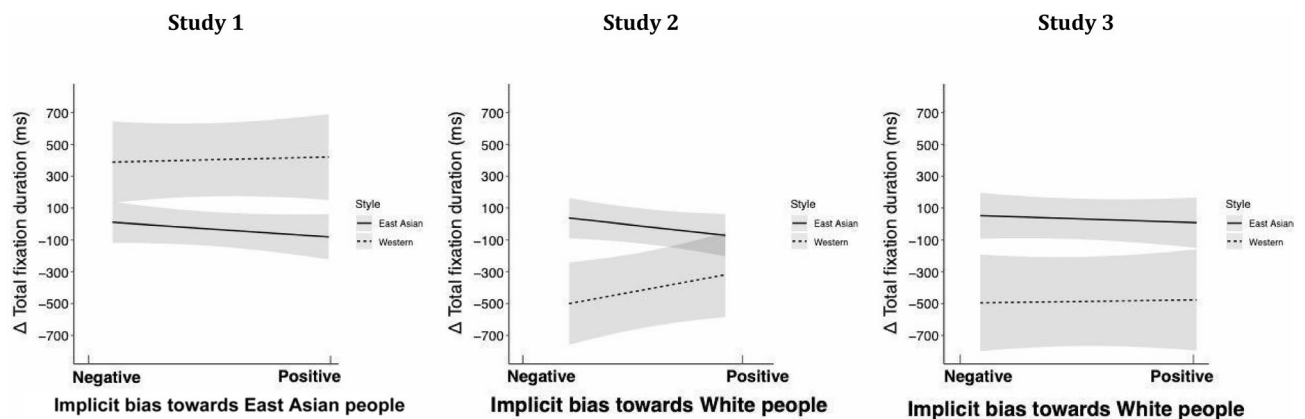


Fig. 1. Mean difference (Δ) in total fixation duration made to faces in study 1–3 as a function of the measures of implicit racial bias and paintings in East Asian [indexed by solid line] and Western [indexed by dashed line] style. Note. The positive scores indicate a longer total fixation duration to other- relative to the own-race faces. The shaded are represent the 95% CI for predicted marginal means.

Study 2

The difference in total fixation duration to other- relative to own-race faces was influenced by the style of paintings and by interactions between style of painting and racial attitudes (Fig. 1). The difference was greater when viewing Western but not East Asian paintings but only for those participants holding negative racial attitudes to White people ($b_{\text{Western}} = 139.79$, 95% [15.64, 263.94]; $b_{\text{East Asian}} = -82.58$, 95% [−206.72, 41.56]).

Study 3

The difference in total fixation duration to other- relative to own-race faces was influenced by the style of paintings, individuating experience, and by an interaction between racial attitudes and individuating experience (Fig. 2). The difference was greater when viewing Western but not East Asian paintings, for individuals with low than high individuating experience who also held a negative racial attitudes towards White people ($b_{\text{IE: low}} = -170.42$, 95% [−299.61, −41.22]; $b_{\text{IE: high}} = -42.87$, 95% [−144.23, 58.49]).

In sum, differences in gaze behaviour to own and other-race faces was found when viewing Western paintings in Studies 1–3. In addition, Studies 1 and 3 show that negative racial attitudes are associated with a difference in gaze behaviour to own- and other-race faces when individuating experience is low. The interaction between negative racial attitude and individuating experience is such that high levels of negative attitudes, when associated with low level of individuating experience, is linked to increased gaze on other-race faces. Study 1 tested British participants and Studies 2 and 3 tested Chinese participants, meaning that the gaze behaviour must be influenced by participants rather than image factors. For completeness, Study 1 also found similar effects with respect to face recognition ability and social contact.

Discussion

Three studies explored gaze behaviour when determining their liking of figurative paintings. The specific figurative paintings were chosen for this study because they included representation of White and East Asian individuals. We were interested in how racial attitudes and self-reported quality of experience might be associated with gaze when reaching a decision about the preference of paintings. The findings show that the racial attitudes by themselves did not influence the eye movements towards other-race faces. However, other-race faces were looked at more when participants held negative attitudes towards other-race people and had a low level of individuating experience with them, suggesting that racial bias does not independently influence the eye movements. The interaction between racial attitudes and individuating experience on gaze behaviour

