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Face recognition in the presence of angry expressions: A target-race effect rather than a cross-race effect

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HIGHLIGHTS

- We tested the effect of angry expressions on memory of White and Black faces.
- We used a new stimuli set, to account for possible stimulus issues in past work.
- We found that angry expressions impaired memory for Black faces, compared to neutral.
- We tested both a White and a Black participant sample, finding similar results.
- We propose a stereotype-congruency explanation for the findings.

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ABSTRACT

Perceivers usually recognize the faces of members of their own racial group more accurately than the faces of other races — a difference which is called the cross-race effect (CRE). When showing this effect, research has typically used facial stimuli with neutral emotional expressions. A few studies have examined the effect with faces showing angry expressions (Ackerman et al., 2006; Krumhuber & Manstead, 2011; Young & Hugenberg, 2012), and these have generally shown enhanced recognition of outgroup angry faces, an effect that Ackerman et al. (2006) attributed to greater attention paid to threatening outgroup members. However, these studies suffer from stimulus confounds, in that the Black angry faces were particularly unusual, as revealed in our pretest data. Additionally, only White participants were used in these studies, raising the question of whether the reported effects are truly ingroup–outgroup effects. Reported here are two studies, using first White and then Black participants, that used a novel stimulus set that avoided earlier confounds. Participants studied and later attempted to recognize White and Black faces, varying in their emotional expression (angry versus neutral) both at encoding and testing. Both experiments showed a pro-ingroup CRE. However, contrary to prior research, both participant races had relatively more difficulty recognizing angry Black faces, such that when the faces were angry, the pro-ingroup CRE was strengthened for White participants and weakened for Black participants. We discuss theoretical explanations for these results which substantially qualify past conclusions about the role of facial emotions in cross-race facial recognition.

Introduction

Social psychologists have had a long-standing interest in what is commonly called the cross-race effect (CRE), the tendency for participants to remember the faces of ingroup members more effectively than the faces of outgroup members (for reviews, see Hugenberg, Young, Bernstein, & Sacco, 2010; Meissner & Brigham, 2001; Young, Hugenberg, Bernstein, & Sacco, 2012). In a typical demonstration of this effect, White participants are shown to remember White faces better than Black (e.g. Malpass & Kravitz, 1969) or Asian faces (e.g. Ferguson, Rhodes, Lee, & Sriram, 2001). Theoretically, this effect is of interest because of what it reveals about face processing and about the role of social categorization in face processing. On a more applied level, the effect has major consequences for eye-witness identification in interracial contexts.

Had researchers only tested the CRE with White participants, one would be concerned about whether the effect is truly a cross-race effect, due to ingroup versus outgroup targets, or the effect is just specific to particular participant and target groups. However, subsequent research has found that the CRE is generalizable even to non-racial ingroup–outgroup contexts, as well as across both perceiver race and target race. Social psychologists have found the "cross-race effect" between

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minimal groups (Bernstein, Young, & Hugenberg, 2007; Van Bavel, Packer, & Cunningham, 2011), students from different universities (Hugenberg & Corneille, 2009), and the sexes (Slone, Brigham, & Meissner, 2000). CRE researchers have also used Asian (Goldinger, He, & Papesh, 2009; Rhodes et al., 2009), Hispanic (Evans, Marcon, & Meissner, 2009; Marcon, Susa, & Meissner, 2009), Egyptian (Megreya, White, & Burton, 2011), and Black (Chiroro, Tredoux, Radaelli, & Meissner, 2008; Malpass & Kravitz, 1969; Pauker et al., 2009) participant samples, and have generally found that non-White participants have poorer memory for White faces than for faces of their own race. According to a meta-analysis, however (Meissner & Brigham, 2001), White participants tend to show a stronger CRE than non-White participants. In sum, the effect clearly seems to be an ingroup–outgroup one, although there can be group-specific moderators of its strength.

Multiple explanations have been proposed for the CRE. These can be generally divided between perceptual learning models on one hand, and social cognitive models on the other. As suggested by Hugenberg et al. (2010), there is good support for both. The perceptual learning models start with the assumption that people are more familiar with their own race than others, and therefore they have more expertise in processing own-race than other-race faces (Meissner & Brigham, 2001). Accordingly, people should come to have smaller CREs and better memory for outgroup faces as they gain more experience with the outgroup. Indeed, Meissner and Brigham (2001) found in a meta-analysis that the CRE tends to be reduced among participants who have higher levels of prior interracial contact.

In contrast, according to the social-cognitive models, people have the skill but not the will to remember outgroup faces. That is, people find the ingroup to be particularly relevant to the self, and so by contrast, people attend to them more closely and process them more thoroughly than outgroup members (Correll & Park, 2005; Rodin, 1987; Van Bavel, Swencionis, O'Connor, & Cunningham, 2012). Additionally, Levin (1996, 2000) argues that people are more likely to spontaneously categorize outgroup members than ingroup members (Fiske, Lin, & Neuberg, 1999). As a consequence, they individuate outgroup members less and hence have lower recognition memory for them.

According to Hugenberg et al. (2010), the social-cognitive models imply that categorization and attention should moderate the CRE. For example, researchers have found a larger CRE when White participants encode White faces before Black faces in separate blocks, as opposed to a single mixed block, presumably because White faces are categorized less often when contrasting Black faces are not yet present (Young, Hugenberg, Bernstein, & Sacco, 2009). Researchers have also shown improved recognition rates for outgroup faces by instructing participants to differentiate outgroup members from each other (Hugenberg, Miller, & Claypool, 2007). They have also found smaller CREs in situations where the outgroup has more power and social status, making them more attention-worthy (Ratcliff, Hugenberg, Shriver, & Bernstein, 2011; Shriver & Hugenberg, 2010; Shriver, Young, Hugenberg, Bernstein, & Lanter, 2008).

Conflicting research on angry expressions as a moderator of the CRE

In the present research, we investigate another potential moderator that may affect attention and categorization processes: angry facial expressions of the target faces. We are interested in this CRE moderator, because there are alternative theoretical possibilities for how and why it may moderate the CRE, and because there are conflicting findings in the literature on the subject (Ackerman et al., 2006; Corneille, Hugenberg, & Potter, 2007).

