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The other-race effect does not rely on memory: Evidence from a matching task

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Viewers are typically better at remembering faces from their own race than from other races; however, it is not yet established whether this effect is due to *memorial* or *perceptual* processes. In this study, UK and Egyptian viewers were given a simultaneous face-matching task, in which the target faces were presented upright or upside down. As with previous research using face memory tasks, participants were worse at matching other-race faces than own-race faces and showed a stronger face inversion effect for own-race faces. However, subjects' performance on own and other-race faces was highly correlated. These data provide strong evidence that difficulty in perceptual encoding of unfamiliar faces contributes substantially to the other-race effect and that accounts based entirely on memory cannot capture the full data. Implications for forensic settings are also discussed.

Keywords: Other-race effect; Face matching.

People are generally better at remembering faces of their own race than faces from a less familiar racial group. The other-race effect (ORE) is among the most replicated effects in the face recognition literature (e.g., Brigham & Malpass, 1985; Cross, Cross, & Daly, 1971; Malpass & Kravitz, 1969; O'Toole, Deffenbacher, Valentin, & Abdi, 1994; Shepherd, Deregowski, & Ellis, 1974; Valentine & Bruce, 1986) and has been demonstrated in applied studies of eyewitness identification performance (e.g., for reviews see Brigham, Bennett, Meissner, & Mitchell, 2007; Chance & Goldstein, 1996). Furthermore, it is a particularly strong effect: A meta-analysis carried out by Meissner and Brigham (2001) demonstrated that across 39 studies and 5,000 subjects, people were more than twice as likely to recognize own-race than other-race faces. Importantly, however, despite the large literature reporting OREs in face *memory*, no study has yet determined whether this performance deficit is observed in a task where target and test face images are presented simultaneously.

In this study, we wish to determine whether the ORE is observed under conditions of face *matching* rather than face memory, and we therefore present

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target images alongside comparison images. This question is of theoretical importance, as determining whether or not baseline face-matching performance is reduced for other-race faces will inform an enduring theoretical debate in the literature. In particular, there remains significant disagreement as to whether the deficit in other-race recognition memory is due to differences in the way the faces are initially perceived (Levin, 1996, 2000; Sporer, 2001), or the way in which they are subsequently stored in memory (e.g., Valentine, 1991). In addition, this design has practical relevance because face matching has become a commonplace task—for example, when presenting passports or other photo-ID. Despite some advances in biometric technology, image inspection by human observers remains the most common method for identity verification worldwide.

In fact, face matching is known to be highly error prone. For example, Bruce and colleagues (1999) asked participants to find a target face in a line-up of 10 face images, which were of good quality, were taken on the same day (eliminating any transient differences such as hair style, weight, and health), and were presented in a similar full-face pose (see Figure 1). Despite these favourable conditions, subjects' performance on the task was strikingly low, with mean error rates of about 30% in both target-present and target-absent line-ups. Subsequent studies have reported similar poor performance in tasks where the targets are always present (Bruce et al., 1999; Burton, Miller, Bruce, Hancock, & Henderson, 2001), where participants make only "same" or "different" responses to pairs of faces (Bruce, Henderson, Newman, & Burton, 2001; Burton, White & McNeill, 2010; Z. Henderson, Bruce, & Burton, 2001; Megreya & Burton, 2006, 2007, 2008), and where subjects are asked to match photographic ID to live faces (Kemp, Towell, & Pike, 1997; Megreya & Burton, 2008).

