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Guns Are Not Faster to Enter Awareness After Seeing a Black Face: Absence of Race-Priming in a Gun/Tool Task During Continuous Flash Suppression

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Abstract

In the Weapon Identification Task (WIT), Black faces prime the identification of guns compared with tools. We measured race-induced changes in visual awareness of guns and tools using continuous flash suppression (CFS). Eighty-four participants, primed with Black or Asian faces, indicated the location of a gun or tool target that was temporarily rendered invisible through CFS, which provides a sensitive measure of effects on early visual processing. The same participants also completed a standard (non-CFS) WIT. We replicated the standard race-priming effect in the WIT. In the CFS task, Black and Asian primes did not affect the time guns and tools needed to enter awareness. Thus, race priming does not alter early visual processing but does change the identification of guns and tools. This confirms that race-priming originates from later post-perceptual memory- or response-related processing.

Keywords

stereotypes, continuous flash suppression, race priming, vision, visual awareness

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Introduction

The New Look movement (Bruner, 1957, 1992) argued that there is no pure percept: The perceptual process is always shaped by internal (social) goals and biases. One particularly well-studied topic is how stereotypes about groups (e.g., related to race, class, or gender) change perception. Studies have shown, for example, that the group membership of a person can alter how children interpret an ambiguously aggressive act of that person (Sagar & Schofield, 1980), how a doctor evaluates that person (Van Ryn & Burke, 2000), or how harshly that person will be sentenced (Bowers et al., 2003). Based on this wide range of findings, current theories of perception suggest that social information can directly influence perception (Jenkin & Siegel, 2015; Newen & Vetter, 2017; Ogilvie & Carruthers, 2016; Otten et al., 2017; Siegel, 2012; Vetter & Newen, 2014). These ideas, rooted in the principle of predictive processing, suggest that perception is the result of a comparison between the perceptual signal and the internal predictions about the causes of that signal. Especially when the perceptual signal is weak, the resulting percept can be shaped by internal predictions (Otten et al., 2017). According to this view, social knowledge in the form of stereotypes may also change whether and when a stimulus enters perceptual awareness, as the stereotype can function as a social prediction about which objects or actions are likely to follow, preparing the visual system for specific subsets of visual stimuli. Here we tested whether this is the case for the well-studied stereotype-based social association between Black faces and weapons.

In the Weapon Identification Task (WIT), participants are presented with an image of a Black or White face (the prime), followed by an image of a weapon or a tool. Participants are faster and more accurate in identifying the target as a weapon or tool when the target follows a stereotype-congruent prime (weapon following a Black face or tool following a White face) than when the target follows a stereotype-incongruent prime (weapon following a White face or tool following a Black face; Eberhardt et al., 2004; Kidder et al., 2018; Payne, 2001, 2006; Payne et al., 2005). These results demonstrate the existence of a stereotype-based association between the group and the response to the target. Although such priming

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effects are sometimes interpreted as reflecting a change in perception, they could similarly originate from later processing stages related to memory, decision, or response selection and execution.

In the standard WIT, participants *identify* the target as a weapon or a tool and then initiate a response. In other words, the target object needs to be visually processed, and the resulting visual representation needs to be recognized, which involves both memory retrieval and matching of the visual representation to the memory representation. Faster or better visual recognition of congruent targets, therefore, does not necessarily imply that congruent targets are *seen* faster or better. Whenever the task involves target identification, effects of race on identification times may instead reflect faster memory retrieval or matching, for example, through primed associations in memory networks.

In the WIT, priming effects could also reflect activation of the response rather than perceptual or memory effects (Wentura & Degner, 2010). For example, when participants have the goal to identify weapons versus tools, due to their stereotypical relationship with weapons, Black face primes may activate the response required for weapons. This activation of the response would be independent of the identity of the target (response activation may precede the presentation of the target) and could lead to an overall tendency to choose the weapon response in the case of a Black face prime and a tool response in case of a White face prime. Analyses of response patterns from the WIT where the targets (guns and tools) are fully visible indicate that the observed differences between Black and White primes are predominantly a consequence of response biases (Klauer & Voss, 2008; Payne, 2001; Payne et al., 2005), although some studies suggest a role for stereotype-induced shifts in perception as well (see e.g., Greenwald et al., 2003).