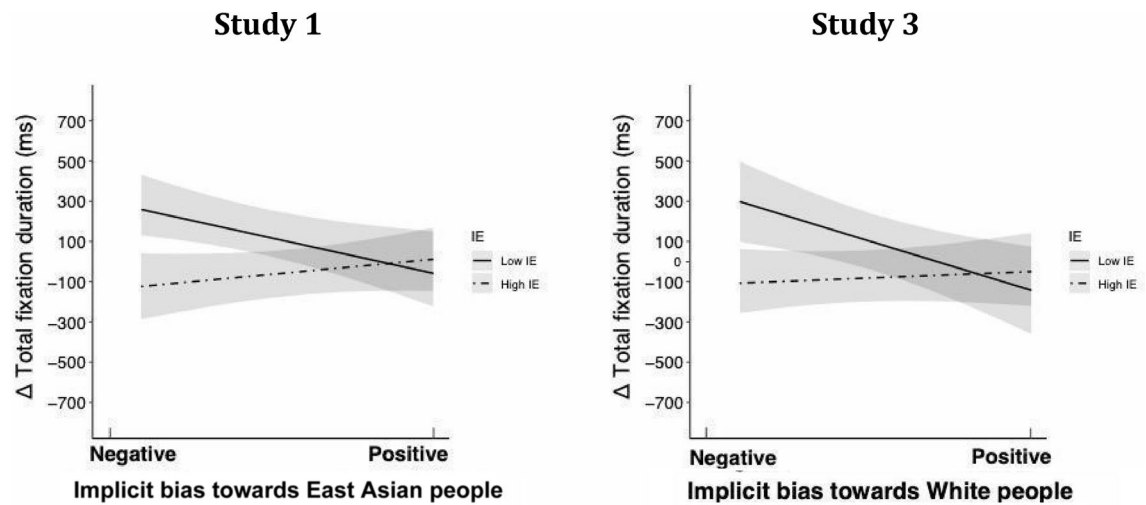


Fig. 2. Mean difference (Δ) in total fixation duration made to faces in study 1 and 3 as a function of 1 SD above and below the means of the measures of implicit racial bias and low [indexed by solid line] and high [indexed by dashed line] individuating experience (IE) with East Asian (Study 1) or White (Study 3) people. *Note.* The positive scores indicate a longer total fixation duration to other- relative to the own-race faces. The shaded are represent the 95% CI for predicted marginal means.

remained whether considering British or Chinese participants even though what counts as same- and other-race faces were different for the participant groups. Therefore, the present findings show an interaction of attitudinal and individuating experience on gaze behaviour that is subject to cross-cultural influence when participants are engaged in the viewing of paintings depicting social scenes.

Furthermore, in Study 1, which involved only British participants, the interaction between racial attitudes and individuating experience emerged alongside interactions involving racial attitudes, face processing ability, and social contact. We included face processing skill and social experience in our design based on prior research suggesting their relevance to other-race face processing²⁶. However, these variables were not the primary focus of the present investigation. Crucially, the key effect of interest persisted even when the effects of face processing ability and social contact were statistically controlled.

Our findings appear to conflict with the in-group favouritism account, which would predict more attention to same-race faces⁵⁵. Specifically, our data showed that individuals holding more negative attitudes toward a racial out-group, and with less individuating experience with that group, tended to look longer at out-group faces. In other words, rather than avoiding out-group members, perceivers with negative bias and limited individuating experience may focus on them.

One plausible explanation is threat-related vigilance. Psychological research shows that negative or threatening stimuli capture attention more rapidly than neutral ones⁵⁶. In social contexts, people with negative attitudes or fear toward another group may unconsciously treat out-group faces as potential threats. Consistent with this, recent cognitive studies report that negative attitudes drive early attentional capture by out-group faces. For example, Giménez-Fernández et al.⁵⁷ found that a face of the prejudice out-group member elicited stronger ERP markers of attentional capture than an in-group. Richeson and Trawalter²⁹ similarly noted that high-anxiety perceivers initially orient towards out-group faces before subsequently avoiding them.

Some might wonder whether simple novelty could account for the effect we report (i.e. that less familiar faces attract more gaze). However, the work of Giménez-Fernández et al.⁵⁷ demonstrates that even when out-group faces are made familiar through habituation, racial bias continues to predict increased attentional processing. In other words, lack of social experience alone cannot explain the attentional bias we observe. Thus, our finding that negative attitudes predict greater looking towards out-group faces is consistent with a threat-related vigilance mechanism rather than simple avoidance.