Major theoretical accounts of OREs differ in the extent to which they implicate memory processes. For instance, a number of theories have been proposed that explain OREs as a failure of the cognitive system appropriately to encode the dimensionality of other-race faces in memory. Known broadly as "face-space" models (e.g., Byatt & Rhodes, 2004; Valentine, 1991; Valentine & Endo, 1992), these models predict that problems associated with recognizing other-race faces are caused by inefficient storage and/or retrieval of face representations from memory. However, alternative theories postulate that the ORE occurs because of differences in the way that own-race and other-race faces are initially processed. For instance, Sporer's (2001) "in-group/out-group" and Levin's (2000) "race-coding" hypotheses both propose that race affects the level of perceptual processing that is afforded to face stimuli, with other-race faces being processed on a more superficial level than own-race faces. Despite the perceived importance of this question, however, empirical demonstrations of the ORE have tended to employ memory-intensive tasks (for reviews see Meissner & Brigham, 2001; Sporer, 2001). Crucially, the dominant recognition-memory paradigm produces performance data that are reflective of memory processes and therefore are limited in their potential for discriminating between the opposing predictions made by major theoretical accounts.

Some recent studies have addressed this inconsistency. For instance, Papesh and Goldinger (2010) have demonstrated that psychological similarity spaces (as derived from multidimensional scaling analyses of same–different decisions for simultaneously presented faces) are different for same and other-race faces. This result was observed despite own and other-race faces being structurally identical and differing only on skin tone. Similar results are reported by Byatt and Rhodes (2004), who also find that, in general, other-race faces are perceived as being more similar to own-race faces. Unfortunately, neither of these studies recruited participants from the comparison racial group and due to this asymmetry did not eliminate the possibility that artificial properties of the stimuli contributed to this effect. Further evidence of encoding differences has been observed in eye movements during the learning phase of a standard recognition memory procedure (Goldinger, He, & Papesh, 2009),

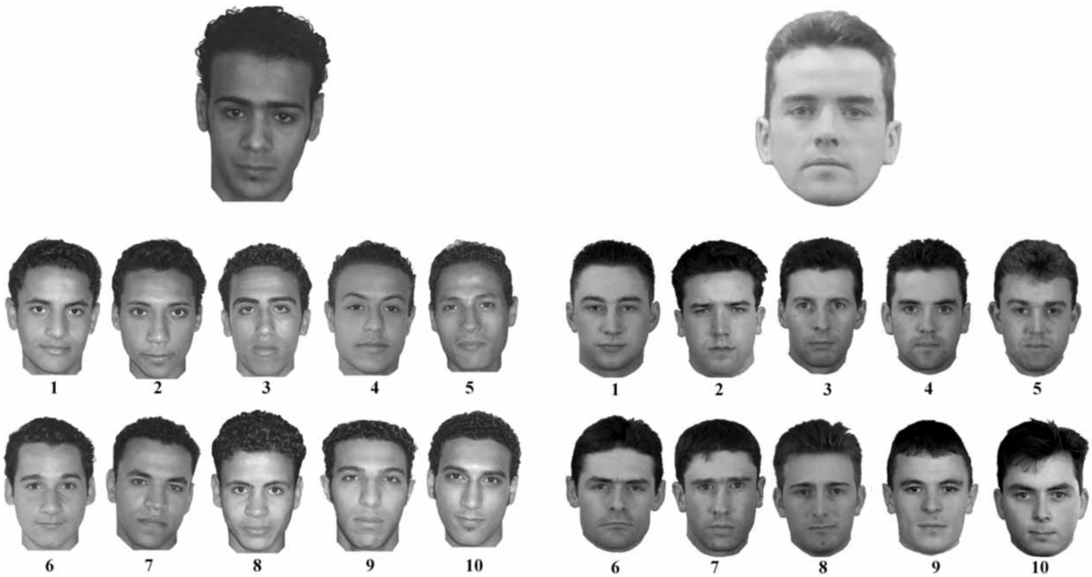

Figure 1. *An example of Egyptian (left) and UK (right) face-matching arrays. The person shown at the top may or may not be one of the 10 below. Subjects' task is to decide whether he is present, and, if so, which he is. For further details regarding the method used to construct these arrays see Megreya and Burton (2008).*

where other-race faces were found to be fixated less, with each fixation lasting longer on average, and also inducing higher levels of pupil dilation than same-race faces.