Previous studies inferred the effects of race primes on perception versus responding by comparing patterns of correct and erroneous categorization, inspired by signal detection theory. This is an indirect way of assessing potential perceptual effects of (social) context. In the current study, we provide a more direct test of the effect of race primes on visual perception by combining continuous flash suppression (CFS; Tsuchiya & Koch, 2005) with a simple localization task that did not involve a decision about the identity of the target object. CFS is a variant of binocular rivalry, where "Mondrian-like" masks flashed into one eye can render an image presented to the other eye invisible for up to several seconds. The time it takes an image to break through such interocular suppression and become visible is often regarded as an index of potency to gain access to visual awareness. Therefore, a "breaking CFS" task (b-CFS: Jiang et al., 2007 for a review of this method see Stein, 2019) provides a way to compare the sensitivity of the visual system with different types of visual stimuli. Faster detection times for race-primed CFS-masked stimuli would indicate greater perceptual sensitivity and would suggest that social context (the face) attunes the visual system to specific, stereotype-congruent subgroups of objects.

Indeed, previous work has revealed that (non-social) contextual factors such as primes can influence when observers become aware of a suppressed stimulus, indicating that the visual system has differential sensitivity for specific visual input depending on the context. For example, the duration of perceptual suppression is shorter when words predict a target's object identity, category, or color (Lupyan & Ward, 2013; Pinto et al., 2015; Stein & Peelen, 2015). Even purely semantic priming has an effect in b-CFS (Costello et al., 2009): Suppression times are shorter when a word target (e.g. "salt") follows a semantically congruent word prime (e.g., "pepper"). Thus, b-CFS may represent a particularly powerful method for detecting the effects of stereotype activation on perception.

Importantly, as suppression times are measured with simple localization tasks, post-perceptual influences from memory or response selection are less likely in b-CFS than in the standard WIT. In b-CFS, participants indicate in which location any part of an initially invisible target breaks through CFS and becomes visible. Thus, there is no requirement to identify or recognize the target. Furthermore, in contrast to the standard WIT, there is no association between the prime and the response. Shorter suppression times for congruently primed targets in the weapons task would therefore indicate that a semantic association between primes and targets can influence visual perception, equipping stereotype-congruent targets with privileged access to awareness.

In addition to the b-CFS target localization task, where the targets were initially suppressed from conscious awareness, participants also completed a traditional WIT, where both primes and targets were normally visible and the targets needed to be identified as a weapon or tool. We expected to replicate the standard WIT findings that compared with baseline face primes, Black primes will lead to shorter response times and less errors when identifying guns and longer response times and more errors when identifying tools. If these effects were partly due to more effective perceptual processing of guns after seeing a Black face, then CFS-masked guns should enter awareness faster relative to tools after a Black prime face compared with the baseline prime face. If, however, the effects observed in the WIT are post-perceptual, then the race of the prime face should not affect b-CFS times for guns and tools.

Method

Participants

Eighty-eight participants were recruited through the University of Amsterdam participant pool. We only tested participants who indicated that they had normal or corrected-to-normal vision and who had a racial background different from the face photographs used as prime stimuli. Participants were naive to the research question and received course credit for their participation. Informed consent was obtained following a protocol approved by the University of Amsterdam ethics committee. Four participants were excluded because their response accuracy was below 75% correct in either the identification or the b-CFS task. The final sample consisted of 84 participants (70 women, mean age 20.1 years, $SD = 2.5$). Participants received written and verbal instructions and practice trials, and both tasks contained two short obligatory breaks. Half of the participants first did the identification task and then the breaking CFS task; for the other half, the order was reversed.

Statistical Power

Sample size was determined before any data analysis based on the following power analysis. Kidder and colleagues (2018) reported a meta-analytic effect size for the standard weapons identifications task of $d_z = 0.46$. With our sample size of 84 participants, we had 98.6% power to detect effects of this size. Furthermore, we had 80% power to detect effect sizes of $d_z > 0.30$ and thus sufficient power to detect effects of the size of the lower bound of the 95% *CI* reported in the meta-analysis of Kidder and colleagues ($d_z = 0.36$). Note that these power calculations apply to standard paired *t*-tests or repeated-measures analyses of variance (ANOVAs) testing for mean differences between conditions, following most previous WIT studies. In this article, we also report results from linear mixed-effects models that take into account variability within and across participants and items (prime and target stimuli) simultaneously. Post-hoc power estimations for the linear mixed-effects models are reported in the Results section.