Beyond establishing selection criteria for the inclusion of paintings in the stimulus set, the images seen by participants varied in many ways. For example, we did not control for differences in the perspective used to organise elements within the paintings⁵⁸, the attractiveness of the sitter's face⁵⁹, the social status of figures represented⁶⁰ or the gaze direction of the sitters⁶¹, all of which might influence visual exploration. The outcome of this variation in the stimulus set was that participants tended to look more to East Asian people in the Western paintings but not East Asian paintings. At first sight, this might seem like a curious result. However, analyses of the paintings used in the studies show that the face ROIs covered by East Asian faces was larger in Western paintings but not in East Asian paintings. The difference in overall looking at East Asian and White people in the Western paintings is, therefore, probably accounted for by this difference. It is important to clarify, however, that the overall patterns of gaze behaviour of East Asian and White people provide a baseline against which the effect of individual factors on gaze behaviour can be measured.

The analysis of differences in total gaze duration leaves a key question unanswered if we are to fully understand the impact of attitudinal and individuating experience on viewing. The key question is whether prolonged

gaze to other-race faces occurs as a result of speeded fixations towards them that lead to more opportunity for prolonged viewing during looking. We report this analysis in the OSF project repository and in supplementary information (SI: Study 1–3). The analysis shows that the effect of attitudinal and individuating experience on viewing was contributed to by speeded fixations to other-race faces. These findings indicate that the salience of other-race faces in a visual scene is influenced by negative racial attitudes and limited individuating experience. One possible explanation is that the attentional templates guiding fixation to faces are shaped by racial biases and experience, influencing gaze behaviour. For individuals with lower individuating experience, attentional templates may prioritise race-based visual features, leading to increased fixations on other-race faces. When we refer to an individual having an “attentional template” for an out-group, we mean that their cognitive system maintains a rough mental representation of the typical features of out-group faces, informed by limited exposure or cultural stereotypes. Such templates frequently incorporate salient visual cues, including skin pigmentation, facial morphology, and eye geometry. Notably, neurocognitive research indicates that skin pigmentation alone can exert a powerful influence on early face processing, even when facial structure remains constant⁶².

Interestingly, positive racial attitudes appear to mitigate the effects of low individuating experience, while higher individuating experience reduces the overall impact of racial attitudes on gaze behaviour. This suggests that experience-driven processing can reshape the attentional templates guiding fixations to faces, leading to gaze patterns that rely less on race-based cues. Given that changing individuals’ racial attitudes is challenging⁶³ our findings raise an important question: Can increasing individuating experience modulate the effects of racial bias on gaze behaviour? While behavioural studies exploring the influence of group membership on detection of other-race face in visual-search⁶⁴ or race-categorisation tasks have shown similar results^{65–67} we are unaware of a similar effect being reported for eye movements made to scenes.

There is, however, evidence from the other studies that neural sensitivity to faces is subject to racial bias. For example, Katsumi et al.⁶⁸ investigated neural responses to the nonverbal social cues of own- and other-race individuals in dynamic scenes using EEG recordings. Their findings suggest that neural sensitivity to nonverbal social cues is modulated by the willingness to approach in-group members. Similarly, Scheepers et al.⁶⁹ demonstrated that strong activation in brain areas related to social identity emerged only in participants who reported high identification with the in-group when viewing in- relative to out-group faces. Together, these findings suggest that group membership influences visual information processing.

The results also demonstrated subtle differences in how liking ratings were affected by racial bias held by both British and Chinese participants. While this difference in the ratings made by British and Chinese participants of the images is interesting, the ratings were not the main focus of the study. The rating task was used to allow us to explore the effects of racial attitudes and experience without priming participants on the issue of race.

There are reasons why the potential importance of the present findings might be minimised if considered to reflect what might be found in the real world. First, we chose paintings as the stimuli for these studies as they allowed us to give participants a stimulus-relevant task that required formulating judgement about inspected images. Indeed, artworks are made to be inspected. No mention was made of making fixations to people or faces when reaching a decision about liking. In contrast, had we used non artistic photographs of social scenes then it would have been more difficult to find a meaningful task to encourage participants’ engagement. It is, nevertheless, possible our stimulus choice means that the findings only relate to the act of making liking decisions to paintings such that the findings do not speak to gaze behaviours in other circumstances.

Second, the paintings used as stimuli show social scenes in one form or another. The alignment of task requirements with the choice of stimulus allowed the study of the effects of racial attitudes on the perception of social scenes in a relatively indirect manner. In the real world beyond the psychology laboratory, we are rarely disinterested observers of social scenes but active participants. While other studies have also reported interesting effects of eye movements in the free viewing of social scenes^{4,5} it raises the question of whether the effects we report are task-dependent or would generalise to other tasks, and especially in tasks that emphasise the crucial importance of faces. Future studies should be run to determine whether this effect generalises to other kinds of tasks. However, in each case, future studies will need to do their best to create tasks that minimise the risk of priming the relevance of facial identity to performance.

