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Self-pacing study of faces of different races: metacognitive control over study does not eliminate the cross-race recognition effect

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Abstract People often recognize same-race faces better than other-race faces. This cross-race effect (CRE) has been proposed to arise in part because learners devote fewer cognitive resources to encode faces of social out-groups. In three experiments, we evaluated whether learners' other-race mnemonic deficits are due to "cognitive disregard" during study and whether this disregard is under metacognitive control. Learners studied each face either for as long as they wanted (the self-paced condition) or for the average time taken by a self-paced learner (the fixed-rate condition). Self-paced learners allocated equal amounts of study time to same-race and other-race faces, and having control over study time did not change the size of the CRE. In the second and third experiments, both self-paced and fixed-rate learners were given instructions to "individuate" other-race faces. Individuation instructions caused self-paced learners to allocate more study time to other-race faces, but this did not significantly reduce the size of the CRE, even for learners who reported extensive contact with other races. We propose that the differential processing that people apply to faces of different races and the subsequent other-race mnemonic deficit are not due to learners' strategic cognitive disregard of other-race faces.

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Recognizing faces plays a central role in social and professional interactions. Both failing to recognize and falsely recognizing people can cause social embarrassment for the perceiver and offense for the target. Even more important is the weight eyewitness testimony carries in legal proceedings: For example, when mock jurors judged the same court case with or without eyewitness testimony, eyewitness testimony increased the percentage of subjects voting for a conviction from 18 % to 72 % (Loftus, 1975). Many factors influence whether we correctly recognize faces, including exposure duration, number of exposures, schedule of repetitions, and characteristics of both the learner and stimuli. In the present experiments, we provided learners with varying degrees of metacognitive control over the study of faces to examine why learners recognize faces of their same race better than those of other races.

Theoretical bases for the cross-race recognition effect

The cross-race effect (CRE) is a robust and consistent finding across diverse populations and study paradigms. In a meta-analysis, Bothwell, Brigham, and Malpass (1989) concluded that the CRE is a medium-sized effect that is found in about 80 % of published reports. Meissner and Brigham (2001), in another meta-analysis, concluded that learners show a recognition deficit for other-race faces such that they are both 1.4 times more likely to recognize same-race faces than other-race faces and 1.6 times more likely to false alarm to other-race faces than to same-race faces. The CRE has been found between a variety of populations, including Blacks and Whites (Anthony, Copper, & Mullen, 1992; Bothwell et al., 1989), Blacks and Hispanics (MacLin, MacLin, & Malpass, 2001), Asians and Whites (Luce, 1974), and Turks and Germans (Sporer, 1999). Furthermore, the CRE has been found across a variety of different memory tasks, including recognition tasks (Luce, 1974; Malpass, 1974), matching tasks (Malpass, Erskine, & Vaughn, 1988), facial reconstruction tasks (Ellis, Davies, & McMurran, 1979), and eyewitness lineup tasks (Berger, 1969; Doty, 1998; Fallshore & Schooler, 1995).

Although theories of the CRE have been proposed for almost 100 years (Feingold, 1914), no single theory has received strong empirical support. Current competing theories of the CRE fall into two major classes: perceptual expertise views and social-cognitive views. Perceptual expertise views suggest that learners' lack of contact with other races results in an impaired ability to effectively encode other-race faces. These views suggest that different races may have different variability in their facial features; consequently, facial features provide differential distinctiveness between races (Ellis, Deregowski, & Shepherd, 1975; Shepherd, 1981; Shepherd & Deregowski, 1981). Because of lack of contact, learners do not know which features maximally differentiate among other-race faces and place insufficient emphasis on the most distinguishing features during encoding (Lucas, Chiao, & Paller, 2011). Learners encode same-race and other-race faces similarly, but because of different distinguishing features, learners are less able to distinguish among other-race faces. By this view, the CRE is a direct consequence of a biased knowledge base and *cannot* be easily remedied by instructions or by changes in the amount of control learners have over encoding.

Social-cognitive views suggest that the CRE arises because learners encode social out-group members differently than in-group members. In one instantiation of a social-cognitive view, Rodin (1987) argued that learners categorize other-race faces as out-group members and subsequently "cognitively disregard" them. More recent social-cognitive views incorporate cognitive disregard as one possible explanation for the CRE. For example, in Sporer's (2001) in-group/out-group model (IOM), out-group categorization can serve as a cue to cognitively disregard faces, and learners may direct their attention elsewhere. Sporer (2001) argued that "out-group member cues may reduce effort expended in encoding." Learners cognitively disregard other-race faces by devoting less attention to them or by processing categorizing information for other-race faces at the expense of individuating information (MacLin & Malpass, 2001, 2003; Meissner, Brigham, & Butz, 2005). Social-cognitive views suggest that learners know how to encode other-race faces as well as same-race faces but that out-group categorization of faces reduces the quality or amount of encoding that other-race faces receive. Social cognitive views are rooted in the fact that learners are "cognitive misers": Learners expend mental resources only when necessary. Learners disregard other-race faces because they want to conserve cognitive effort; disregarding other-race faces minimizes effort expended while usually not carrying large negative consequences (Rodin, 1987). Learners process own- and other-race faces differently in order to save mental energy and resources (e.g., Devine, 1989; Macrae, Milne, & Bodenhausen, 1994). Differences in cognitive effort should be reflected in differential time devoted to encoding different faces.

Some empirical evidence supports social-cognitive views. As predicted by social-cognitive views, information that allows learners to categorize perceptually identical faces on the basis of race determines how well those faces are remembered. In one study, learners studied faces consisting of 50 % same-race and 50 % other-race features. Each face was paired with a name that is stereotypically associated with the learner's same race or other race. Even though the visual features of the faces were identical between conditions, learners exhibited better memory performance for faces with names associated with their own race than for faces with names associated with another race (Hourihan, Fraundorf, & Benjamin, 2013). This result suggests that the CRE can be caused by purely top-down processing (although it does not imply that that is the only route.). Additionally, eye-tracking and ERP evidence shows that learners engage in differential encoding for same-race and other-race faces. Learners make fewer and longer fixations when studying other-race faces, indicating that they are not processing the relations between features for other-race faces as much as for same-race faces (Goldinger, He, & Papesh, 2009). Learners show greater activation of H200 fronto-central and P2 occipital-temporal potentials to remembered other-race faces than forgotten ones, but not for same-race faces (Lucas et al., 2011). The authors suggest that this increased activation is tied to encoding that focuses on individuating information, which is more variable for other-race faces.

Whether learners exhibit strategic control over the differential encoding remains unspecified. Rodin (1987) suggested that differential encoding is adaptive, since it minimizes the amount of cognitive effort exerted, but does not suggest whether it is under the control of the learner. Hugenberg, Miller, and Claypool (2007) implied that learners have some control over differential encoding, because instructions to individuate other-race faces reduce the size of the CRE.