Display

Participants viewed stimuli presented on a 24-inch LCD (1920 × 1080 pixels resolution, 60 Hz refresh rate) dichoptically through a custom-built mirror stereoscope using a chin-and-head rest placed approximately 60 cm away from the screen. The mirrors of the stereoscope were adjusted for each observer to yield stable binocular fusion. Experiments were programmed in Matlab using Psychtoolbox (Brainard, 1997) functions. Presentation times were synchronized with the vertical refresh cycle of the screen. Two fusion contours (7.0° × 7.0° of visual angle) consisting of random black and white pixels (width 0.2°) were displayed side-by-side on the screen such that one contour was shown to each eye (distance between the centers of the two contours 16°). A small black fixation cross was presented in the center of each contour, and the remainder of the space enclosed by the contour was white. The rest of the screen outside these contours was black. Participants were asked to maintain fixation throughout the breaking CFS experiment (moving the eyes between trials if necessary), not to close one eye and to blink between trials only.

Stimuli

For the prime stimuli, 15 images of Black males and 15 images of Asian males, all with neutral facial expressions, were selected from the Chicago Face Database. To preserve all potentially relevant differences between Black and Asian primes, the prime stimuli (7.0° × 7.0°) were presented in their original color and not further processed (e.g., cropped and contrast-matched). As target stimuli, we selected six color photographs of guns and six photographs of tools (can openers) from the internet. For each category, three targets were pointing to the left side, and three were pointing to the right side. Targets were resized to fit into the same rectangle (3.9° × 3.0°), but no further processing was applied (e.g., no adjustment of contrast or luminance), as we were interested in response to identical stimuli as a function of the primes. We also generated 200 “Mondrian-like” masks (7.0° × 7.0°) consisting of randomly arranged circles of different sizes in various colors (diameter 0.3–1.2°).

Identification Task

Every trial started with a 1-s presentation of the fixation cross, followed by a 200-ms presentation of a prime (Black or Asian face). After 17 ms of fixation, a target (gun or tool) was presented for 200 ms to one randomly selected eye (Figure 1A). The target image was vertically centered 1.8° either above or below the fixation point, and its horizontal position was jittered randomly from trial to trial with an offset from the horizontal center to the left or right of 0°, 0.4°, 0.9°, or 1.3°. Target presentation was followed by a mask presented to both eyes until response or for a maximum of 1.8 s (corresponding to the maximum time window in which participants could enter their response). Participants were asked to categorize the target as quickly and accurately as possible as a gun or can opener, using the left and right arrow keys on the keyboard. In a random subset of 12.5% of trials, participants were then asked to select the prime stimulus presented on that trial from two sequentially presented face stimuli (shown for 200 ms each, with a 650 ms blank in-between) of which the foil always displayed the other race than the actual prime. These prime-check trials were included to keep participants’ attention on the primes (and they were instructed to do so). There were 288 trials in which each combination of two eyes for target presentation, target location above or below the central fixation cross, gun and tool target, six target identities, and Black and Asian prime occurred equally often. The identity of the prime was selected at random for each trial, and the trial order was randomized.

Breaking CFS Task

Stimulation in the b-CFS task was identical, except for the target presentation sequence (Figure 1B). Masks changing