The existence of qualitative differences between own and other-race face processing is further supported by data showing that own-race faces are processed more holistically than other-race faces. First of all, in tasks where part- versus whole-face processing abilities are compared (e.g., Tanaka & Farah, 1993), other-race faces are often processed in a more piecemeal fashion than own-race faces (Hayward, Rhodes, & Schwaninger, 2008; Michel, Caldara, & Rossion, 2006; Rhodes, Hayward, & Winkler, 2006; Tanaka, Kiefer, & Bukach, 2004). Furthermore, it appears that the extent of the ORE in face recognition is proportional to the difference between configural coding in own- and other-race faces (Hancock & Rhodes, 2008) and that differences in the reliance on holistic processes are reflective of visual experience (Michel, Corneille, & Rossion, 2010). In addition, the face composite effect (Young, Hellawell, & Hay, 1987) is also stronger for own-race faces than for other-race faces. Michel, Rossion, Han, Chung, and Caldara (2006) demonstrated that both same- and other-race face-halves were recognized less well when aligned with the bottom half of a different face. However, this disruption was greater for same-race than for other-race faces, showing a greater effect of holistic processes on same-race face recognition. Similarly, demonstrations of the face inversion effect (FIE; see Yin, 1969) are typically larger in same-race than other-race faces (e.g., Fallshore & Schooler, 1995; Rhodes, Brake, & Taylor, 1989). Inversion has been argued selectively to disrupt configural processing (see Bartlett, Searcy, & Abdi, 2003), and therefore this result is taken as evidence that recognition of other-race faces is less reliant on configural information. Notably, this difference is abolished by familiarization with other-race faces (McKone, Brewer, & MacPherson, 2007), which may explain why interactions between the ORE and FIE have not been universally observed (Buckhout & Regan, 1988; Valentine & Bruce, 1986).

Although the literature, discussed above, strongly indicates that other-race face processing does not rely on configural information to the same extent as own-race face processing, all of these studies use either recognition memory or sequential matching tasks. This is despite a number of these studies claiming to employ perceptual discrimination tasks (e.g., Michel, Caldara, & Rossion, 2006; Tanaka et al., 2004). Likewise, a number of studies have reported differences in two-alternative forced-choice accuracy during early visual processing, suggesting an own-race advantage in the structural encoding stage of face processing (e.g., Levin, 2000; Lindsay, Jack, & Christian, 1991; Marcon, Meissner, Frueh, Susa, & MacLin, 2010; Walker & Hewstone, 2006; Walker & Tanaka, 2003). Again, all of these experiments used sequential matching tasks where comparison images were not presented simultaneously. Perceptual discrimination advantages for own-race faces have been shown using sequential face-matching procedures (Marcon et al., 2010; Walker & Tanaka, 2003). However, both of these studies presented target images for brief periods followed by a short masking interval and then presented the comparison image. Crucially, this paradigm does not allow perceptual comparison of images: Participants are not permitted to return their gaze to target images, and therefore because comparison is always between a target image and a memory trace, this paradigm does not convincingly test perceptual performance.

In the present investigation, we tested unfamiliar-face-matching performance in British and Egyptian subjects using British and Egyptian face stimuli under conditions of simultaneous presentation. We believe this provides the first robust test of *perceptual* discrimination of other-race faces compared to own-race faces. In addition, we present target images both upright and inverted to test the hypothesis that configural information is more heavily implicated in own-race face *matching*.

Method

Participants

A total of 52 subjects participated in this experiment. A total of 26 were undergraduate students at the University of Glasgow (18 female, 8 male; mean age = 20.9 years), and the remaining 26 were undergraduate students at Menoufia University (14 female, 12 male; mean age = 17.2 years). All subjects were asked whether they had spent any time in the comparison country, and none reported having done so. Subjects either were paid in cash or received course credit in return for their participation.

Stimuli

A total of 240 target-present and target-absent arrays were taken from British (see Bruce et al., 1999) and Egyptian (see Megreya & Burton, 2008) face-matching databases to use as stimuli in this study. All arrays were presented in greyscale. All images showed full-face view of young clean-shaven men with neutral expression and were sized approximately 5 × 7 cm.