The categorization-individuation model of the CRE combines ideas from both the perceptual and social-cognitive views. It suggests that learners need both perceptual expertise and motivation to encode other-race faces to avoid the CRE (Hugenberg, Young, Bernstein, & Sacco, 2010). According to this model, learners who can differentiate among other-race faces (because of their extensive perceptual experience) do not individuate other-race faces unless motivated to do so. Learners who do not have the requisite perceptual experience to distinguish among other-race faces struggle to individuate other-race faces even when highly motivated to do so. This model is supported by evidence that shows that the amount of interracial experience modulates the CRE only when learners are instructed to individuate other-race faces (Young & Hugenberg, 2012).

To summarize, perceptual-expertise views seem to suggest that learners cannot control how well they encode faces of different races, but social-cognitive views argue that much of the recognition deficit for other-race faces occurs because learners voluntarily apply lesser processing to other-race than to same-race faces. In the present experiments, we measured explicitly how learners control their study for same-race and other-race faces by allowing learners to control the pace of study and, also, how provision of control affects memory.

Learners often exercise metacognitive control over their encoding in order to boost their subsequent mnemonic performance. Learners effectively choose which items to restudy (Tullis & Benjamin, 2012), how to schedule their study (Benjamin & Bird, 2006; Son, 2004), which items can benefit from self-testing (Tullis, Benjamin, & Fiechter, 2014), and how to allocate study time across a list of words (Tullis & Benjamin, 2011). Learners can make effective choices because they can base control choices upon personal monitoring and access to idiosyncratic knowledge states. For example, when allocating study time to a list of words, learners can selectively allocate more study time to items they find difficult, while reducing the study time they spend on items they find unchallenging. Learners can therefore allocate study time more efficiently across the set of stimuli. In the present experiments, we explored whether learners can use their metacognitive control to both improve recognition of faces and selectively improve recognition of other-race faces.

In general, learners allocate their control processes strategically (for reviews, see Benjamin, 2008; Finley, Tullis, & Benjamin, 2010). They allocate study resources in accordance with their goals, such that they devote more study resources to highly valued items than to less valued items (Castel, Benjamin, Craik, & Watkins, 2002). If learners value remembering other-race faces less than same-race faces, as suggested by social-cognitive views, they should devote less study time to other-race faces. This strategic allocation of resources may underlie the CRE. The pure attention-based account of the CRE, as put forth by Rodin (1987), predicts that if learners spend equal amounts of time on same- and other-race faces, the CRE should be eliminated. Alternatively, perceptual views suggest that learners do not know how to encode other-race faces, so the CRE should persist even if learners allocate similar amounts of study time to same- and other-race faces. Finally, the categorization-individuation models suggest that learners with extensive interactions with other races should reduce the CRE, but only when instructed to do so. Here, we specifically test the basic predictions of these models of the CRE.

Experiment 1

In the present set of experiments, we explored whether learners' strategic allocation of resources contributes to or can reduce the CRE. We investigated how learners allocate study resources to same- and other- race faces by providing some learners control over their study time, as in Tullis and Benjamin (2011). In Experiment 1, we compared the CRE for Caucasian and Chinese learners who studied a set of same-race and other-race faces either for as long as they wanted (the self-paced condition) or for the average time taken by a yoked self-paced learner (the fixed-rate condition). The critical prediction of social-cognitive views, then, is that self-paced learners will cognitively disregard other-race faces and spend less time studying them than own-race faces. Social-cognitive views suggest that learners both will spend less time studying other-race faces and also will recognize other-race faces more poorly than same-race faces. Alternatively, perceptual views suggest that control over encoding will not affect the size of the CRE. Regardless of the time spent studying same- and other-race faces, a CRE should persist. If self-paced learners can reduce the size of the CRE through their allocation of study time, learners can control the quality of the encoding for other-race faces, and the predictions of perceptual views would not be supported.

Method

Subjects

One hundred forty-two self-identified Caucasian subjects, who were introductory-level psychology students from the University of Illinois, participated in exchange for course credit. One hundred four introductory-level Chinese students from Tianjin Normal University in China participated in exchange for a small gift.

Materials

One hundred twenty grayscale pictures of faces were collected. The Caucasian faces were obtained from the Center for Vital Longevity Face Database (Minear & Park, 2004). The Asian faces were photos taken of volunteers at the Institute of Psychology at the Chinese Academy of Sciences for use in research and included an equal number of males and females. Pictures were of emotionally neutral faces in front of a white wall and were cropped to display only the face, neck, and hair. In the experiment, 60 pictures were of white students and 60 were of Chinese students, each with an equal number of males and females. For each pair of subjects, 60 of the pictures (15 each of white males, white females, Chinese males, and Chinese females) were randomly selected and ordered to make up the study list. All 120 faces made up the test list.

Design and procedure

The quasi-experiment was a 2 (condition: self-paced or fixed-rate) × 2 (face stimuli: Caucasian or Chinese) × 2 (subjects: Caucasian or Chinese) mixed design. Subjects were run individually on desktop computers in individual rooms and were alternately assigned to self-paced and fixed-rate conditions. The first subject in a given computer room was assigned to the self-paced condition, and the next subject to complete the experiment on that computer was assigned to the fixed-rate condition. In the self-paced condition, subjects studied each face for as long as they desired and proceeded to the next face by pressing the space bar. The average amount of time spent studying each face was calculated for each self-paced subject. The fixed-rate subjects viewed the same list of pictures in the same order as their yoked partners, but each picture they viewed was presented for the average amount of time taken by their self-paced partner. In this way, self-paced subjects and fixed-rate subjects studied the faces for the same overall amount of time, but how that time was divided among faces differed across conditions. Caucasian subjects were yoked only to other Caucasian subjects, and Chinese subjects were yoked only to other Chinese subjects. Faces were presented individually in the middle of a white computer screen in black at a resolution of 600 × 800 pixels. All subjects were instructed to “do your best to remember the faces for a later memory test.” The instructions for the Chinese students were presented in Mandarin.

After studying the target list of 60 faces, subjects completed a recognition task that included the 60 studied faces and 60 unstudied faces. During the recognition task, the 120 faces were randomly ordered for each pair of subjects, and each face remained on the screen until subjects provided a recognition judgment on a scale of 1 to 4. This scale ranged from *I am certain I have not seen that face* (1) to *I think I have not seen that face* (2) to *I think I have seen that face* (3) to *I am certain I have seen that face* (4). Confidence ratings for same-race and other-race faces were separately used to compute measures of discrimination (d_a) between old and new same-race and other-race faces using unequal-variance signal detection theory (Green & Swets, 1966). D_a is a measure of sensitivity that is preferable to measures like d' because it allows the variances of the signal and noise distributions to be unequal.