A third reason to be cautious about the present findings is that we measured implicit, but not explicit, racial bias. Implicit racial biases operate unconsciously and can lead to unintentional discrimination, while explicit racial biases involve conscious attitudes and beliefs that can manifest in acts of racism and discrimination^{70–72}. Both types of biases contribute to racial inequalities and disparities in various domains^{73–75}. However, explicit biases, compared to implicit biases, are more controllable and are often concealed due to social norms⁷⁶. In this study, we focused on the effect of implicit racial biases on gaze behaviour, which is more difficult to control consciously and affects the processing of social scenes in a more subtle way. It is for future studies to determine to what extent the effects reported here can be predicted by a person’s explicit racial attitude.

Finally, due to the general tendency for individuals to hold more favourable attitudes towards their own group and more negative attitudes towards out-groups, obtaining a well-distributed range of implicit racial bias scores for any specific target group can be challenging²⁶. In our studies, we successfully captured a broad range of positive and negative implicit biases towards East Asian individuals among British participants (Study 1), and towards White individuals among Chinese participants (Study 3). However, this was not the case in Study 2, where participants reported no experience with White individuals, and the distribution of implicit bias scores was skewed more negatively and showed less variability compared to Studies 1 and 3 (see Table 1). As a result, it was not possible to include experience as a fixed factor in the model for Study 2, nor did we observe a significant effect of racial attitudes. We suggest that the limited variability in bias scores in Study 2 accounts for this finding. We hope that increasing multicultural interactions may, over time, promote greater variability in intergroup attitudes, thereby enhancing the capacity of future research to examine the effects of implicit biases on social perception, including gaze behaviour.

In conclusion, the present results add important new data to the general literature on gaze behaviour. Specifically, the current results suggest that gaze behaviour to figurative paintings showing social scenes containing same and other-race faces is affected by implicitly held attitudes and individuating experiences. The effect of implicitly held attitudes and individuating experiences on gaze to faces occurs in a task where the faces themselves might be thought tangential to the judgement being made. Finally, the influence of implicitly held attitudes and individuating experiences on gaze to faces is found across cultures.

Materials and methods

Participants

Forty-four participants were tested in Study 1 ($M_{age} = 20.8$, $SD_{age} = 4.09$), 40 in Study 2 ($M_{age} = 21.23$, $SD_{age} = 3.50$), and 39 in Study 3 ($M_{age} = 25.79$, $SD_{age} = 7.88$). The participants in Study 1 were British and in Studies 2 and 3 were Chinese. Participants received course credits or subsistence allowance for their participation. They reported normal or corrected-to-normal vision. The final sample sizes were determined based on previous studies examining cross-cultural influences on art perception²³ and individual differences between implicit racial bias and experience with other races²⁶. Using data from Trawinski et al.²⁶ and the pwr R package⁷⁷ we estimated the sample size required to detect the effect of negative implicit racial bias on differences in eye movements to East Asian and White faces among participants with low individuating experience. With $\alpha = 0.05$, power = 0.80, and an effect size (Cohen's f^2) derived from $\beta = -0.48$, the required sample size was 44 participants, consistent with our initial sample for Study 1.

The study was approved by the Ethics Committee of the School of Psychology, Liverpool Hope University (SEL-09012023-002). The study was conducted in accordance with the code of practice of the British Psychology Society. The informed consent was obtained from all participants.

Materials and equipment

The experiment had five stages: an Art interest questionnaire, a Preference task where gaze behaviour was recorded, an evaluation of racial attitudes using the Implicit Association Test, a face recognition assessment through the Cambridge Face Memory Test, and a two-part experience questionnaire measuring levels of social contact and individuating experience⁷⁸. We used implicit rather than explicit measures of racial attitudes because explicit evaluations are influenced by personal beliefs and values that are consciously endorsed and are less reliable⁷⁹.

Art interest

Art interest was measured using an art interest questionnaire based on the art interest questionnaire from The Vienna Art Interest and Art Knowledge Questionnaire⁴⁷. The questionnaire consisted of 8 items assessing agreement with statements, as well as the frequency of art-related behaviours. Participants respond using a 7-point Likert scale ranging from 0 to 6. The total sum scores have been calculated to provide the final art interest score.

Preference task

A common set of high-resolution images of 30 East Asian and 30 Western style images of the paintings were shown to all participants (Fig. 3). We limited our selection of Western and East Asian-style paintings to those



Fig. 3. Example of paintings used in the Study 1–3: (a) Amerika-jin yuko sakamori by Utagawa Yoshitora (source: The Trustees of the British Museum) and (b). Cutting a Path, Sierra Nevada by Mian Situ (source: Mian Situ's collection).