Full details of array construction can be found in Bruce et al. (1999) and Megreya and Burton (2008). Briefly, the UK arrays consisted of a target video still (taken from a high-quality video camera) presented above an array of 10 digital photographs taken by a high-quality digital camera on the same day as the video clips; see Figure 1 for an example. Arrays were created using the UK Home Office PITO database, and all showed Caucasian police trainees. Distractor images were chosen as those rated most similar to the target by independent raters. Egyptian arrays were created following the same method as that of Bruce et al. (1999), with a face database comprising male Egyptian students.

Procedure

UK and Egyptian participants completed an identical experimental procedure. Participants sat in front of a 15″ LCD monitor with resolution 1,152 × 864 pixels. A random sequence of 60 UK arrays (15 upright present/15 upright absent/15 inverted present/15 inverted absent) and 60 Egyptian arrays (15 upright present/15 upright absent/15 inverted present/15 inverted absent) was presented to each subject. Participants were asked to decide whether the person pictured to the top of the screen was present in the array, and if so they were to specify which person using keys labelled 1 to 10. The procedure was self-paced: Participants were explicitly informed that there was no time constraint and were asked to be as accurate as possible. Stimuli were counterbalanced to ensure that, across the experiment, each target identity appeared equally often in each of the four array conditions (upright/inverted, present/absent), while individual subjects saw targets only once.

Results

Following previous work, we break overall performance into its components. For target-present items there are three possible responses: *hits* (identifying the correct match); *misses* (deciding that the target is absent when it is actually present); and *misidentifications* (misIDs; identifying a distractor, despite the presence of a target). For target-absent trials there are two types of response: *false positives* (FPs; identifying a foil while the target is absent) and *correct rejections*—as these two measures are complementary, we present only false positives. In addition, we calculated an overall accuracy measure by taking the mean of *hits* and *correct rejections*. For practical, forensic, reasons it is useful to break down the data in this way. Note, however, that our design does preclude calculation of signal detection measures of sensitivity and criterion because subjects sometimes make misidentifications in target-present trials. Table 1 shows average scores on each performance measure for the two groups.

Overall performance data

Overall accuracy data were subjected to a three-way mixed factor analysis of variance (ANOVA) with the between-group factor "subject nationality" and within-group factors of "array nationality" and "orientation" (upright vs. inverted). There was a large main effect of target orientation, $F(1, 50) = 223.2$; $p < .05$, but no reliable main effects of subject nationality or array nationality, $F(1, 50) = 1.83$ and 3.95, respectively, *ns*. In addition there was a significant three-way interaction, $F(1, 50) = 17.38$. Analysis of simple simple main effects confirmed the standard ORE pattern, with performance on upright own-race arrays being superior for both British, $F(1, 50) = 32.38$; $p < .05$, and Egyptian, $F(1, 50) = 4.05$; $p < .05$, participants. There was no effect of array nationality for either British or Egyptian subjects when targets were inverted ($F < 1$). Despite this pattern, the effect of subject nationality was significant only on Egyptian upright arrays, $F(1, 50) = 9.48$; $p < .05$, and not for UK arrays, with the two groups performing equivalently overall on these trials. Inversion effects were significant across all levels of analysis (all Fs > 10).

Below we present other-race effects (OREs) and face inversion effects (FIEs) separately by calculating subtractive measures for each of our five performance components (hits, misses, misIDs, FPs, and accuracy). For clarity, subtractions were calculated such that positive values indicate superior performance in own-race (or upright) conditions. So, for hits and overall accuracy, the ORE was quantified by subtracting the percentage of hits for other-race arrays from percentage hits for same-race arrays; whilst for misses, misidentifications, and false positives, difference scores were calculated by subtracting same-race scores from other-race scores. As above, we present Egyptian and UK participants' data separately.