Results

All statistics reported here are significant at an $\alpha < .05$ level unless otherwise noted. As is shown in Fig. 1, self-paced

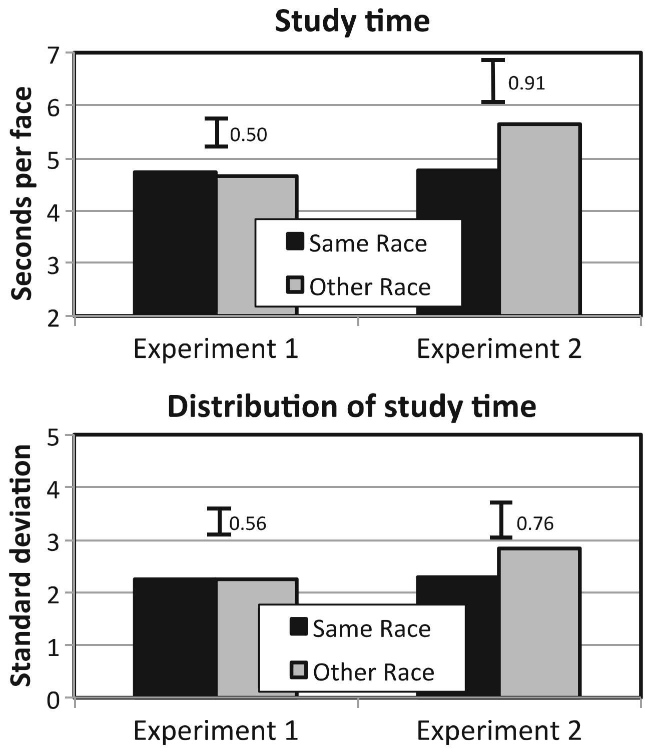

Fig. 1 Study time and variability of study time for faces in Experiments 1 and 2. Error bars and values show the width of within-subjects 95 % confidence intervals of the difference between time spent on same- and other-race faces within each experiment. Error bars are not placed on the means themselves, because they show the within-subjects variability of the differences between time spent

learners did not differentially allocate study time per face across same-race and other-race faces ($M_{\text{same-race}} = 4.72$ s, $SD = 3.13$; $M_{\text{other-race}} = 4.66$ s, $SD = 3.11$), $t(122) = 0.56$, $p = .87$, Cohen’s $d = 0.05$. Additionally, we compared how learners allocated their study time across items by computing the standard deviation of study time allocated across all faces within each subject. The variability of study times across faces for same-race stimuli did not differ ($\text{std}_{\text{same-race}} = 2.20$, $SD = 2.00$; $\text{std}_{\text{other-race}} = 2.24$, $SD = 2.46$), $t(122) = 0.30$, $p = .75$, Cohen’s $d = 0.03$). Study times spent on same-race faces and other-race faces were highly correlated ($r = .92$) across subjects. No evidence exists to suggest that learners differentially allocated study resources to same-race and other-race faces, and the power to detect a medium-sized effect (Cohen’s d of 0.3) in either average time spent or variability (Cohen, 1988) is 0.99.

Mean discriminability (d_a) is displayed in Fig. 2, and hit and false alarm rates are presented in Table 1. Differences in discriminability are due largely to differences in false alarm rates. A cross-race recognition deficit due only to differences in false alarms has been found before (Hourihan, Benjamin, & Liu, 2012; Ng & Lindsay, 1994). A 2 (self-pacing or fixed-rate) × 2 (same or other race) × 2 (learners’ race) mixed model ANOVA on discriminability showed that learner’s race significantly

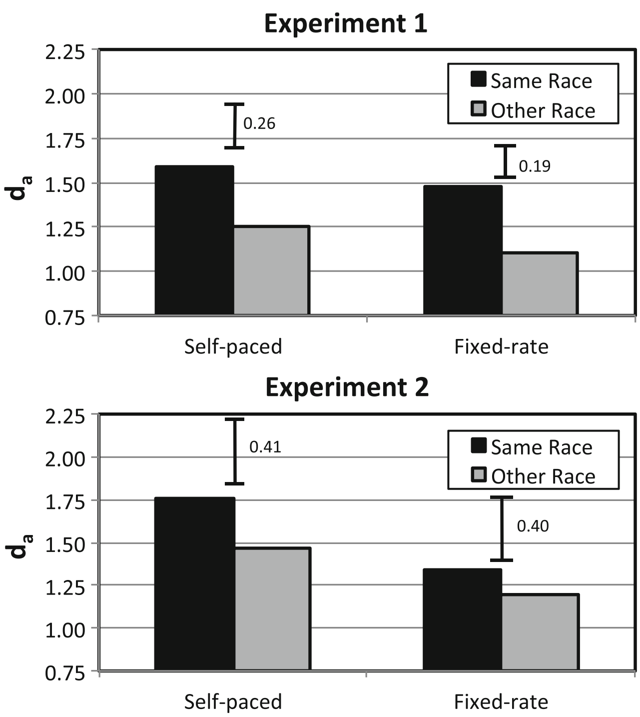

Fig. 2 Mean discriminability for Experiments 1 and 2. Error bars and values show the width of within-subjects 95 % confidence intervals of the difference between recognition performance on same- and other-race faces for each timing condition

interacted with the race of the face stimuli, $F(1, 121) = 6.29$, $p = 0.01$, $MSE = 0.13$, $\eta^2 = .05$).[1] This result reflects the fact that the CRE is somewhat smaller for Chinese learners than for Caucasian learners, but it is still reliable for both self-paced Chinese learners, $t(51) = 2.61$, and fixed-rate Chinese learners, $t(51) = 5.26$. The CRE is often of different magnitudes between races (Anthony et al., 1992; Hourihan et al., 2012; Meissner & Brigham, 2001), and this effect is not of central concern to the present study, so we will collapse across the race of the learner in all further analyses.

We collapsed across race of the learner and computed a 2 (self-paced or fixed-rate) × 2 (same- or other-race face) repeated measures ANOVA on discriminability. The ANOVA revealed a significant mnemonic advantage for same-race faces over other-race faces, $F(1, 122) = 115.35$, $MSE = 0.14$, $\eta^2 = .49$, and a significant mnemonic advantage for self-pacing over fixed rate time allocation, $F(1, 122) = 4.64$, $MSE = 0.42$, $\eta^2 = .04$. No significant interaction between self-pacing condition and face stimulus obtained, revealing that self-pacing did not moderate the size of the cross-race effect, $F(1, 122) = 0.34$, $p = .55$, $MSE = 0.12$, $\eta^2 = .003$, and the power to detect a medium-sized effect of the interaction (Cohen's $d = 0.3$) is large (power = .99).