First, angry faces and other threatening stimuli are known to capture and hold attention (Fox et al., 2000; Öhman, Flykt, & Esteves, 2001; Öhman, Lundqvist, & Esteves, 2001). Because of this extra attention, faces that are threatening may be more memorable. Additionally, as argued by Ackerman et al. (2006), angry outgroup faces may be even more threatening and attention-grabbing than angry ingroup faces. Accordingly, angry expressions might attenuate the CRE by increasing attention to outgroup faces. This argument was advanced and seemingly supported in research reported by Ackerman et al. (2006) and Young and Hugenberg (2012).

On the other hand, in the context of Black and White target groups, perceivers could be affected by stereotypic expectations about these two target groups, which could play a role in how angry facial expressions moderate the CRE. There is now considerable evidence that Blacks in the United States are stereotyped as threatening and potentially dangerous (Correll, Park, Judd, & Wittenbrink, 2002; Devine, 1989; Hugenberg & Bodenhausen, 2003). If perceivers have worse recognition memory for faces that they categorize, rather than individuate, then it seems possible that perceivers may categorize faces more when the faces have facial expressions that are stereotypically consistent for their racial category, leading to worse recognition memory. This would suggest worse recognition for angry Black faces than for non-angry Black faces. White participants would then show a larger CRE with angry faces, due to impaired memory for angry outgroup (i.e., Black) faces. On the other hand, if the social stereotype really is shared even among Blacks (Correll et al., 2002), then Black participants might also increase categorization processes when faced with angry Black faces, thus perhaps reducing the CRE for them. This stereotype-congruency view predicts that memory for angry Black faces might be impaired by angry expressions for all participants.

In support of their argument that angry expressions decrease the CRE generally, Ackerman et al. (2006) had White participants view several angry White, angry Black, neutral-expression White, and neutral-expression Black faces. On a later memory test, participants were less accurate at remembering Black neutral faces than White neutral faces, consistent with the CRE, but they were actually better at remembering Black angry faces than White angry faces. Similar results were found by both Krumhuber and Manstead (2011) and Young and Hugenberg (2012), for whom White participants showed a reversed (Krumhuber & Manstead, 2011) or non-significant (Young & Hugenberg, 2012) CRE with angry White and Black faces, even as they showed a significant CRE with neutral faces.

Although these results have been replicated, there are some reasons to question them. First, all of the research cited above exclusively used White participants. Accordingly, it is unclear whether these results are due to the outgroup being better remembered when its members manifest anger or due to a general tendency for the angry Black targets to be better remembered. In other words, these results are entirely consistent with anger enhancing memory for Black faces rather than enhancing memory for outgroup faces more generally.

A second and related concern is that these prior results may be due to the particular samples of stimulus faces used. Ackerman et al. (2006) used very small stimulus samples (for instance, only four encoded Black angry faces with four Black angry lures). Furthermore, to us, the Black angry faces appeared to have many idiosyncrasies and were particularly striking. Thus, we suspect that these angry Black faces were particularly memorable and would be so for any group of participants. We test this suspicion in ways we describe below. In replicating the Ackerman et al. (2006) results, Young and Hugenberg (2012) used nearly an identical photo set, and Krumhuber and Manstead (2011) used many of the same photo sources. Thus, it is possible that these successful replications are simply due to the specific stimuli used throughout all of these studies. Additionally and importantly, in Ackerman et al. (2006) and Young and Hugenberg (2012), targets with angry expressions were not the same individuals as targets with neutral expressions. In other words, the specific features of individual targets (e.g., perhaps a strange hairstyle) were not held constant across emotional expressions.

One additional study has explored the effect of angry expressions on the magnitude of the CRE, using a totally different face stimulus set. Corneille et al. (2007) used a large set of computer-generated Black and White faces with either a happy or an angry facial expression, holding constant their other features. They found only chance memory for previously-seen angry Black and happy White faces, but significantly higher than chance memory for angry White and happy Black faces. These results are thus quite different from those found in the other studies and consistent with an explanation based on stereotypic categorization consistency: Black faces were remembered less well when they had angry expressions. Again though, these results are difficult to interpret, because Corneille et al. (2007) exclusively used White participants. As a result, the memory differences as a function of angry expressions could be equally attributable to an ingroup–outgroup difference or to a difference associated with the specific target races.

The present research

Given the inconsistent empirical results we have just reviewed and the conflicting theoretical ideas about how angry facial expressions might moderate CRE, we undertook a series of studies to reexamine this issue while addressing the limitations of the earlier studies.

First, in an initial pilot study, we examined the specific faces used in Ackerman et al. (2006) to determine whether the confounding of specific faces with their emotional expressions might have contributed to their results. Then, in a subsequent study, we pilot-tested a new, larger set of faces, which we subsequently used in our studies. Our goal here was to come up with a large set of stimulus faces that would overcome the limitations of earlier stimulus sets.

Following these pilot studies, we conducted two recognition studies: one with White participants and one with Black participants. These studies corrected a number of limitations with the earlier studies. First, by using participants of both racial groups, we unconfounded cross-race effects from target-race effects. Second, because each target person in our stimulus sample posed with both a neutral and an angry expression, we were able to unconfound the specific target individuals from their facial expressions, so that any effects of expression could not be attributed to idiosyncrasies of the particular target faces used. Finally, based on our second pilot test, we could be confident that the anger expressed by the Black targets and the White targets was equal in distinctiveness and emotional intensity, unlike many of the earlier studies.

Pilot studies

For the sake of brevity, here we only summarize the pilot studies. For greater detail, see the Supplementary material. For the first pilot study, we contacted Joshua Ackerman, who kindly provided the photo stimuli from Ackerman et al. (2006; photos originally sampled from Beaupré & Hess, 2005; Tottenham et al., 2009). We had participants from Amazon's Mechanical Turk (N = 51) rate each of these 36 photos on how angry and how unusual they looked, on two 1–7 scales. The resulting mean ratings were each analyzed using a 2 (photo expression) by 2 (photo race) ANOVA. For the unusualness rating we found a significant interaction between photo expression and photo race, $F(1,32) = 6.30$, $p = .017$, $\eta^2 = .04$, such that angry Black photos were seen as much more unusual ($M = 4.35$, $SD = .79$) than neutral Black photos ($M = 2.29$, $SD = .22$), whereas this difference was smaller when comparing the White photos (angry $M = 3.70$, $SD = .29$; neutral $M = 2.39$, $SD = .37$). Thus, for Ackerman et al. (2006) and the replicating studies, participants may have had better memory because the Black angry faces were more distinctive.