	East Asian faces <i>M (sd)</i>	White faces <i>M (sd)</i>	<i>U</i>	<i>p</i>	<i>r</i>
Mean number of faces					
East Asian paintings	5.27 (4.98)	3.53 (2.49)	289	0.02	0.358
Western paintings	8.1 (5.83)	7.3 (13.17)	256	0.004	0.432
Mean percentage of face size as a proportion of the total area of paintings					
East Asian paintings	0.76 (0.39)	0.65 (0.35)	381	0.314	0.153
Western paintings	1.25 (1.13)	0.49 (0.55)	174	0.002	0.613

Table 5. The number and relative size [in pixels] of the face ROIs in East Asian and Western paintings.

depicting only East Asian and White individuals. Each painting depicted at least one East Asian and one White sitter. The height of each image was standardised at 650 pixels subtending a visual angle of 11° in height. The width of each image ranged from 274 to 1750 pixels, giving visual angles between 4° and 29° in width. In each painting, the region of interest (ROI) was drawn around East Asian and White faces (see Table 5).

The studies at both locations were conducted using a 53 cm x 30 cm monitor (screen resolution was 1920p x 1080p; refresh rate 100 Hz). Participants used a chin and headrest and were seated 90 cm from the screen, giving a visual angle of 32.81° x 18.92°. Gaze behaviour was recorded using a SR Research Limited Eye-Link 1000 eye-tracker operating at 1000 Hz. Eye movements were calibrated to less than 0.5° error using a standard 9-point calibration procedure at the beginning of the task.

Implicit association test

The IAT was conducted using six Asian and six White faces from the Chicago Face Database⁸⁰ and with six positive and six negative words was used to measure participants’ implicit racial bias⁴⁶. The six positive words were loyal, kindness, happy, trust, friend, and pleasure. The six negative words were terrible, toxic, hatred, useless, brutal, and traitor. In Studies 2 and 3, the instructions and word stimuli were translated into Mandarin using the back-translation method. All word stimuli consisted of two characters and were matched to the English words in terms of frequency and emotional valence.

The IAT followed a standard procedure of five blocks of trials. For the procedure details refer to²⁶. *D* scores were computed to measure implicit racial bias. *D* scores were standardised across the studies in such way that a positive *D* score indicated a positive implicit racial bias towards people of the other race (i.e. East Asian people in Study 1 and White people in Study 2 & 3), while a negative *D* score signified a negative implicit racial bias towards people of the other race.

*Cambridge face memory test*⁴⁸

Across three blocks of trials, participants were tested on their ability to identify 6 unfamiliar individuals. During the initial study phase, 6 target faces were presented. During the test phase, one of the target faces appeared with 2 distractor faces on each trial. In Block 1, the test images were identical to the study phase. In Block 2, the test images were novel images (e.g., shown in different orientations) of the same individual. In Block 3, novel images with supplementary visual noise were used. As is standard, accuracy scores across the three blocks of trials were used as a measure of face recognition ability.

*Experience questionnaire*⁸¹

Participants completed a two-part questionnaire about their social contact and individuating experience with White and East Asian people. The set of social contact items measure the quantity of personal contact with people and the set of individuating experience items measure the frequency of substantial personal interactions (i.e., quality of the experience; 5 items for each race group). Responses were made on a 5-point scale. Average scores on both sets of items reveal the amount of social contact and individuating experience with White and East Asian people reported by participants.

Procedure

The study began with completion of the Art Interest questionnaire, followed by the Preference task, the IAT, the CFMT, and finally, the experience questionnaire. Participants completed the study in a fixed order and were allowed to take self-paced breaks in between the stages. The items in the questionnaires were presented in a fixed order. In contrast, trial order was randomised in the Preference and IAT task. All three studies followed the same procedure.

With respect to the Preference task, the study trials followed completion of the calibration of eye movements. Each trial began following fixation on a central fixation point. The trials were split into blocks showing East Asian and Western paintings, with the block order counterbalanced over participants. After 7 s, a 100-point slider was presented underneath the painting being presented and remained until response. Responses were made using a mouse. The slider ends were labelled as “Dislike very much” to “Like very much”.

Data availability

Preregistration: The hypotheses and methods for Study One and Two were preregistered (<https://doi.org/10.17605/OSF.IO/69K7X>) on 2022-04-14, prior to data collection which began on 2023-01-09. Data: All primary

data are publicly available (DOI: 10.17605/OSF.IO/WBZZXD). Analysis scripts: All analysis scripts are publicly available (DOI: 10.17605/OSF.IO/WBZZXD).

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Declarations

Competing interests

The authors declare no competing interests.

Additional information

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