[1] The interaction between race and self-pacing reached marginal significance, $F(1, 121) = 3.41$, $p = .07$, $MSE = 0.41$, $\eta^2 = .03$.

Discussion

Importantly, learners spent equal amounts of study time on same- and other-race faces. Despite equal attention to the two classes of stimuli, self-paced learners showed a significant CRE such that they recognized same-race faces better than other-race faces. Self-pacing did not reduce the size of the CRE. The persistence of the CRE given equal amounts of cognitive effort to same- and other-race faces fails to support the predictions of the social-cognitive views of the CRE and is in line with predictions of the perceptual-expertise views of facial recognition.

Even though learners allocate equivalent amounts of study time to same-race and other-race faces, they may engage in different kinds of encoding for the faces. They may, for example, encode other-race faces categorically and same-race faces individually. Differential encoding can require equivalent amounts of time while resulting in qualitatively different memories (e.g., Craik & Lockhart, 1972). However, social-cognitive views suggest that categorical encoding should require fewer resources and attention than individuating encoding, since learners engage in categorical encoding specifically in order to minimize the cognitive costs expended. If learners are minimizing cognitive costs for other-race faces, they should be devoting less study time to those faces. We find no evidence that they devote fewer resources to other-race faces. The equal amount of time spent studying same- and other-race faces, combined with the persistence of the mnemonic advantage for own-race faces, is consistent with a view in which perceptual expertise, and not strategic encoding, underlies the other-race recognition deficit.

However, the learners in this experiment may not be motivated to encode other-race faces as well as same-race faces. According to the categorization-individuation model, motivation to differentiate other-race faces is critical to reducing the CRE. In the second experiment, we encouraged subjects to differentiate other-race faces (and reduce the CRE) by explicitly asking them to encode other-race faces as well as they encode same-race faces. This is a strong test of the social-cognitive view of the CRE, because if learners cannot overcome the CRE even when motivated to individuate other-race faces, it would be difficult to defend a purely social basis for the effect. We measured subjects' motivation and effort during encoding by measuring the time spent studying own- and other-race faces. If the CRE is under strategic control of learners, as suggested by social-cognitive views, instructions to individuate other-race faces should eliminate the CRE for motivated self-paced learners. If the CRE is caused by perceptual expertise, instructions to individuate faces with self-controlled study time should affect performance only in those subjects with sufficient perceptual expertise to effectively encode other-race faces.

Table 1 Mean recognition memory performance for Caucasian and Asian subjects (numbers in parentheses are standard deviations of the means)

		Experiment 1				Experiment 2		Experiment 3			
		Standard Instructions				Individuation Instructions		Standard Instructions		Individuation Instructions	
		Caucasian Subjects		Chinese Subjects		Caucasian Subjects		Caucasian Subjects			
		Self-Paced	Fixed-Rate	Self-Paced	Fixed-Rate	Self-Paced	Fixed-Rate	Self-Paced	Fixed-Rate	Self-Paced	Fixed-Rate
Hits	Caucasian	0.73	0.72	0.72	0.68	0.77	0.68	0.74	0.74	0.75	0.73
	Faces	(0.14)	(0.17)	(0.17)	(0.14)	(0.15)	(0.15)	(0.16)	(0.16)	(0.17	(0.12)
	Chinese	0.74	0.72	0.70	0.68	0.78	0.74	0.76	0.76	0.80	0.73
	Faces	(0.14)	(0.15)	(0.17)	(0.15)	(0.13)	(0.11)	(0.14)	(0.11)	(0.14)	(0.13)
False Alarms	Caucasian	0.14	0.14	0.24	0.31	0.14	0.16	0.13	0.16	0.13	0.16
	Faces	(0.12)	(0.10)	(0.14)	(0.18)	(0.09)	(0.15)	(0.11)	(0.14)	(0.14)	(0.13)
	Chinese	0.32	0.30	0.13	0.18	0.25	0.29	0.29	0.30	0.24	0.26
	Faces	(0.16)	(0.16)	(0.09)	(0.13)	(0.1)	(0.17)	(0.14)	(0.20)	(0.16)	(0.16)
d_a	Caucasian	1.61	1.57	1.34	1.04	1.76	1.34	1.70	1.58	1.78	1.52
	Faces	(0.70)	(0.61)	(0.68)	(0.53)	(0.76)	(0.65)	(0.79)	(0.78)	(0.92)	(0.59)
	Chinese	1.18	1.15	1.55	1.35	1.47	1.20	1.34	1.28	1.49	1.30
	Faces	(0.53)	(0.50)	(0.78)	(0.53)	(0.59)	(0.51)	(0.61)	(0.59)	(0.69)	(0.70)

Experiment 2

In the first experiment, self-paced learners spent equivalent amounts of study time on same- and other-race faces. Even though they spent the equivalent effort on these two classes of stimuli, learners still exhibited an own-race mnemonic bias. In the second experiment, we encouraged learners to spend more effort on other-race faces and to individuate other-race faces in order to overcome the CRE (as in Hugenberg et al., 2007). Requiring learners to spend more time on other-race faces has eliminated the CRE in prior literature (Valentine & Bruce, 1986). In this experiment, we encourage learners to individuate other-race faces, which may prompt learners to spend more time on other-race faces and, ultimately, a reduction in the CRE. We instructed learners on how to avoid the CRE, measured how learners used metacognitive control to try to avoid the CRE, and analyzed whether this reduced the CRE.

Method

Subjects

Eighty-six self-identified Caucasian learners who were introductory-level psychology students from the University of Illinois participated in exchange for course credit.

Materials

The same 120 face pictures were used in this experiment as were used in Experiment 1.

Design and procedure

As in Experiment 1, time-allocation condition (self-paced or fixed-rate) was manipulated between subjects, while the race of the face stimuli (Caucasian or Chinese) was manipulated within subjects. Subjects followed the same procedure as in Experiment 1, except that, in addition to being told to remember the faces for a later memory test, all subjects were given *individuation* instructions. Individuation instructions were taken verbatim from Hugenberg et al. (2007) and are as follows:

> Previous research has shown that people reliably show what is known as the Cross-Race Effect (CRE) when learning faces. Basically, people tend to confuse faces that belong to other races. For example, a White learner will tend to mistake one Black face for another. Now that you know this, we would like you to try especially hard when learning faces in this task that happen to be of a different race than you. Do your best to try to pay close attention to what differentiates one particular face from another face of the same race, especially when that face is not of the same-race as you. Remember, pay very

close attention to the faces, especially when they are of a different race than you in order to try to avoid this Cross Race Effect.