To mitigate the risk of stimulus effects, we pretested a new set of stimuli for the following experiments, which were sampled and edited from Ma, Correll, and Wittenbrink (in press); see www.chicagofaces.org for access to full stimulus set. We had Mechanical Turk participants (N = 95) provide ratings of the ethnicity, angriness, and unusualness of 384 photos, taken of 96 target individuals (48 Blacks, 48 Whites), each with two photos taken with both angry and neutral expressions. From this, we selected a set of 64 target individuals (256 photos in total) with no racially-ambiguous members, such that anger and unusualness ratings were on average equivalent across White and Black facial photos.

Experiment 1

Using the final set of 64 target individuals, we conducted our first recognition study using a White participant pool. Each participant was initially exposed to 32 target individuals, with eight different angry Black, angry White, neutral Black, and neutral White photos in the encoded set. Thus race and facial expression varied within each participant's encoded set. Subsequently, participants were shown the full set of 64 target individuals and asked whether or not that target person had been seen before. Of these, 32 were the encoded individuals, and 32 were new individuals, serving as lures.

Our goal was to examine whether these White participants would show more accurate recognition of White than Black target individuals and whether this would be moderated in turn by angry versus neutral facial expressions. To replicate Ackerman et al. (2006), we would expect a smaller, non-significant, or reversed CRE with angry faces, due to improved memory performance with angry Black faces. Conversely, according to the stereotype congruency hypothesis, we would predict that participants would have a larger CRE with angry faces, due to impaired recognition of angry Blacks. Since facial expression at exposure might act differently from facial expression at test (during the recognition trials), facial expression was manipulated at both times independently.

Method

Participants and design

Ninety-three undergraduates participated at a predominantly-White university, for partial course credit. Four participants were excluded for failing to follow directions or due to a programming error. In demographics, the ethnicity item allowed multiple designations. Seven participants reported their ethnicity as at least partially Black and were eliminated from the dataset. Of the remaining 82 participants, 66 indicated (at least partial) White background, 11 indicated Latino/a background, 9 indicated Asian/Pacific-Islander background, 2 indicated Native-American background, and 3 indicated other backgrounds. We restricted the analysis to just the 66 Whites (43 females), of whom 4 also indicated Latino/a background, 3 also indicated Asian background, and 2 also indicated Native American background. No analyzed participant selected more than two backgrounds.[1]

Each participant was initially exposed to 32 target person photographs (each of a different person), varying in target race (White or Black) and target emotional expression (angry or neutral). These are referred to as the encoded faces or targets. Following this exposure, all 64 target persons were presented during a recognition test, including the 32 encoded faces and an additional 32 lures. Of the 32 encoded faces, half of each set of 8 faces (defined by race and target emotional expression) switched emotional expression at test. Thus for the 32 encoded faces, at test there were three within-participant factors: race (White or Black), encoded emotional expression (angry or neutral), and whether the emotional expression switched or not from encoding to test. Note that for angry encoded faces, switching meant they had a neutral expression at test, whereas for neutral encoded faces, switching meant they had an angry expression at test. Critically, all target photos in the test phase were actually new photos of the target individuals, and this was true for both individual targets who switched emotional expression and those who did not. This was done because faces that switched emotion from encoding to test necessarily involved new photos and we

[1] We also analyzed the data after excluding the 10 multi-racial White participants (N = 56 White-only participants). These results did not differ in any substantial way from the reported results.

wanted this to be true as well in the non-switch condition. Unlike some prior research, this provided a pure test of memory for the target individuals, rather than memory for particular photographs. The 32 lures used at test were defined by the two factors of race (White or Black) and testing emotional expression (angry or neutral).

Additionally, we used 16 different counterbalancing conditions to ensure that each target person was found equally often in each cell of the design for their race. Consequently, each target individual was used equally as an encoded face and as a lure, encoded as an angry or neutral face or as an angry or a neutral face at test. Thus any idiosyncrasies due to individual targets were unconfounded with the manipulated variables, other than race. For the encoding task, four fixed presentation orders were used for each counterbalancing condition, so participants were randomly assigned to one of 64 (16×4) face-presentation sets at encoding.

Materials

All 64 target individuals from the pretest were used. Each target person had four photos available: two with a neutral expression, and two with an angry expression. The experiment itself was programmed using Qualtrics (Qualtrics Labs Inc., Provo, UT).

Between exposure to the 32 encoded faces and the subsequent recognition trials, participants completed a race-unrelated questionnaire to serve as a distraction. After the memory test, participants completed measures of Racial Identification (adapted from Luhtanen & Crocker, 1992), Interracial Contact (Cloutier, Li, & Correll, 2014), and Social Dominance Orientation (SDO; Pratto, Sidanius, Stallworth, & Malle, 1994). Then they completed a Weapons Identification Task (WIT; Payne, 2001), which was intended to test if threat stereotypes predict memory for (both neutral and angry) Black faces. However, none of these measures interacted with race to predict recognition performance; accordingly they are not reported further.

Lastly, participants completed demographic questions, indicating their political orientation, age, gender, racial background, and parental education.

Procedure

Prior to the encoding task, participants were told that they would study a series of faces with each one appearing for only one second, preceded by a fixation cross. Participants were instructed that they would be asked to identify the faces later. Thus intentional memory instructions were used, since we were concerned that with this large encoding set, memory might otherwise be rather poor.

Each participant saw the 32 encoded faces via a pre-recorded video. Each photo was preceded by a 500 ms blank screen and a 500 ms fixation cross, and then the photo was shown for 1000 ms.

After the video, participants were given a comments box to report any issues with the video, and then they completed the distractor task. They then received instructions for the memory test. Participants were warned that photos of the encoded faces might change at test, but that they were to focus on whether or not they had seen the photographed person before, not on whether or not they had seen the specific photo itself before. In fact, photos always changed from encoding to memory test, such that even if the emotional expression was the same, participants saw an alternate photo of the same target person showing the same emotional expression. Each test photo was presented on its own screen with two questions. The first was “Have you seen this PERSON before?” with response options “yes” and “no.” The second question was “How confident are you about your previous answer?” with response options “not at all confident,” “somewhat confident,” and “very confident.” For each participant, the 64 test faces were presented in a fully randomized order. After the memory test and the subsequent questionnaire measures, participants were probed for suspicion and debriefed.