Other-race effects

Figure 2 shows mean OREs for the two participant groups in each measure of performance with error bars representing confidence intervals (alpha = .05) against the null hypothesis (i.e., hypothetical mean of zero). When target faces were presented upright, both UK and Egyptian participants performed better overall with own-race arrays than with other-race arrays. The two experimental groups did, however, produce opposite patterns of OREs with respect to the performance components. Specifically, OREs were observed in misidentifications and false positives for UK subjects and in hits and misses for Egyptian subjects. Conversely, when targets were presented upside down, there was no overall advantage for own-race faces. Furthermore, UK participants actually made significantly more hit

Table 1. *Performance of British and Egyptian participants in matching unfamiliar own- and other-race arrays*

Participants		*Accuracy*	*Hit*	*Miss*	*MisID*	*FPs*
UK	Own-race upright	67.4 (13.5)	68.2 (17.4)	17.7 (12.1)	14.1 (13.5)	33.3 (24.6)
	Own-race inverted	43.8 (16.0)	35.9 (23.1)	28.2 (16.0)	35.9 (26.7)	48.2 (19.4)
	Other-race upright	52.6 (14.1)	64.1 (14.6)	8.5 (12.9)	27.4 (15.1)	59.0 (20.5)
	Other-race inverted	44.2 (15.3)	48.7 (18.5)	14.1 (9.7)	37.2 (18.8)	60.3 (22.4)
Egyptian	Own-race upright	69.4 (19.9)	72.6 (14.0)	13.1 (10.7)	14.3 (14.2)	33.8 (27.8)
	Own-race inverted	46.5 (15.7)	34.8 (16.4)	36.7 (21.4)	28.5 (20.4)	41.8 (24.8)
	Other-race upright	64.1 (16.0)	63.3 (13.6)	21.5 (13.5)	15.2 (12.4)	35.1 (26.7)
	Other-race inverted	47.7 (15.6)	40.0 (16.5)	33.1 (18.3)	26.9 (17.5)	44.6 (25.8)

Note: In percentages. Standard deviations in parentheses. MisID = misidentification. FP = false positive.

and fewer miss responses to other-race faces than to own-race faces when the target was inverted.

Face inversion effects

Face inversion effects were calculated by subtracting inverted performance from upright performance (note that, as with OREs, the reverse calculation is made for misses, misidentifications, and false positives so that a positive score consistently represents superior performance in the upright condition). For both groups of participants, all face inversion effects were significantly greater than zero ($p < .05$), with the exception of UK participants' false-positive scores to Egyptian arrays, $t(25) = 0.437$; *ns*. Figure 3 shows mean FIE scores for the five performance measures.

To test the hypothesis that FIEs were greater for same-race than for other-race arrays, paired-sample t tests were carried out separately for each performance measure. In overall accuracy scores, FIEs were larger in same-race faces for both UK, $t(25) = 3.327$; $p < .05$, and Egyptian participants, $t(25) = 2.621$; $p < .05$. However, the performance components showing this difference differed between our two groups of participants. UK participants showed significant differences between FIEs for same-race and other-race arrays in hits, $t(1, 25) = 3.077$; $p < .05$, and false positives, $t(1, 25) = 2.210$; $p < .05$, but not in misses, $t(1, 25) = 1.096$; $p = .284$, or in misIDs, $t(1, 25) = 1.767$; $p = .089$. Conversely, Egyptian participants showed significantly larger FIEs for own-race faces in hits,