Results

Unlike in Experiment 1, self-paced learners spent significantly more time studying other-race faces than same-race faces ($M_{\text{other-race}}$ = 5.64, *SD* = 4.19; $M_{\text{same-race}}$ = 4.77, *SD* = 3.38), $t(42) = 4.35$, as is shown in Fig. 1. Also, unlike in Experiment 1, self-paced learners varied study times for other-race faces more than for same-race faces (std $_{\text{other-race}}$ = 2.84, *SD* = 2.85; std $_{\text{same-race}}$ = 2.28, *SD* = 2.30), $t(42) = 3.47$. Time spent studying same-race faces was highly correlated with time spent studying other-race faces ($r = .96$) across subjects, as in Experiment 1.

Mean discriminability (d_a) is shown in Fig. 2, and hit and false alarm rates are shown in Table 1. A 2 (condition) × 2 (stimulus) ANOVA on discriminability revealed a significant mnemonic advantage for same-race over other-race faces, $F(1, 42) = 12.72$, $MSE = 0.16$, $\eta^2 = .23$, and a mnemonic advantage for self-paced over fixed-rate allocation, $F(1, 42) = 11.71$, $MSE = 0.45$, $\eta^2 = .22$. Once again, the interaction between self-pacing and race of the face stimuli was not significant, $F(1, 42) = 1.52$, $p = .22$, $MSE = 0.17$, $\eta^2 = .04$, and the power to detect a medium-sized interaction is large (power = .99). Differences in discrimination were driven largely by differences in false alarm rates, as in Experiment 1.

In order to replicate the conditions of Hugenberg et al. (2007), we combined the fixed rate conditions across the two experiments into one analysis. A 2 (face stimuli: same or other race) × 2 (instructions: standard [Experiment 1] or individuation [Experiment 2]) ANOVA on discriminability revealed a significant interaction between face stimuli and instructions, $F(1, 164) = 7.31$, $MSE = 0.12$, $\eta^2 = .04$, replicating the effect of Hugenberg et al. (2007). Same-race faces were remembered better than other-race faces, $F(1, 163) = 35.3$, $MSE = 0.12$, $\eta^2 = .18$, but individuation instructions reduced the size of the CRE. However, because this analysis was conducted between experiments (with attendant lack of control over sample differences), this analysis must be interpreted with caution. We replicated this set of conditions in Experiment 3, where learners were randomly assigned to conditions for both the pacing and instruction variables.

Discussion

Individuation instructions changed how learners approached other-race faces, since they spent significantly more time studying other-race than same-race faces and exhibited greater variability in study time across those faces. These two results contrast with subjects' behavior in Experiment 1, where they spent equivalent amounts of time across the two categories. However, spending more study time on other-race faces did not reduce the CRE. In fact, as compared with the fixed-rate group, who got the same individuation instructions and same total study time, the self-paced group showed a numerically larger CRE. This suggests that learners do not have strategic control over how they process other-race faces. Study time devoted to other-race faces is used less efficiently than the time spent studying SR faces, since learners spent more time encoding them but remembered them more poorly.

Experiment 3

Comparisons between Experiments 1 and 2 hint that individuation instructions can reduce the CRE. In Experiment 3, we directly tested whether individuation instructions reduce the CRE by combining Experiments 1 and 2 into one experiment where subjects were randomly assigned to the self-paced or fixed-rate conditions and to standard or individuation instructions. Furthermore, in Experiment 3, we measured learners' self-reported interactions with own and other races. Perceptual expertise and categorization-individuation views suggest that the amount of interaction with other races is a crucial variable that underlies the ability to successfully encode other races; in these views, the amount of interactions with other races should moderate learners' ability to encode other-race faces.

Method

Subjects

One hundred sixty Caucasian learners, who were introductory-level psychology students from Indiana University, participated in exchange for course credit.

Materials

The same 120 face pictures from the previous two experiments were used in this experiment.

Design and procedure

Experiment 3 combined the two standard instruction conditions from the first experiment with the two individuation instruction conditions from the second. Subjects were yoked together in groups of 4, such that each subject in a group studied and was tested on the same list of faces. The first subject on each computer was assigned to the self-paced standard instruction condition, the second was assigned to the yoked fixed rate standard instruction conditions, the third was assigned to the self-paced individuation instruction condition, and the fourth was assigned to the yoked fixed rate individuation instruction condition. The second subject in each group was yoked in total time to the first subject, and the fourth subject in each group was yoked to the third subject. After subjects completed the recognition test, they completed racial contact questions, as described in Hancock and Rhodes (2008). This questionnaire measured self-reports of interactions with Caucasian and Chinese races.

Results

Study time allocation for Experiment 3 is shown in Fig. 3. A 2 (stimuli) × 2 (instruction condition) repeated measures ANOVA on study times revealed a significant interaction, $F(1, 39) = 10.40$, $MSE = 1.70$, $\eta^2 = .21$. Learners in the standard instruction conditions spent numerically more time studying own-race faces ($M = 7.67$, $SD = 8.84$) than other-race faces ($M = 7.05$, $SD = 6.86$), $t(39) = 1.57$, $p = .12$, while those in the individuation instructions conditions spent more time studying other-race faces ($M = 6.68$, $SD = 4.04$) than own-race faces ($M = 5.97$, $SD = 3.78$), $t(39) = 5.10$, $p < .01$. Furthermore, while the standard deviations of study time allocation across stimuli within subjects did not differ under standard instructions ($M_{\text{same-race}} = 3.64$, $SD = 4.11$; $M_{\text{other-race}} = 3.80$, $SD = 3.21$), $t(39) = 0.46$, $p = .65$, the standard deviation of study times to other-race faces ($M = 2.82$, $SD = 1.46$) was larger than those to own-race faces ($M = 2.31$, $SD = 1.23$) under individuation instructions, $t(39) = 3.08$.

We analyzed whether instruction condition changed how learners allocated study time across face stimuli. Using the ratings of Caucasian subjects from Experiment 1, we computed each face's discriminability (d_a), where a larger d_a indicates an easier item. Then, for each subject, we computed the correlation between study time allocated to each face and their normative difficulty within each race. A negative correlation indicates that learners spent more time studying the more difficult items (and is analogous to discrepancy reducers in other research; see Tullis & Benjamin, 2011). The correlations are displayed in Fig. 4. A 2 (instruction) × 2 (stimuli) repeated measures ANOVA on study time allocation revealed two main effects. Subjects selectively allocated more time to difficult other-race faces than to own-race faces, $F(1, 39) = 16.64$, $MSE = 0.02$, $\eta^2 = .30$. Subjects also allocated more time to difficult items under individuation instructions than under standard instructions, $F(1, 39) = 3.95$, $MSE = 0.05$, $\eta^2 = .09$. Learners allocated study time differently under the instruction conditions, so we analyzed whether these differences in study time allocation affected recognition performance across conditions.