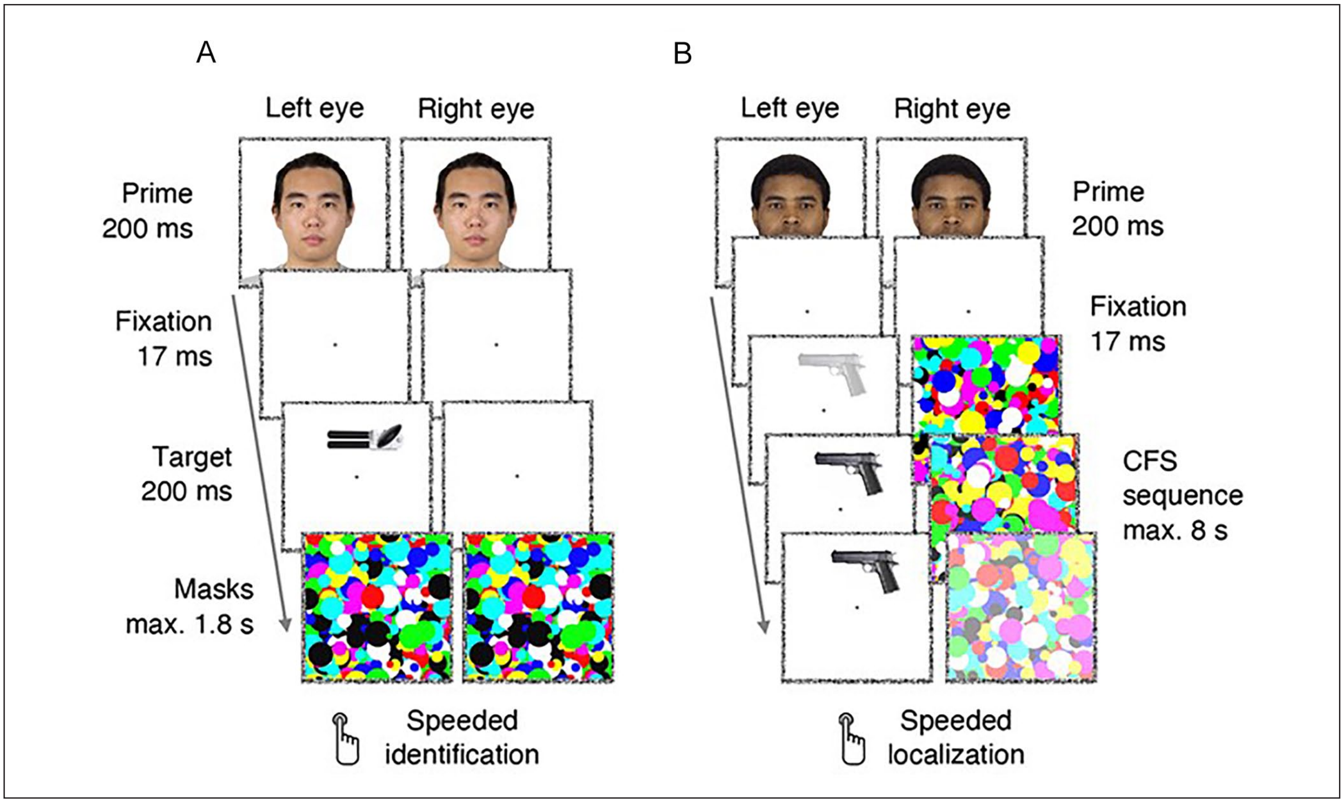

Figure 1. Schematic trials from the two tasks.
Note. In both tasks, participants were primed with either a Black or an Asian face, followed by a gun or tool target. (A) In the identification task, participants identified a target as quickly and accurately as possible as a gun or a tool. (B) In the breaking CFS task, targets were presented to one eye while CFS masks flashing at 10 Hz were presented to the other eye, and participants indicated in which location (above or below the fixation cross) a target became visible. CFS = continuous flash suppression

every 100 ms were presented to one eye, and a target was gradually introduced to the other eye by decreasing its transparency from 100% to 0% for the first second of a trial. Beginning 1 s after trial onset, the contrast of the CFS masks was linearly decreased to zero for 6 s to force an eventual breakthrough. The target was presented until response or for a maximum trial length of 8 s. Participants were asked to indicate as quickly and accurately as possible where a target or any part of a target (i.e., any stimulus or part of a stimulus not belonging to the mask) became visible, using the up and down arrow key for locations above or below the fixation cross, respectively. The prime-check trials, number of trials, and randomization of conditions were the same as in the identification task.

Analyses

In these experiments, we report all measures, manipulations, and exclusions. Trials without a response were counted as incorrect. For analyses of response times (RTs) and suppression times, we only included trials with correct responses (identification task: *Mdn* = 95.3% correct, interquartile range [*IQR*] = 4.5; b-CFS task *Mdn* = 97.6% correct, *IQR* = 3.7). Because proportional data such as accuracy are not strictly normally distributed, descriptive statistics in the text are given as median and *IQR*, and all statistical analyses on mean accuracies were carried out following a rationalized arcsine transformation (RAU, where a score of 50 corresponds to 50% correct, with RAU values scaling between −23 and 123). As RTs and suppression times also violate the assumption of normality, they were $\log_{10}$-transformed before condition means were calculated and statistical analyses were carried out. For illustration purposes and easy eyeballing of the results in standard units for the text and figures, $\log_{10}$-transformed suppression times were transformed back. Finally, to directly compare priming effects from the identification and b-CFS task, (raw) mean differences between the respective conditions from each task were divided by their pooled standard deviation (i.e., *z*-transformed).