Results

Calculation of SDT measures

Signal detection theory (SDT; Green & Swets, 1966) is routinely used to examine recognition accuracy in memory studies. In its routine application, the SDT model represents encoded faces and lures as two different probability distributions (each with a different mean but equal variance) that are mapped onto an underlying decision axis, which is interpreted to be subjective familiarity. The equal variance assumption is an unfortunate one, however, as it is typically found that encoded targets are more variable in familiarity than lures are (Pazzaglia, Dubé, & Rotello, 2013; Starns, Pazzaglia, Rotello, Hautus, & Macmillan, 2013; Starns & Ratcliff, 2014; Wixted, 2007; Yonelinas & Parks, 2007). Additionally, we cannot safely assume that the variance will not differ by race or by emotion. For example, perhaps White encoded targets will have relatively high variance, with some targets remembered very well and some accidentally forgotten, while Black encoded targets will look homogenously unfamiliar. With a more finely-graded decision scale (not simply ‘old’ versus ‘new’), one can more appropriately specify an unequal-variance, variable criterion SDT model, using a maximum-likelihood estimation procedure (Harvey, 2013), which is more widely used in psychophysics and recognition memory research (Macmillan & Creelman, 2005; Starns & Ratcliff, 2014; Swets, Tanner, & Birdsall, 1961; Wixted, 2007). As we detail in Supplementary material, it turns out that allowing these unequal variances is warranted in the present data, as there are significant differences in the distribution variances.

In the present study, we asked participants to make an ‘old’ versus ‘new’ judgment for each test face, followed by a three-point confidence rating. This was turned into a decision variable with six levels, ranging from ‘high-confidence old’ to ‘high-confidence new,’ so we could specify an unequal-variance SDT model. Our full model estimated a mean and SD for each of 12 frequency distributions — four lower-familiarity lure distributions defined by the crossed factors of race and test emotional expression, and eight higher-familiarity encoded-target distributions defined by the crossed factors of race, encoded emotional expression, and emotional expression switch. White neutral lures were used to define the baseline, so their mean familiarity was set at 0 and their SD was set at 1 rather than being estimated. All other means and SDs were maximum likelihood estimates, relative to that baseline (Harvey, 2013).

The estimated means were used directly in analyses that are reported in the Supplementary material. These analyses permitted us to see, for instance, if some types of targets were less familiar and more prone to misses than others, and also if some types of lures were more familiar and more prone to false alarms than others. Those analyses supplement our primary interests and analyses, which were focused on 8 mean target-lure differences (d_a) as the primary dependent measures, where each d_a was the difference between each encoded target mean and its corresponding same-race, same-testing-emotion lure mean, expressed as the number of pooled standard deviations between the two distribution means. This measure is used with unequal-variance models and is numerically equal to d' when the variances are equal (Simpson & Fitter, 1973). In essence these eight discriminability scores tell us how much each set of encoded target faces (defined by the factors of race, emotion at encoding, and emotion switch) differs in subjective familiarity from the matched lures.

d_a analysis

With eight d_a's for each of the eight types of targets, we examined the mean differences between the d_a's with a 2 (target race) by 2 (encoding emotional expression) by 2 (switched/consistent emotional expression) repeated-measures ANOVA (see Table 1). Note that with this design, the interaction between encoding emotion and emotional expression switch is equivalent to a main effect of emotional expression at test, since faces that did not switch maintained their original emotional expression at test (e.g., angry at encoding and angry at test),

Table 1
Mean d_a in Experiment 1 (SDs given in parentheses).

d_a	Neutral encoding expression		Angry encoding expression	
	Switch emotion	No switch	Switch emotion	No switch
White	0.600 (0.647)	1.039 (0.638)	0.657 (0.608)	1.065 (0.569)
Black	0.611 (0.652)	0.897 (0.559)	0.478 (0.644)	0.599 (0.617)
White–Black (CRE)	−0.011	0.142	0.179	0.466

whereas switched faces took on the other emotions at test (e.g., angry at encoding and neutral at test).

As predicted, the cross-race effect was observed as the significant main effect of target race, $F(1,65) = 11.50$, $p = .0012$, $\eta^2 = .15$, with higher discriminability (d_a) for White faces ($M = .840$, $SD = .615$) than for Black faces ($M = .647$, $SD = .618$). Also significant was the main effect of encoding emotional expression, $F(1,65) = 5.73$, $p = .0196$, $\eta^2 = .08$, with higher d_a for neutral-encoded faces ($M = .787$, $SD = .624$) than for angry-encoded faces ($M = .700$, $SD = .609$). Unsurprisingly, the main effect of switch was also significant, $F(1,65) = 63.72$, $p < .0001$, $\eta^2 = .50$, such that d_a was considerably lower when emotional expression switched between encoding and test (switched: $M = .587$, $SD = .638$; consistent: $M = .900$, $SD = .595$). Additionally, the effect of switch was qualified by target race, $F(1,65) = 8.99$, $p = .0038$, $\eta^2 = .12$, such that participants were more impaired by emotional expression switches with White faces (switched: $M = .628$, $SD = .628$; consistent: $M = 1.052$, $SD = .603$) than with Black faces (switched: $M = .545$, $SD = .648$; consistent: $M = .748$, $SD = .588$). This interaction could also be interpreted as meaning that the CRE was larger without emotional expression switch (White–Black CRE difference: .304) than with a switch (CRE dif: .083).

Most importantly, there was also a race by encoding emotional expression interaction, $F(1,65) = 8.37$, $p = .0052$, $\eta^2 = .11$. The CRE was smaller with neutral-encoded faces (White: $M = .819$, $SD = .642$; Black: $M = .754$, $SD = .606$) than with angry-encoded faces (White: $M = .861$, $SD = .589$; Black: $M = .539$, $SD = .630$), directly contrary to the effects found by Ackerman et al. (2006) and others. This effect was not qualified by whether or not the face switched emotion, $p = .53$. In Figs. 1A and B, we plot the means for this significant race by encoding emotional expression interaction separately for the consistent-emotion and emotion-switch conditions. Overall, White participants recognized White faces better than Black faces, particularly for angry faces but less so for switched-emotion faces, and they also recognized angry faces and switched-emotion faces more poorly.

To further clarify these results, we conducted a simple 2 (target race) by 2 (encoding emotional expression) repeated-measures ANOVA, first within consistent-emotion targets (as in the design of Ackerman et al., 2006), and then again within switched-emotion targets.