Furthermore, we examined whether differences in study time allocation affected memory. Mean discriminability (d_a) is shown in Fig. 5, and hit and false alarm rates are shown in Table 1. A 2 (pacing) × 2 (instruction) × 2 (stimulus) ANOVA on discriminability revealed a significant mnemonic advantage for same-race over other-race faces, $F(1, 39) = 29.99$, $MSE = 0.23$, $\eta^2 = .44$, a marginal mnemonic advantage for self-paced over fixed-rate allocation, $F(1, 39) = 3.17$, $p = .08$, $MSE = 0.60$, $\eta^2 = .08$, but no significant differences resulting from the instruction condition, $F(1, 39) = 0.19$, $p = .67$, $MSE = 0.96$, $\eta^2 = .005$. No interactions were found (all ps > .29).

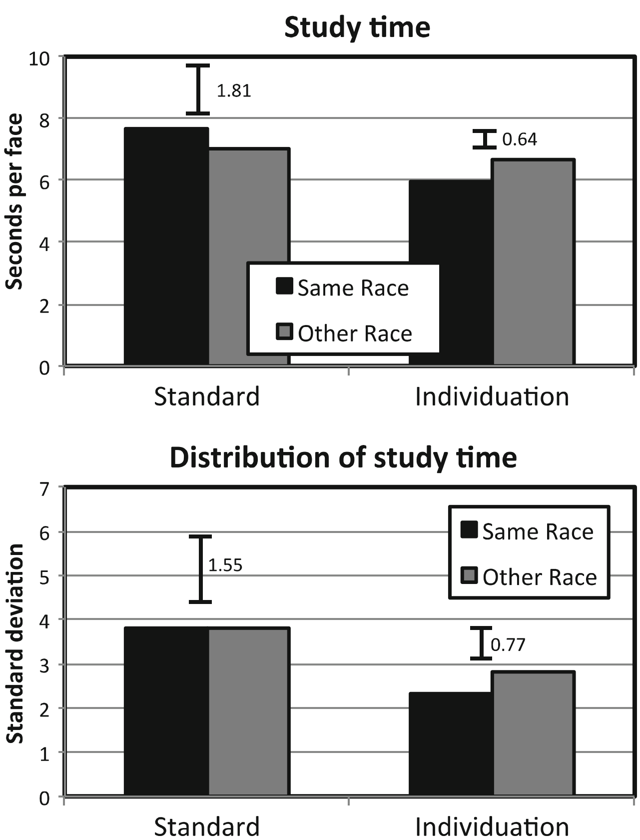

Fig. 3 Study time and variability for faces in Experiment 3. Error bars and values show the width of within-subjects 95 % confidence intervals of the difference between time spent on same-and other-race faces for each instruction condition

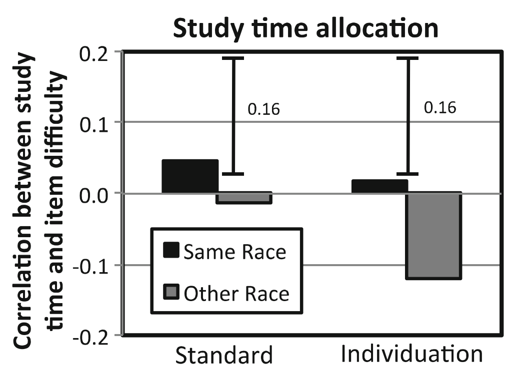

Fig. 4 Correlation between study time allocated and item difficulty as a function of stimulus and instruction conditions for self-paced learners in Experiment 3. Negative correlations indicate more study time to more difficult items. Error bars and values show the width of within-subjects 95 % confidence intervals of the difference between correlations for same- and other-race faces for each instruction condition

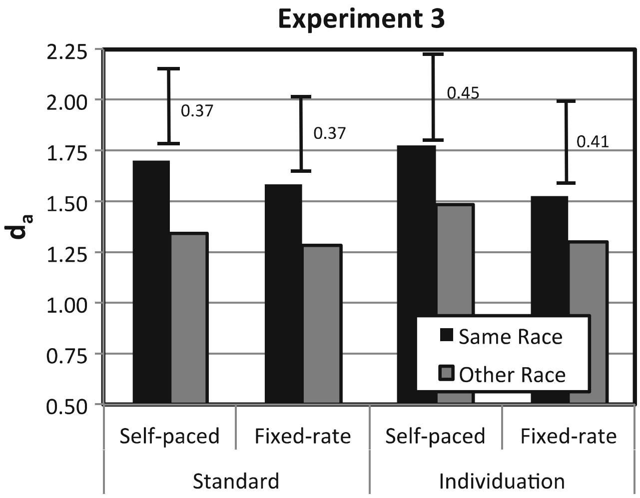

Fig. 5 Mean discriminability (d_a) for faces in Experiment 3. Error bars and values show the width of within-subjects 95 % confidence intervals of the difference between recognition performance on same- and other-race faces within each condition

Differences in discrimination were driven largely by differences in false alarm rates, as in the prior experiments. To more specifically test how self-pacing and instruction conditions affected the CRE, we computed the difference between memory performance for own- and other-race faces within each subject as the measure of the CRE. A 2 (pacing) × 2 (instruction) repeated measures ANOVA on this CRE variable revealed no significant interaction, $F(1, 39) = 0.01$, $p = .94$, $MSE = 0.26$, $\eta^2 < .000$, no main effect of instructions, $F(1, 39) = 1.08$, $p = .31$, $MSE = 0.20$, $\eta^2 = .03$, and no main effect of self-pacing condition, $F(1, 39) = 0.57$, $p = .46$, $MSE = 0.31$, $\eta^2 = .01$. These data confirm the earlier claim that control over study time does not affect the CRE.

We also analyzed whether amount of interaction with the other race affected memory for other-race faces. We examined whether the amount of interaction affected how learners allocated their study time. First, we computed the correlation between study time and other-race face difficulty for all self-paced learners. This shows how learners allocated their study time among other-race faces, as discussed above. Greater positive correlations indicate that learners spent more time on the easier items, while negative correlations indicate that learners spent more time on the easier items. We computed the correlation between self-reported interaction with other races and this measure of study time allocation. This correlation was significantly lower than zero ($r = -.28$), $t(78) = 2.59$, $p = .01$, and indicates that learners with more other-race experience were more likely to allocate greater study time to more (normatively) difficult other-race faces. Greater experience with other-race faces does change how study time to those faces is allocated; learners with greater other-race experience allocate their study time more selectively among other-race faces than do learners with less other-race experience. Finally, we investigated whether the differences in study time allocation impacted memory for other-race faces. To do so, we plotted mean discriminability of Chinese faces against the amount of self-reported interaction with Chinese people, as shown in Fig. 6. The correlation between the amount of interaction with Chinese people and the discriminability of Chinese faces was not significantly different than zero in either the individuation conditions ($r = .06$), $t(78) = 0.53$, $p = .60$, or the standard instruction conditions ($r = -.06$), $t(78) = 0.53$, $p = .60$.