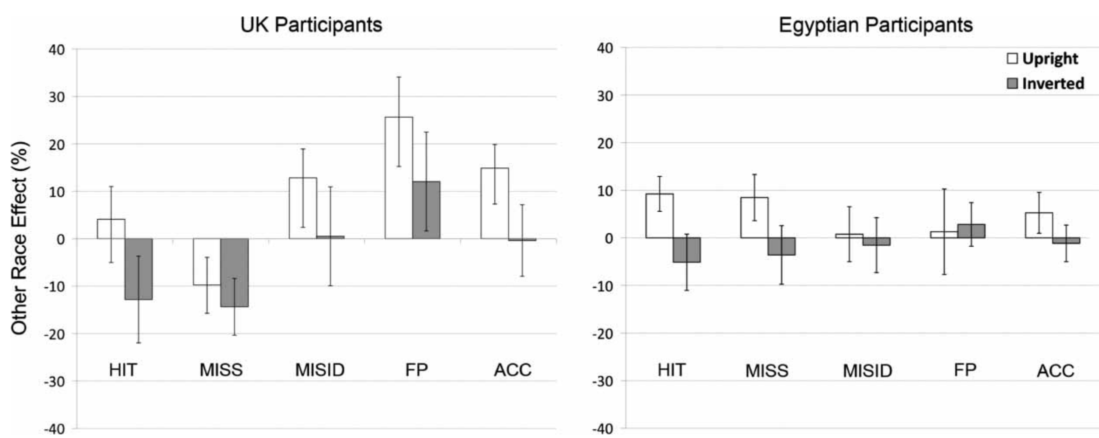

Figure 2. *Other-race effects calculated as difference scores between own-race and other-race performance. Positive scores indicate better performance for own-race faces and negative scores better performance for other-race faces. Error bars represent 95% confidence intervals of the mean. MISID = misidentification. FP = false positive. ACC = accuracy.*

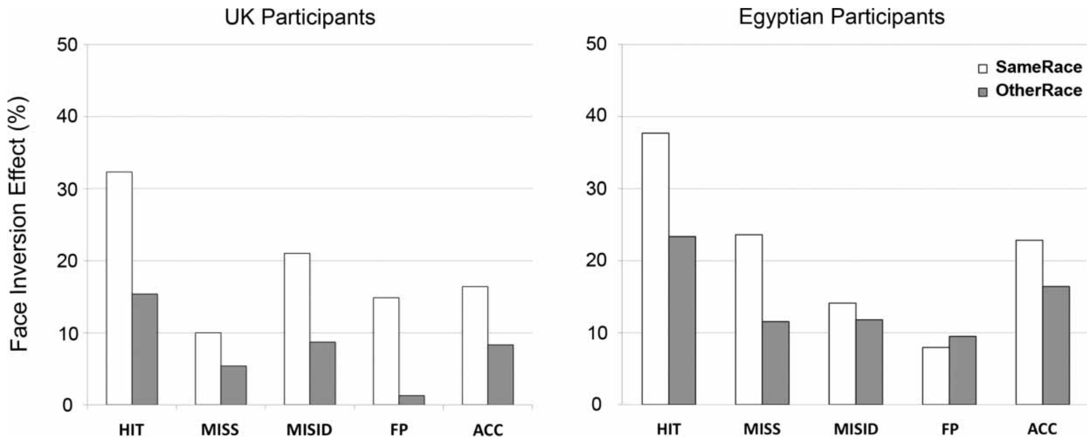

Figure 3. *Face inversion effects calculated as difference scores between own-race and other-race performance. Positive scores indicate better performance for upright faces. MISID = misidentification. FP = false positive. ACC = accuracy.*

$t(1, 25) = 4.033$; $p < .05$, and misses, $t(1, 25) = 2.975$; $p < .05$, but no differences for false positives, $t(1, 25) = -0.323$; $p = .749$, or misidentifications, $t(1, 25) = 0.618$; $p = .542$.

Correlations

UK subjects showed strong reliable Pearson correlations between UK and Egyptian faces on all measures (hits: $r = .44$, $p < .05$; misses: $r = .43$, $p < .05$; misidentifications: $r = .45$, $p < .05$; FPs: $r = .58$, $p < .01$; accuracy: $r = .60$, $p < .01$). Egyptian subjects showed similar strong associations (hits: $r = .79$, $p < .01$; misses: $r = .53$, $p < .01$; misidentification: $r = .43$, $p < .05$; FPs: $r = .67$, $p < .01$; accuracy: $r = .78$, $p < .01$). Consistent with previous work (and with our decision to present target-present and target-absent data separately), there was no correlation between hit and false-positive measures for either Egyptian arrays (Egyptian subjects: $r = -.05$; UK subjects: $r = -.26$) or British arrays (Egyptian subjects: $r = -.17$; UK subjects: $r = -.21$).