For consistent-emotion targets, there was a main effect of target race, $F(1,65) = 20.58$, $p < .0001$, $\eta^2 = .24$, indicating the CRE (White: $M = 1.052$, $SD = .604$; Black: $M = .748$, $SD = .588$). There was also a marginal effect of encoding emotional expression, $F(1,65) = 3.81$, $p = .0554$, $\eta^2 = .06$, such that d_a was marginally higher for neutral faces ($M = .968$, $SD = .598$) than for angry faces ($M = .832$, $SD = .593$). There was also the key race by encoding emotional expression interaction, $F(1,65) = 8.29$, $p = .0054$, $\eta^2 = .11$, indicating that the CRE was stronger for consistently-angry targets (White–Black CRE dif: .466) than for consistently-neutral targets (White–Black CRE dif: .142). Critically for consistent-emotion targets, White participants recognized White faces better than Black faces, especially in the case of angry expressions.

For switched-emotion targets, the effect of race was non-significant ($p = .30$), as were and all other effects ($p > .24$). Thus, the effects of interest were primarily in the consistent-emotion targets. We suspect that this was due in part to the overall much poorer memory for the faces that switched emotion at test (Fig. 2).

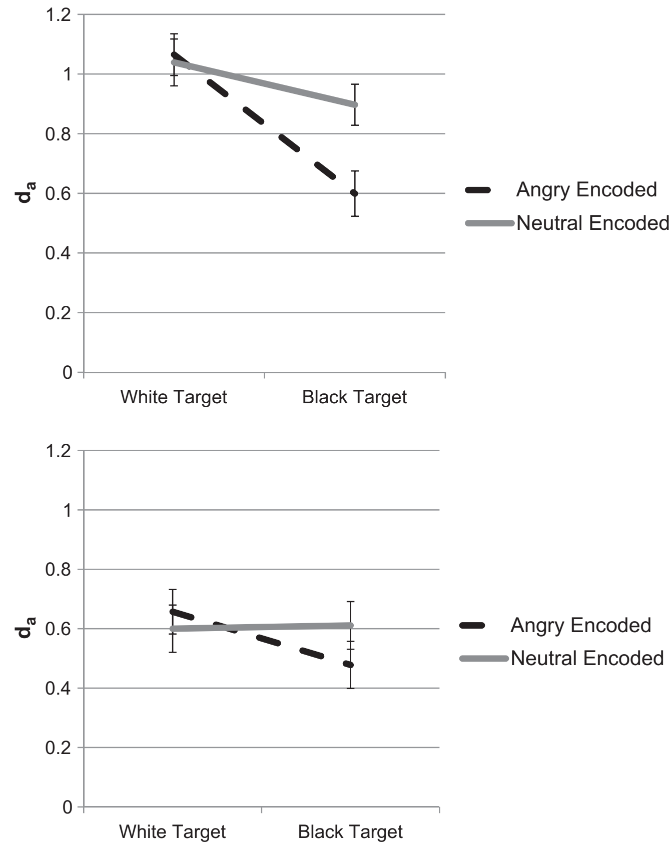

Fig. 1. A and B. Discriminability and the CRE both moderated by angry expressions in Experiment 1, for consistent-emotion and switched-emotion encoded targets, respectively. The CRE is indicated by a downward line slope.

We conducted further simple effect analyses on the effect of target race within each of the four conditions defined by encoding emotional expression and emotional expression switch. There was a sizable CRE (White: $M = 1.065$, $SD = .569$; Black: $M = .599$, $SD = .617$) for angry no-switch faces, $F(1,65) = 30.79$, $p < .0001$, $\eta^2 = .32$, and a marginal CRE (White: $M = .657$, $SD = .608$; Black: $M = .478$, $SD = .644$) for angry switched-emotion faces, $F(1,65) = 2.88$, $p = .0942$, $\eta^2 = .04$. However, there was no significant CRE for neutral faces, with ($p = .92$) or without ($p = .13$) an emotional expression switch. Thus, while the CRE held overall, and generally in the usual direction, the effect was driven primarily by the angry faces, and especially when the emotional expression remained consistently angry.[2]

Discussion

We asked White participants to study and subsequently recognize the faces of White and Black men whose expressions were either angry or neutral. Overall, the results revealed a robust CRE, with better memory for White targets than Black targets. However, this overall effect was moderated by two factors: the emotional expression at the time of encoding, and whether or not that emotional expression switched at the time of testing. Overall memory was substantially worse for targets that switched emotion than for targets that did not. Also, the overall CRE was substantially smaller for switched-emotion targets than for consistent-emotion targets, which is perhaps unsurprising, given the relatively poor recognition of targets whose emotion switched.

[2] See Supplementary material for the results of a more-typical equal-variance SDT model, for Experiments 1 and 2. Its results were similar to the unequal-variance SDT model.

Most importantly in terms of our goals for this research, participants showed a larger CRE when angry faces were encountered at encoding. Contrary to the earlier findings of Ackerman et al. (2006) and others, participants were particularly poor at recognizing Black angry faces. Thus our findings are inconsistent with the argument that people pay more attention to outgroup members and have better memory for them when the outgroup members have an angry emotional expression. Though White participants could possibly still be paying more attention to angry Blacks, it is clear that in this experimental context, angry expressions are not helping participants *individuate* outgroup members and tell them apart.

We would suggest that our results are inconsistent with earlier results due to the care taken in selecting the stimuli, so that they do not contain the confounds present in the stimuli of prior studies. Our initial pilot study revealed that these prior studies had particularly distinctive Black angry faces. Conversely, our own stimuli were pretested to ensure equal distinctiveness. Importantly, our stimuli also did not confound the target's specific identity with their emotional expression.

Our results are more consistent with those of Corneille et al. (2007), who also found worse memory for angry Black faces than for angry White or non-angry Black faces. Both our and Corneille et al.'s (2007) results could be explained by stereotype congruency, where race is more salient to perceivers when the face has a stereotype-congruent expression, and the faces are consequently individuated less (Levin, 1996, 2000).

If stereotypes are socially shared, then perhaps these stereotype-congruency effects are not effects associated with *outgroup* stereotypes and with a cross-race effect, but rather with the stereotype of particular target groups (e.g., Blacks) and with a target-race effect. To tease apart these possibilities, unlike all prior studies involving emotional expression and cross-race facial recognition, we turn to a replication study using all Black participants.

Experiment 2

The same procedures and stimulus materials were presented to an all-Black sample in Experiment 2, as a critical test between the target-race effect versus the cross-race effect accounts for Experiment 1. One possibility is that angry *outgroup* faces tend to be categorized more and hence individuated less. In this case, Black participants should show a larger cross-race recognition effect with angry targets and show impaired memory for White (*outgroup*) angry faces. On the other hand, if our effects are driven by the widely-shared cultural stereotypes linking Blacks to threat (Correll et al., 2002), then Experiment 1's results may be specific to angry Black targets, regardless of participant race and of the target's ingroup/outgroup status. If angry Black faces are more likely to be categorized, then perhaps Black participants will also show impaired memory for Black angry faces, which in this case are angry *ingroup* faces.