Statistics

For standard repeated-measures ANOVAs of mean scores, we report both standard frequentist statistics and Bayes factors (BFs) calculated in JASP (JASP Team, 2020) with default prior scales (Cauchy distribution, scale 0.707). When frequentist statistics indicate a significant effect, the corresponding BF quantifies the evidence for the alternative hypothesis (BF_{10}); when the effect is not significant, the reported BF quantifies the evidence for the null hypothesis (BF_{01}). For multifactorial ANOVAs, we report the inclusion BF quantifying the evidence for all models containing a particular effect compared with all models without that effect. To test for priming effects in the identification and b-CFS task, we also performed linear mixed-effects models using the lme4 package (Bates et al., 2014) for R (R Core Team). To test for the key interaction between prime and target, a model with the prime-by-target interaction was compared with a model with the two fixed effects only. Models contained random intercepts for participants, prime exemplar, and target exemplar, and random slopes for participants. Likelihood ratio tests were used to find the models that best fitted the data. To follow-up on significant interactions, null models containing only the random effects were tested against models with the additional main effect of prime, separately for the two target categories.

Results

Prime-Check Trials

We first analyzed performance in the prime-check trials, in which participants were quizzed about the prime stimulus at the end of 12.5% randomly selected trials. Median accuracy in the prime-check trials was very similar in the identification task (*Mdn* = 91.7% correct, *IQR* = 25.0) and in the b-CFS task (*Mdn* = 90.3% correct, *IQR* = 19.4); a paired *t*-test on the mean RAU scores revealed slightly better performance in the identification task, $t(83) = 2.50$, $p = .016$, $d_z = 0.27$, 95% confidence interval [CI] for d_z [0.05, 0.49], but $BF_{10} = 2.04$.

Identification Task

A repeated-measures ANOVA with the factors prime (Black, Asian face) and target (gun, tool) on $\log_{10}$-transformed RTs revealed a significant interaction between prime and target, $F(1, 83) = 35.50$, $p < .001$, $\eta_p^2 = .30$, $BF_{10} = 4.34 \times 10^3$. As can be seen in Figure 2A, for gun targets, responses were significantly faster when preceded by a Black prime than by an Asian prime, $t(83) = -4.39$, $p < .001$, $d_z = -0.48$, 95% CI for d_z [−0.70, −0.25], $BF_{10} = 545.59$. For tool targets, by contrast, responses were significantly slower when preceded by a Black prime than by an Asian prime, $t(83) = 4.59$, $p < .001$, $d_z = 0.50$, 95% CI for d_z [0.27, 0.73], $BF_{10} = 1.08 \times 10^3$.

Similarly, as shown in Figure 2B, for accuracy in RAU scores, the interaction between prime and target was significant, $F(1, 83) = 18.44$, $p < .001$, $\eta_p^2 = .18$, $BF_{10} = 355.20$. For gun targets, responses were significantly more accurate when preceded by a Black prime than by an Asian prime, $t(83) = 3.85$, $p < .001$, $d_z = 0.42$, 95% CI for d_z [0.20, 0.64], $BF_{10} = 89.31$. For tool targets, responses were significantly more accurate when preceded by an Asian prime than by a Black prime, $t(83) = 2.29$, $p = .019$, $d_z = 0.26$, 95% CI for d_z [0.04, 0.48], but $BF_{10} = 1.76$.

The linear mixed-effects analyses also revealed significant prime-by-target interactions for $\log_{10}$-transformed RTs, $\chi^2(1) = 49.08$, $p < .001$, as well as for accuracy, $\chi^2(1) = 22.48$, $p < .001$. For gun targets, responses were significantly faster, $\chi^2(1) = 16.85$, $p < .001$, and more accurate, $\chi^2(1) = 18.20$, $p < .001$, when preceded by a Black prime than by an Asian prime. For tool targets, responses were significantly faster when preceded by an Asian prime than by a Black prime, $\chi^2(1) = 11.23$, $p < .001$. However, there was no significant priming effect on identification accuracy for tool targets, $\chi^2(1) = 2.40$, $p = .13$.