Discussion

First, our data demonstrate that matching own-race faces was highly error prone in both British and Egyptian subjects, a finding that replicates previous research (Bruce et al., 1999; 2001; Z. Henderson et al., 2001; Megreya & Burton, 2006, 2007, 2008). This confirms that the difficulty of matching unfamiliar faces is likely to be a universal finding and not an artefact to any specific face database.

Second, the overall accuracy of matching upright unfamiliar faces was further reduced for faces of a different race for both groups, replicating the well-established other-race effect shown by face recognition memory literature (for reviews see Bothwell, Brigham, & Malpass, 1989; Brigham, 1986; Meissner & Brigham, 2001; Shapiro & Penrod, 1996). This is an important finding because it is the first demonstration of robust performance deficits when matching images of unfamiliar faces. Although there remain slight memory demands in our task (e.g., see Shore & Klein, 2001, for a review of the role of memory in visual search; and J. Henderson, 1997, for trans-saccadic memory representations), the task is designed in such a way that allows participants to freely inspect the images in order to maximize their performance. Not only does this task more accurately replicate important real-world security checks than previous research using serial presentation (e.g., Marcon et al., 2010), it also reduces memory demands significantly. Crucially, participants are able to inspect the target image back and forth, without one of the images being removed. The fact that the

ORE occurs under these conditions strongly suggests that the other-race effect occurs (at least in part) during perceptual encoding, rather than memory. This is in line with previous research using memory-rich tasks (Lindsay et al., 1991; Walker & Hewstone, 2006; Walker & Tanaka, 2003), and therefore the evidence strongly suggests that OREs cannot be explained by the exemplar density of memory representations (Byatt & Rhodes, 2004; Valentine & Endo, 1992).

Interestingly, this design allows us to examine the detailed nature of the ORE for the two experimental groups, and these turn out to be different. UK observers revealed the ORE as a problem of cross-identity differentiation, whereas Egyptian participants revealed it as a problem of within-identity differentiation. Specifically, British subjects made more FPs to Egyptian than to UK faces, but hit rates were similar for the two array types. Conversely, Egyptian subjects made fewer hits to UK than to Egyptian faces, but FP rates were similar. This is a pattern we have observed previously. In an unpublished experiment, we presented a different set of UK and Egyptian subjects with 50 own- and 50 other-race arrays, this time all upright. Very similar patterns emerged, with UK subjects showing a significant ORE in false positives, but not hits, whereas Egyptian subjects showed the converse pattern. Once again, both groups showed significant OREs in overall accuracy, but this effect had different sources. (Full details of this experiment are available from the authors on request.)

The most straightforward explanation for these effects is that Egyptian and British subjects adopted different response criteria when they were presented with the task of matching other-race faces. Specifically, UK subjects tended to adopt a more lax criterion for matching Egyptian faces than their own-race faces, leading to lower miss rates and higher FPs to Egyptian than to UK faces. In contrast, Egyptian subjects tended to adopt a more stringent criterion to UK faces than to their own-race ones, leading to higher miss rates and lower hits to UK than to Egyptian faces. It remains unclear why such a difference exists, though one possibility is that it reflects differences in the level of exposure: Egyptian media is more influenced by western culture than vice versa. This account would also explain why OREs were generally larger for British than for Egyptian subjects. Contact has been shown to improve other-race face processing primarily by reducing false-positive responses (Meissner & Brigham, 2001), which would explain the lack of OREs for Egyptian subjects in target-absent trials. Of course, we must acknowledge that this is a hypothesis, requiring further testing, but the direction of the difference is consistent with an account based on differential exposure.