Method

Participants and design

At an eastern U.S., historically-Black University, 91 undergraduates participated in exchange for partial course credit. Participants were asked two ethnicity questions. The first was the same as Experiment 1, permitting them to indicate multiple ethnicities. The second asked for their primary ethnicity, but it gave them more response categories. From the second question, we excluded three Asian-Americans, three Whites, and one Hispanic from analysis. One additional African-American participant was excluded for giving the same answer on every recognition trial. We included six Africans, 71 African-Americans, and seven Caribbeans/West-Indians who all also indicated some Black ethnicity on the first ethnicity question, giving 83 participants in total (64 females).[3] The design of Experiment 2 was identical to the design of Experiment 1.

Materials and procedure

The materials and procedure were identical to those of Experiment 1, with three exceptions. First, the Weapons Identification Task was not included. Second, the contact questions were repeated as two sets, where the first set asked about contact with European-Americans, and the second set again asked about contact with African-Americans. Third, we asked two ethnicity questions in the demographics, as described earlier. Again, the exploratory and demographic measures did not moderate the results, and hence they are not reported further.

Results

d_a analysis

We used the same unequal-variance SDT model as in Experiment 1, except that we set ingroup Black neutral lures as the baseline, permitting estimation of means and standard deviations for all other groups of stimuli. With that, we calculated the same signal detection measures as in Experiment 1. The resulting eight d_a's were again analyzed using a 2 (target race) by 2 (encoding emotional expression) by 2 (emotional expression switch/consistent) repeated-measures ANOVA (see Table 2).

This analysis revealed a main effect of target race, $F(1,82) = 6.50$, $p = .0126$, $\eta^2 = .07$, such that d_a was higher for Black faces ($M = .814$, $SD = .739$) than for White faces ($M = .680$, $SD = .694$). As in Experiment 1, we found a significant pro-ingroup CRE, indicating better memory for Black than White target faces by these Black participants. There was also a main effect of encoding emotional expression, $F(1,82) = 6.50$, $p = .0126$, $\eta^2 = .07$. As in Experiment 1, participants could more easily discriminate between neutral-encoded faces ($M = .820$, $SD = .747$) than between angry-encoded faces ($M = .674$, $SD = .686$). Unsurprisingly, there was also a large main effect of emotional expression switch, $F(1,82) = 55.13$, $p < .0001$, $\eta^2 = .40$, indicating better discriminability for consistent-emotion targets ($M = .913$, $SD = .747$) than for switched-emotion targets ($M = .580$, $SD = .686$). Overall, Black participants recognized faces better when they were Black, when they had neutral emotional expressions, and when they had consistent emotional expressions.

Unlike the previous experiment, the interaction between race and encoding emotional expression was not significant ($p = .22$). However, the mean difference was in the direction of a smaller pro-Black CRE with anger, primarily due to worse memory for angry Black faces, whereas the pro-White CRE was larger with anger in Experiment 1 for the same reason. Thus, our results are particularly inconsistent with the prediction that Black participants would manifest a larger CRE for angry faces, due to worse memory for *outgroup* (White) angry faces. In sum, Black participants manifested better memory for ingroup than outgroup faces, unaffected by the face's emotional expression. However, the means were nonsignificantly in the direction of a smaller, rather than a larger, CRE with angry target faces.

To further clarify these patterns, as we did in Experiment 1, we conducted tests of the simple target race effect within encoding emotional expression and emotion-switch. There was a significant pro-Black CRE (White: $M = .568$, $SD = .730$; Black: $M = .816$, $SD = .690$) for neutral switched-emotion faces, $F(1,82) = 5.60$, $p = .0203$, $\eta^2 = .06$. However, there was no significant CRE for angry consistent-emotion faces ($p = .82$), neutral consistent-emotion faces ($p = .16$), or angry switched-emotion faces ($p = .22$).

[3] We also analyzed the data after excluding Africans and Caribbeans, leaving just 70 African-Americans. With this sample, the pro-Black CRE is significant, $F(1,69) = 9.27$, $p = .0033$, $\eta^2 = .12$, and it is considerably stronger than the CRE in the larger sample ($\eta^2 = .07$). Otherwise, these results did not differ in any substantial way from the reported results.

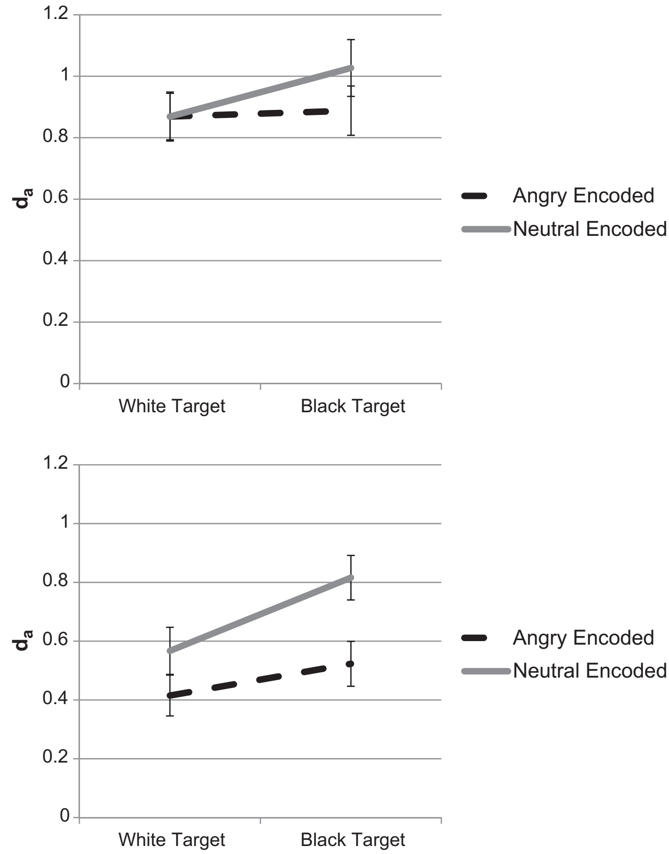

Fig. 2. A and B. Discriminability and the CRE moderated by angry expressions in Experiment 2, for consistent-emotion and switched-emotion encoded targets, respectively. The CRE is indicated by an upward line slope.