Breaking CFS Task

In contrast to the robust race-priming effects observed for the identification of guns and tools, there was no evidence for priming effects in the b-CFS task (Figure 3A). A repeated-measures ANOVA on $\log_{10}$-transformed suppression times revealed only a significant main effect of target, $F(1, 83) = 58.17$, $p < .001$, $\eta_p^2 = .41$, $BF_{10} = 3.13 \times 10^{19}$, with shorter overall suppression times for tools (back-transformed RT $M = 3.06$ s, $SD = 1.38$ s) than for gun targets ($M = 3.28$ s, $SD = 1.39$ s). The interaction between prime and target was not significant, with moderate-to-strong evidence for a null effect, $F(1, 83) = 0.21$, $p = .648$, $\eta_p^2 < .01$, $BF_{01} = 5.97$, indicating that the race of the face prime did not affect how quickly guns and tools entered awareness. For accuracy in RAU scores there were no significant effects; for the interaction effect there was moderate evidence for a null effect, $F(1, 83) = 0.45$, $p = .507$, $\eta_p^2 < .01$, $BF_{01} = 5.15$, indicating that the face primes did not change how likely participants were to detect guns or tools.

The linear mixed-effects analyses confirmed that the race of the face prime did not influence suppression times: There was no significant prime-target interaction for $\log_{10}$-transformed RTs, $\chi^2(1) = 0.15$, $p = .70$, or for accuracy, $\chi^2(1) = 0.03$, $p = .87$. Note, however, that although the standard ANOVA analyses reported earlier were high-powered (see Methods), linear mixed-effects analyses, which take into account variability within and across participants and items at the same time, have less statistical power. Simulation-based post-hoc power analyses were carried out using the *mixedpower* package (Kumle et al., 2018, 2021) for R (R Core Team). We tested how much power the b-CFS task had to detect the effect sizes (beta coefficients) we had obtained in the identification task. The estimated power for the prime-by-target interaction was 63% for RTs and >99% for accuracy. Given that RTs are the main dependent measure in

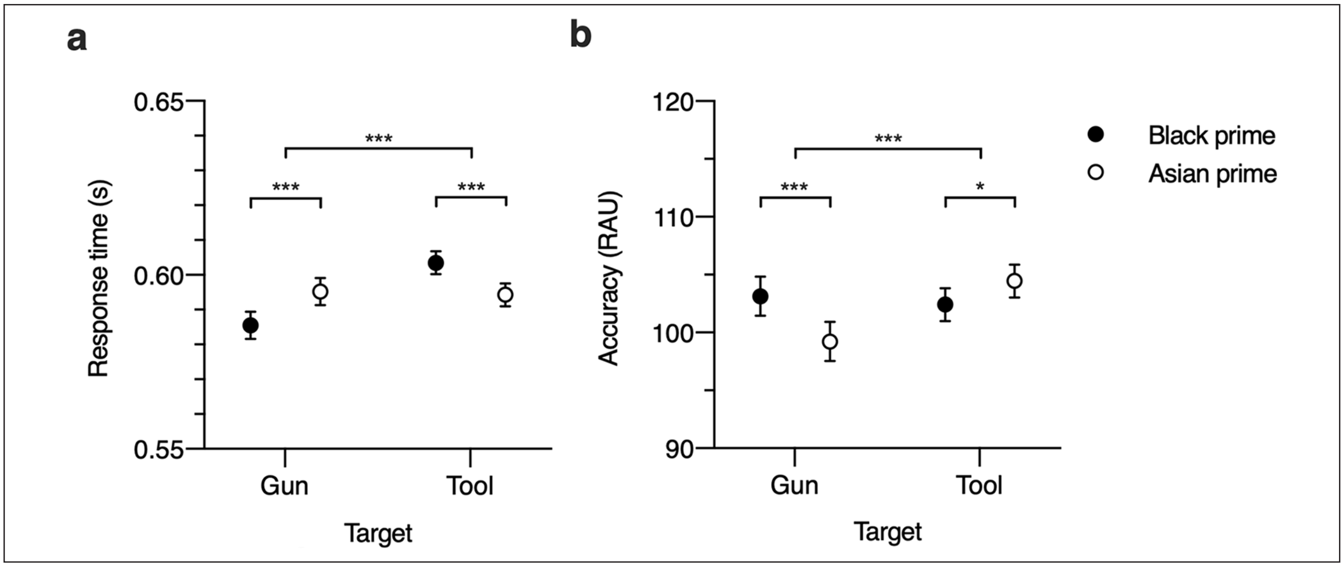

Figure 2. Results from the identification task.
Note. (A) Mean response times as a function of prime and target. For easy eyeballing, $\log_{10}$-transformed suppression times were transformed back to standard units. (B) Mean accuracy in rational arcsine (RAU) scores (where a score of 50 corresponds to a proportion of 0.5, with RAU values scaling between −23 and 123) as a function of prime and target. In Figure 2A and 2B, error bars represent the 95% *CI*s for the respective comparisons between Black and Asian primes. RAU = rational arcsine, *CI* = Confidence interval.
$^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

b-CFS, the null effect in the linear-mixed effect analysis is more likely to reflect a false negative than the null effects obtained with the high-powered standard reported-measures ANOVAs reported earlier.