Discussion

The results from the third experiment largely replicate those from the first two experiments. Learners spent equal amounts of time on own-race and other-race faces, unless instructed to individuate other-race faces. Under individuation instructions, learners studied other-race faces longer than own-race faces. Learners recognized own-race faces better than other-race faces, and neither self-pacing nor individuation instructions reduced this difference. Even though learners allocated more study time to more difficult faces under individuation instructions, the size of the CRE was not reduced. Furthermore, self-reported interaction with Chinese people was associated with how learners allocated their study time among Chinese faces but did not modulate the size of the CRE under standard or individuation instructions.

General discussion

Across three experiments, self-paced learners exhibited large cross-race recognition deficits. When instructed to remember the faces, self-paced learners allocated time equally between the races. Furthermore, self-paced learners showed the same deficit in their ability to remember other-race faces as fixed-rate learners. Self-pacing did not increase or reduce the size of the CRE. The CRE persisted even in Experiments 2 and 3, where self-paced learners were instructed to individuate faces. Instructions to individuate other-race faces led learners to spend more time studying other-race than same-race faces but did not reduce the CRE. In addition, amount of self-reported interaction with other races did not moderate the size of the CRE even when learners were given instructions to individuate those faces.

The inability to overcome the CRE suggests that learners do not have complete strategic control over the encoding processes used to remember faces. Under individuation instructions, learners exert more effort to remember other-race faces but still do not remember them as well as same-race faces. The lack of cognitive disregard, combined with the presence of the CRE, is inconsistent with social-cognitive views. The results presented here provide evidence against

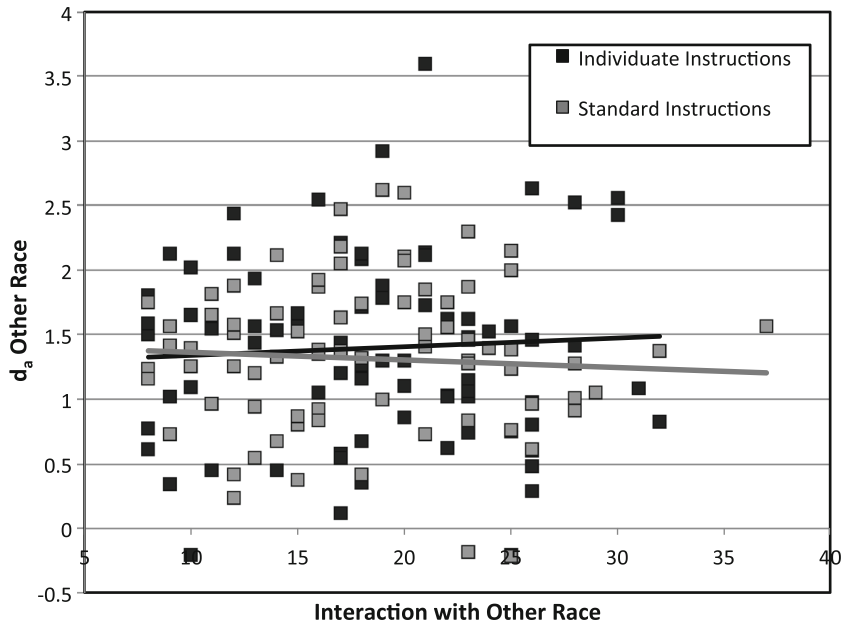

Fig. 6 Mean discriminability (d_a) for other-race faces as a function of instruction condition and self-rated exposure to the other race. Each data point represents a single subject

cognitive disregard views in two major ways. First, even when learners allocate more cognitive resources (as measured by time) to other-race faces, the CRE is not reduced. Learners are not spending less time on other-race faces, and yet their recognition performance for these faces is largely impaired. Second, evidence shows that learners do not process other-race faces categorically and own-race faces individually. In Experiment 3, learners allocated study time more selectively among other-race faces than among own-race faces. This result suggests that learners actively distinguish among other race faces in order to allocate study time among them. Even then, though, the size of the CRE is not reduced. Furthermore, under individuating instructions, the standard deviations of study time allocation are greater among other-race faces than among own-race faces. A greater variety of standard deviations indicates that learners process other-race faces individually.

Social-cognitive views suggest that other-race deficits result from a learner's desire to minimize cognitive effort and maximize efficiency, but we find no evidence for such behavior. Encoding efficiency across all three experiments, operationalized as d_a divided by study time per face, is shown in Fig. 7. A 2 (stimulus) × 2 (self-pacing) × 2 (instruction) mixed model ANOVA on the efficiency of encoding reveals a significant three-way interaction, $F(1, 244) = 8.94$, $MSE = 0.01$, $\eta^2 = .03$, and a significant main effect of stimulus type, $F(1, 244) = 51.32$, $MSE = 0.02$, $\eta^2 = .17$. Learners are significantly more efficient at encoding own-race faces than other-race faces. If learners were maximizing mnemonic efficiency, they would spend less study time on other-race faces, as compared with same-race faces. We found no evidence that learners spent less effort on other-race faces. In fact, learners spent the same amount or more time on other-race faces, as compared with same-race faces, even though other-race faces provided a smaller rate of return for their effort. The analysis about encoding efficiency was not a planned comparison, so this analysis should be interpreted with some caution. However, it provides interesting hints that can be further explored in the future.

Learners likely fail to effectively and efficiently encode other-race faces because they lack the expertise to do so. These results may be most consistent with perceptual expertise views of the CRE, because they suggest that learners do not know how to encode other-race faces. Learners may not effectively encode the features that maximally differentiate between other-race faces, even when given instructions to do so, because they have the expertise to effectively do so. Even with unlimited time to go beyond the "default feature selection" and encode "configural features" of other-race faces (Levin, 2000), learners cannot overcome the CRE.

Although we found that the amount of interaction with the other race did not moderate the size of the CRE in Experiment 3, our sample may not have included a sufficient range of experience with the other race to develop perceptual expertise in distinguishing among other-race faces. Learners reported significantly more interactions with their own race ($M = 37.36$) than with the other race ($M = 18.48$), $t(159) = 28.25$, $p < .01$. In fact, only 2 subjects reported more interactions with the other race than with their own race. Perhaps if our learners had a greater variety of experiences with other races, we could better detect whether and when learners can reduce the size of the CRE.