Table 2
Mean d_a in Experiment 2 (SDs given in parentheses).

d_a	Neutral encoding expression		Angry encoding expression	
	Switch emotion	No switch	Switch emotion	No switch
White	0.567 (0.730)	0.869 (0.726)	0.415 (0.632)	0.869 (0.689)
Black	0.816 (0.690)	1.027 (0.843)	0.523 (0.695)	0.888 (0.731)
Black–White (pro-B CRE)	0.249	0.158	0.108	0.019

Discussion

Unlike all previous studies that explored whether emotional expression moderates the CRE, this experiment utilized an all-Black sample of participants, replicating exactly the procedures of Experiment 1. Overall, we found a significant pro-Black, pro-ingroup CRE. However, this effect did not significantly depend on encoding emotional expression, unlike Study 1. If anything however, the direction of the means suggested a slightly reduced CRE for angry target faces, as compared to neutral target faces. Once the main effect of CRE is factored out, the results from Experiment 2 parallel those of Experiment 1 in that the results are more consistent with worse recognition for Black angry faces.

Experiments 1 & 2 combined analysis

Given the parallel pattern of means in Experiments 1 and 2, and the nearly identical design and procedures used, we decided to combine the two datasets and conduct an overall analysis, treating Participant Race (i.e., Study) as an additional, between-subjects factor in the analysis. In this full design, the overall CRE should be revealed by an interaction of Participant Race and Target Race, rather than as a main effect of Target Race as in the individual experiments. Here we continued to exclude Black participants from the Experiment 1 data and White participants from the Experiment 2 data, with the goal of keeping the participant samples the same as in the analyses just reported.

d_a analysis

We conducted a 2 (participant race) by 2 (target race) by 2 (encoding emotional expression) by 2 (switched/consistent emotional expression) mixed ANOVA with participant race as a between-subjects factor, and d_a as the dependent variable. There were two main effects. First, there was a main effect of encoding emotional expression, $F(1,147) = 10.49$, $p = .0015$, $\eta^2 = .07$, indicating that participants were worse at remembering angry-encoded faces ($M = .685$, $SD = .658$) than neutral-encoded faces ($M = .805$, $SD = .696$). Second, there was a main effect of emotional expression switch, $F(1,147) = 111.21$, $p < .0001$, $\eta^2 = .43$, showing lower recognition accuracy for switched-emotion encoded targets ($M = .583$, $SD = .667$) than for consistent-emotion encoded targets ($M = .907$, $SD = .687$).

There were also three significant two-way interactions. First, the overall CRE effect was significant, as revealed by the significant Participant Race by Target Race interaction, $F(1,147) = 17.70$, $p < .0001$, $\eta^2 = .11$. On average across the two participant groups, memory was better for ingroup targets ($M = .825$, $SD = .690$) than for outgroup targets ($M = .665$, $SD = .664$). Second, there was an interaction between emotional expression switching and target race $F(1,147) = 6.88$, $p = .0096$, $\eta^2 = .04$, such that Black encoded targets were less impacted by emotional expression switches (switched-emotion: $M = .614$, $SD = .673$; consistent-emotion: $M = .865$, $SD = .699$) than White encoded targets were (switched-emotion: $M = .763$, $SD = .672$; consistent-emotion: $M = .950$, $SD = .661$).

Third and most importantly, there was a two-way interaction (see Fig. 3) between target race and encoding emotional expression, $F(1,147) = 6.98$, $p = .0091$, $\eta^2 = .05$, indicating that when the target was Black, recognition performance was worse with angry expression ($M = .622$, $SD = .672$) than with neutral expression ($M = .838$, $SD = .761$), whereas expression had no impact for White targets (angry: $M = .752$, $SD = .624$; neutral: $M = .769$, $SD = .685$). Importantly, this two-way interaction did not depend on participant race ($p = .44$). Thus, memory was significantly impaired by angry expressions with Black targets for both participant groups on average: for White participants (angry Black targets: $M = .538$, $SD = .631$; neutral Black targets: $M = .754$, $SD = .606$) and for Black participants (angry Black targets: $M = .706$, $SD = .713$; neutral Black targets: $M = .922$, $SD = .766$), while this was not true for White targets. In other words, when the CRE was moderated by emotional expression in Experiment 1, it was not an effect of ingroup versus outgroup faces on memory. Instead, across both participant groups, anger leads to worse memory for Black target faces and has no impact on White target faces, consistent with stereotype-congruency.

To support this conclusion, we conducted a simple 2 (encoding emotional expression) by 2 (switched/consistent emotional expression) ANOVA within the four groups defined by participant race and target race. For Black targets, there was a main effect of encoding emotion both for White participants, $F(1,65) = 14.02$, $p = .0004$, $\eta^2 = .18$, and for Black participants, $F(1,82) = 8.83$, $p = .0039$, $\eta^2 = .10$, with both participant groups showing significantly worse memory for angry Black faces than for neutral Black faces. On the other hand, for White targets, there was no main effect of encoding emotion for either White participants ($p = .48$) or Black participants ($p = .39$).

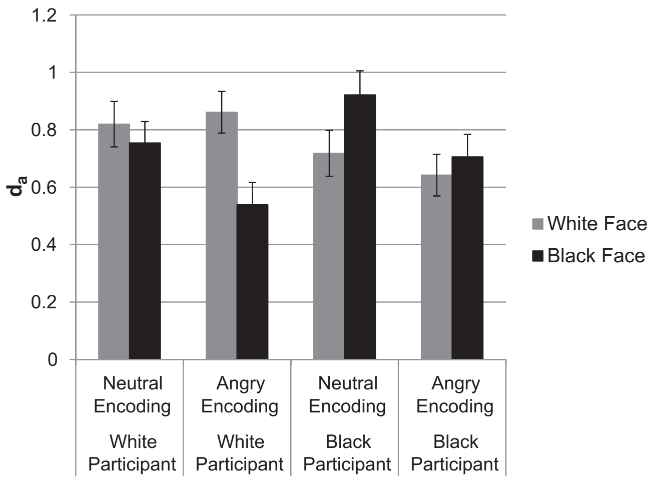

Fig. 3. Discriminability and the CRE moderated by angry expressions for both experiments combined.