We also compared suppression times between the first and the second half of the CFS task. This was done to test whether overall suppression weakened over time, as is commonly found. Indeed, suppression times were longer in the first than in the second part of the experiment, $t(83) = 11.15$, $p < .001$, $d_z = 1.22$, 95% CI for d_z [0.93, 1.50], $BF_{10} = 1.56 \times 10^{15}$. As can be seen in Figure 3B, there was a roughly linear decrease in suppression times when dividing the experiment in four trial bins, $F(3, 249) = 81.88$, $p < .001$, $\eta_p^2 = .50$, $BF_{10} = 2.04 \times 10^{70}$. This linear decrease in suppression times was similar for congruent (Black-Gun/ Asian-Tool) and incongruent (Black-Tool/ Asian-Gun) trials, $F(1, 83) = 0.06$, $p = .806$, $\eta_p^2 < .01$, $BF_{01} = 11.90$; bin × congruency interaction, $F(3, 249) = 0.43$, $p = .730$, $\eta_p^2 < .01$, $BF_{01} = 61.17$.

Identification Versus Breaking CFS Task

In addition to our finding that race priming was restricted to the identification task and not observed in the CFS-localization task, Figure 4 shows that the *z*-transformed priming effects were also significantly larger in the identification task than in the b-CFS task, $t(83) = 4.85$, $p < .001$, $d_z = 0.53$, 95% CI for d_z [0.30, 0.76], $BF_{10} = 2.77 \times 10^3$. Analyses of *z*-scores again revealed strong evidence for race-based priming effects on gun/tool identification, $t(83) = 5.78$, $p < .001$, $d_z = 0.63$, 95% CI for d_z [0.40, 0.86], $BF_{10} = 1.04 \times 10^5$, and strong evidence for the absence of priming effects in the b-CFS task, $t(83) = 0.05$, $p = .962$, $d_z < 0.01$, 95% CI for d_z [−0.21, 0.22], $BF_{01} = 8.30$. Finally, there was strong evidence against a correlation between the *z*-transformed priming effects from the two tasks, $r(82) = -.01$, $p = .92$, $BF_{01} = 7.29$. Thus, there was no evidence that participants who showed stronger priming effects in the identification task also showed stronger priming effects in the b-CFS task.

Discussion

We replicate the classical pattern of racial bias when participants are asked to identify guns and tools: Participants were faster to respond to guns after a Black prime than an Asian prime, and the reverse was observed for tool targets. Moreover, tools were more often misidentified as a gun after a Black prime than an Asian prime, while the reverse was observed for gun targets that were more often identified as a tool following an Asian prime than a Black prime. However, in the same group of participants who showed a clear effect of race on gun/ tool *identification*, Black and Asian faces did not differentially affect *entry into awareness* for guns and tools that were rendered invisible through continuous flash suppression (CFS). Overall, in this experiment, tool targets entered awareness faster than guns, but this effect was not modified by the prime faces that preceded the target objects. This suggests that the association between Black faces and guns measured by the WIT does not gear the perceptual system toward guns during