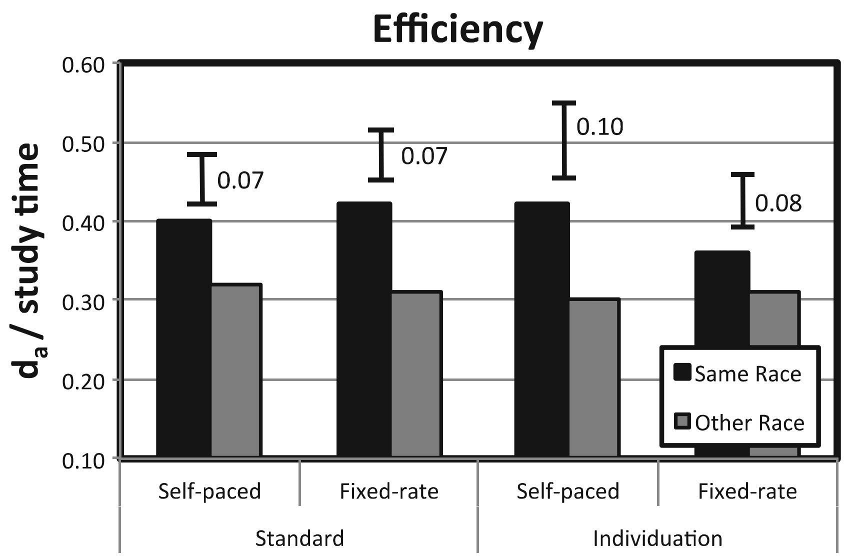

Fig. 7 Encoding efficiency across all experiments. Error bars and values show the width of within-subjects 95 % confidence intervals of the differences between efficiency on same- and other-race faces within each instruction and pacing condition

Learners allocated study time more effectively to other-race faces than across same-race faces. This result is in contrast to prior research indicating that learners are better able to judge the difficulty of same-race faces than other-race faces (Hourihan et al., 2012). If learners can more accurately assess the mnemonic difficulty of same-race than of other-race faces, they should show larger negative correlations between study time and item difficulty for own-race faces than for other-race faces. We computed the correlation between item difficulty and study time (as described in Experiment 3) and found the opposite. Learners allocated study time more effectively among other-race faces than among same-race faces. This combination of results might reveal an interesting dissociation between monitoring and control.

Self-paced learners showed higher memory performance than did yoked fixed-rate learners across experiments. Giving learners control over their study improved their mnemonic performance on faces, as it does for word stimuli (Tullis & Benjamin, 2011). This improvement in performance due to self-pacing reveals that learners have some accurate metacognition about how to best allocate study time and can use this accurate metacognition to better encode both own- and other-race faces. Learners can modulate their own study time on the basis of their idiosyncratic analyses of face difficulty; they can spend more time on faces that are most difficult for them to encode and less time on the faces that are easier for them to encode. This personalized regimen of study time allocation based upon an individual's own determination of difficulty (rather than normative difficulty or fixed-rate presentation) boosts recognition performance.

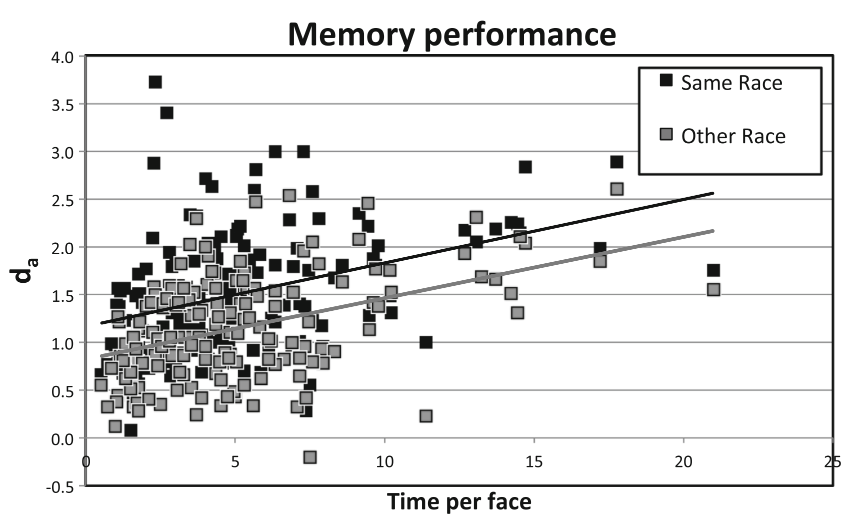

Fig. 8 Memory performance as a function of study time per face for the fixed-rate subjects combined across Experiments 1 and 3. Each subject is represented by a pair of data points

Learners spend more time on faces they believe need more encoding, and this benefits memory performance. However, the results also reveal a significant limitation to the benefits of granting learners metacognitive control over learning. Learners, even when directly instructed to do so, cannot use their control over encoding to reduce the CRE.

Influence of study time on the cross-race effect

Ceding control to learners over their study time also produces a large variety of study times, which allows us to examine in a limited way how study time influences the CRE, even though this analysis is not central to our claims. Extant studies have revealed mixed outcomes: Meissner and Brigham (2001) concluded that more encoding time diminishes the CRE because it leads to fewer other-race false alarms, but Anthony et al. (1992) showed that more exposure time led to a bigger CRE for Caucasian subjects. In order to test whether study time influences the CRE, we calculated the correlation between study time per face and memory performance for the own-race and other-race faces across the fixed rate subjects from Experiments 1 and 3. As is shown in Fig. 8, the correlations between study time and memory performance are nearly identical for own-race and other-race faces. This suggests that the CRE remains consistent across a wide variety of study times. Recognition performance for own- and other-race faces increases at the same rate with increased study time. Such a result is inconsistent with views that postulate substantial differences in the manner or extent of processing applied to same- and other-race faces. A more straightforward interpretation is that the same processing is applied in all cases but that the processing is more appropriately tuned for remembering same-race faces. This analysis should be interpreted with some caution, since it includes comparisons that were not planned and are not central to our hypotheses. Nonetheless, it provides some intriguing hint that should be explored in more detail in future work.

Across these three experiments, we showed that the CRE is not under the strategic control of the learner. Even when learners are instructed to better encode other-race faces and control their study time, the CRE stubbornly remains. Our learners spent as much (standard instruction conditions) or more (individuation instruction conditions) time studying other-race faces than same-race faces, and the CRE persisted. These results suggest that learners may not have had enough experience with other-race faces to know how to best encode them. However, perceptual expertise, as indexed by the self-reported interaction with the other race, did not influence study time allocation or memory, despite the fact that self-pacing proved advantageous overall. The failure of learners' metacognition to overcome the CRE, however, reveals that the CRE likely has multiple origins, some of which involve social factors and some of which involve perceptual expertise. Learners show little strategic control over their encoding deficit for other-race faces, which limits the role that conscious cognitive disregard can play in causing the CRE.

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