General discussion

We asked both White and Black participants to memorize and recognize the faces of White and Black men, with neutral and angry emotional expressions. Unlike previous work on the role of angry facial expressions in cross-race face recognition, we extensively pilot-tested our stimuli to ensure that there were no race differences in the degree of anger expressed or in the degree to which the faces appeared unusual or distinctive. Additionally, within-race, we counterbalanced the facial expression with the identity of the specific target individuals so that, among the targets, no individual differences were confounded with the facial expression difference, unlike Ackerman et al. (2006) and Young and Hugenberg (2012). Finally, we independently manipulated the facial expression at encoding and at recognition test, so that some target individuals maintained the same facial expression at both time points, while others switched from angry to neutral or vice versa.

We analyzed the resulting data with an unequal-variance, variable criterion signal detection model. Overall, we found a robust CRE across both participant groups, such that White participants remembered ingroup White faces better than outgroup Black faces, and Black participants remembered ingroup Black faces better than outgroup White faces.

Most importantly, we found that participants had worse memory performance for Black faces that had an angry expression at encoding than for Black faces that were neutral at encoding. This difference was not found for White faces. Further, this difference was found on average across both experiments, and in simple effects with both White and Black participants. Hence, with the CRE defined as an ingroup–outgroup difference in recognition memory, the CRE was not moderated by an angry emotional expression across our two studies. These findings run counter to speculation by Meissner and Brigham (2001) that the CRE might not generalize to emotionally-expressive faces. They also are quite different from the empirical results of Ackerman et al. (2006), Krumhuber and Manstead (2011), and Young and Hugenberg (2012), who each had reported that angry facial expressions led White participants to have better memory for Black angry faces. Based on our pilot testing, we argue that those earlier results were attributable to the particular facial stimuli used, since the Black target individuals who posed with angry facial expressions were particularly distinctive.

Theoretically, we believe that our results can be explained by invoking ideas introduced by Levin (1996; 2000), who had argued that faces are not individuated to the extent that they are processed categorically. Hence, when the category is salient and categorical processing is engaged, perceivers are less able to discriminate subsequently between multiple faces from the same category. Given that Blacks in America are commonly stereotyped as angry and threatening (Correll et al., 2002; Devine, 1989; Hugenberg & Bodenhausen, 2003), we suspect that our participants were more likely to process Black angry targets in a categorical manner, because of their consistency with the socially-shared stereotype. Consequently, they had worse recognition memory for these target faces. Here our results are more consistent with the empirical work of Corneille et al. (2007), who found worse memory for angry Black and happy White faces, compared to angry White and happy Black faces. However, unlike our studies, Corneille et al. (2007) did not use a design that fully crossed participant racial group with the racial category of the targets. Accordingly, they were unable to discriminate between, on one hand, an explanation based on ingroup–outgroup differences in stereotypes, and on the other hand, the explanation supported by the current results which is based on socially-shared stereotypes about the particular target groups of Blacks and Whites in the United States. Additionally, Corneille et al. (2007) did not include a neutral condition, so when they found that White participants remember angry White faces better than angry Black faces, their results could either indicate that anger produces an exaggerated CRE, like our Experiment 1, or that anger just produces an ordinary, unmoderated CRE.

Although stereotype-congruency is a likely explanation for our results, we cannot rule out explanations based on visual discrimination. Angry faces have altered, tensed/scrunched facial features, and those facial features could perhaps be harder to distinguish with a darker skin tone than a lighter one. If so, both Black and White perceivers would have more trouble as they try to individuate and memorize darker angry faces. Researchers have rarely found evidence of racial differences in visual discriminability (see Hills & Lewis, 2006, 2011, for exceptions), but it cannot be ruled out.

Conversely, it is rather difficult to see how our results could be open to a motivational explanation. In the past, most motivational accounts have argued that one group is remembered better than another, because one group is more powerful (Ratcliff et al., 2011; Shriver & Hugenberg, 2010; Shriver et al., 2008), more socially-relevant (Rodin, 1987), more threatening (Ackerman et al., 2006), or otherwise more attention-worthy than another. It is hard to see why people would be less motivated to pay attention to Black angry men than other Black men, particularly given both the literature on how Blacks are stereotyped as threatening (Correll et al., 2002) and on how threats capture attention effectively (Fox et al., 2000; Öhman, Flykt, & Esteves, 2001; Öhman, Lundqvist, & Esteves, 2001). In fact, our results may represent a rare case where greater attention co-occurs with worse memory.

Arguably, our results may differ from Ackerman et al. (2006), because our paradigm used an intentional learning task, which might minimize motivational/attentional effects. In such a paradigm, participants would be motivated to attend to all faces and do well on the test, whereas if they were idly watching the video screen without a memorization goal, some racial differences in attention may have appeared. However, if this explains why our results differ from Ackerman et al. (2006), it still cannot explain the discrepancy between Ackerman et al. (2006) and Corneille et al. (2007), since they both used an incidental encoding paradigm. Instead, some other methodological difference would have to account for Corneille et al.'s (2007) results, such as their new (computer-generated) stimulus set, or such as the fact that Corneille et al.'s (2007) memory test was much harder than Ackerman et al.'s (2006) memory test, since the encoding phase included a secondary distractor task and over twice as many faces. Future researchers should be mindful of their methodology and especially of their learning paradigm when designing further CRE studies, as intentional learning could minimize motivational/attentional effects.

The current findings underscore that, particularly for effects in cross-race recognition and for other intergroup effects, the research literature needs to make sure that more research designs truly are full intergroup designs, i.e., designs in which participants from both target groups give responses to both target groups (Judd & Park, 1993). Without a fully crossed design, it is impossible to differentiate a genuine ingroup/outgroup effect from an effect that is specific to one group of observers or targets.

The current pretesting and experimental results also underscore the importance of controlling for a variety of factors in developing stimulus sets, so that systematic confounds are not introduced. Particularly when examining memory for faces, it is important to make sure that those faces do not have idiosyncrasies that might be confounded with variables of theoretical interest.

The current findings offer no support for the notion that facial expressions of emotion affect the degree to which ingroup members are remembered better than outgroup members. Instead, the evidence indicates that when faces express a stereotype-consistent emotion, they are processed in a more categorical manner, resulting in worse memory recognition of that target individual. Future research should explore whether this applies to other facial manifestations of group-based stereotypes. It may well be that for other groups, other emotional expressions are stereotype-consistent. Our results suggest that we may find worse recognition with faces that display stereotypically-consistent emotional expressions other than anger, but that remains to be explored.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.jesp.2014.12.001.

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