Next, we consider the effects of inversion. The data presented here replicate the finding that FIEs are greater for own-race than for other-race faces (Rhodes et al., 1989; Sangrigoli & de Schonen, 2004), suggesting that configural processing is engaged more for own-race faces, as has been widely demonstrated (e.g., Hancock & Rhodes, 2008; Michel, Caldara et al., 2006; Rhodes et al., 2006; Tanaka et al., 2004). Previously, this interaction had only been demonstrated in recognition memory tasks (Rhodes et al., 1989; Sangrigoli & de Schonen, 2004), and therefore the present demonstration provides further evidence that qualitative differences exist between early visual processes for own- and other-race faces (e.g., Tanaka et al., 2004). However, although we found greater FIEs for own- than for other-race faces in general, this was not observed for all performance components. The standard interaction between ORE and FIE was detected in hits for both groups, but it was further detected in miss responses only for Egyptian participants, whereas UK participants revealed this pattern for false-positive responses. This asymmetry somewhat mirrors the pattern found for OREs, in that FIEs were stronger for own-race stimuli in present trials for Egyptian subjects and in absent trials for UK participants. That the ORE and FIE effects are correspondent in this respect might be taken to suggest that whatever process is causing the ORE in our task is also causing FIEs.

However, conclusions regarding differences in cognitive processes used in same- and other-race arrays must be tempered by the correlation evidence reported here. We found that although matching own-race faces and matching other-race faces were quantitatively different, they were qualitatively similar. UK subjects who were good at matching their own-race faces were also good at matching Egyptian faces, and this same positive association was found for Egyptian subjects. These reliable correlations suggest that other- and own-race faces are subject to some overlapping cognitive processing. Of course, the level of overlap may be rather general—reflecting components common to all visual tasks (perhaps attentional or alertness components). On the other hand, our correlation evidence concurs with recent studies of ERP responses to upright and inverted own- and other-race faces (Stahl, Wiese, & Schweinberger, 2008; Wiese, Stahl, & Schweinberger, 2009).

In the study conducted by Stahl et al. (2008), an N170 response was detected for presentations of both same- and other-race faces, with other-race faces causing a delay in the N170 response. Wiese et al. (2009) replicated this finding and showed that the effects of race (and even species) and inversion were additive with regard to the length of delay observed for the N170. Because the authors observed no interaction between stimulus type and inversion, they conclude that the same processes are responsible for own- and other-race faces. The individual differences in performance data observed in the current study are consistent with this conclusion.

The data presented in this paper suggest a way of teasing apart some of the different processes involved in face matching. First, we observed that inversion impacted same-race face matching more than other-race face matching, suggesting that configural processing mechanisms were engaged more for same-race face matching than for other-race face matching. Second, we demonstrated that performance on same-race face matching predicted performance on other-race face matching, suggesting that common mechanisms supported performance on these two tasks. These findings appear to provide an opportunity, in future work, to elucidate which processes (or processing strategies) are common to the two tasks and which are different.

Indeed, a previous study by Yovel and Kanwisher (2008) provides further data addressing this issue. In an experiment designed to test individual differences in face-processing ability, the authors reported a high correlation between performance on configural and featural face-processing tasks. If there is a common mechanism for processing all face stimuli, this might help explain why in a previous study we reported a high correlation between upright and inverted unfamiliar face matching performance (Megreya & Burton, 2006), while at the same time observing a substantial decrement in performance for inverted stimuli.

Demonstrating the other-race effect using a simultaneous matching task also has important forensic implications. For example, if eyewitness misidentifications rely primarily on perceptual rather than memorial constraints (Megreya & Burton, 2008), then any improvements for eyewitness identifications of other-race culprits, which are more error prone than own-race perpetrators (e.g., for reviews of empirical studies see Brigham et al., 2007; Chance & Goldstein, 1996; and also for an archival analysis, see Behrman & Davey, 2001), need to concentrate primarily on enhancing how to encode other-race faces. In addition, the results imply that face verification of people from an "other" race would be particularly error prone. In the present study, the identity verification error rate for same-race arrays was roughly 30%, and for other-race arrays there were roughly 40% errors. Thus, in international airports, passport issuance, and settings with similarly high prevalence of ethnic diversity, we predict poorer detection of fraudulent photo-ID for foreign nationals than for local citizens. Further research may examine ways to improve the poor performance reported in this paper, either through perceptual training or by selection of employees based on ability in specific face-matching tasks.

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