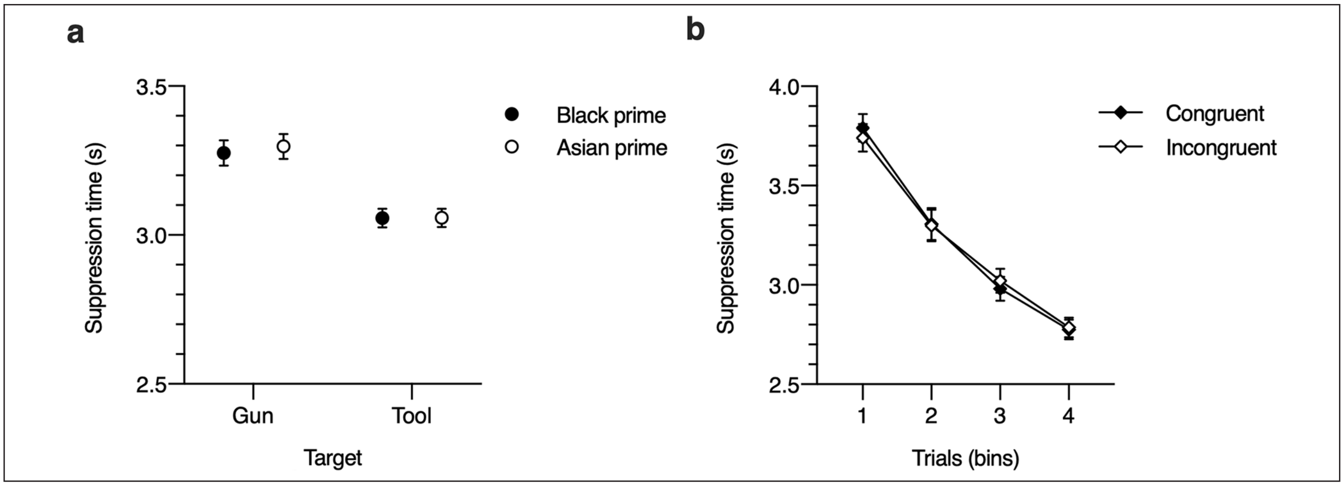

Figure 3. Results from the b-CFS task.

Note. For easy eyeballing, log_{10}-transformed suppression times were transformed back to standard units. (A) Mean suppression times as a function of prime and target. Error bars represent the 95% *CI*s for the respective comparisons between Black and Asian primes. (B) Mean suppression times in "congruent" trials (Black prime, gun target, or Asian prime, tool target) and in "incongruent" trials (Asian prime, gun target, or Black prime, tool target) as a function of the trial bin. Error bars represent the 95% *CI*s for the comparisons of congruent and incongruent trials, separately for each trial bin. b-CFS = breaking CFS; *CI* = Confidence interval.

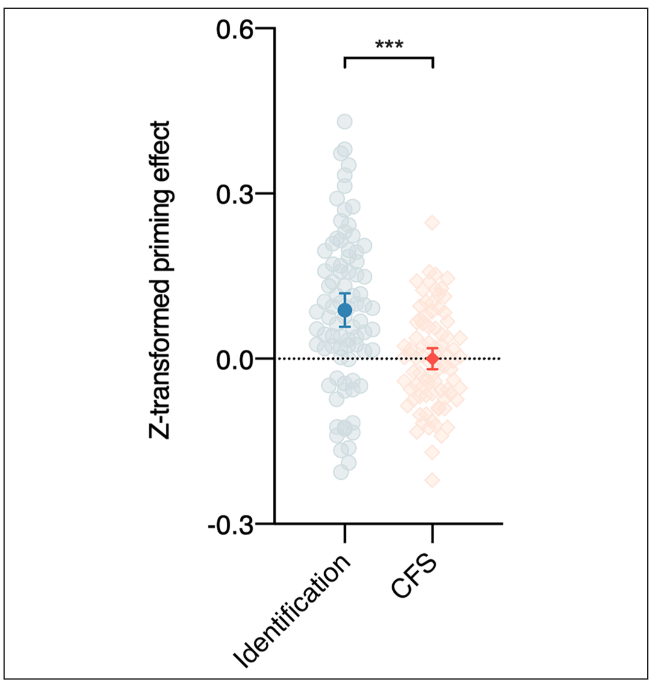

Figure 4. Standardized RT priming effects (congruent vs. incongruent trials) from the identification task and the breaking CFS task.

Note. The saturated symbols represent the mean and error bars the 95% *CI*s. The desaturated symbols represent individual participants ($N = 84$). CFS = continuous flash suppression; *CI* = Confidence interval; RT = response time.

***$p < .001$.

the early stages of visual processing. Instead, priming with a Black or Asian face led to similar early visual processing of guns and tools. This suggests that the race-based association between Black faces and guns (and/or Asian faces and tools) exerted its effect only after the gun or tool entered visual awareness.

This finding is in line with Pylyshyn's (1999) suggestions that basic perceptual processing proceeds independent of higher-level knowledge. Although the race biases observed in the WIT might *suggest* changes in perception, they *measure* changes in response to perceptual stimuli (Firestone & Scholl, 2014, 2016), which, as explained in the introduction, also potentially include effects of the prime on memory and response processes. The current b-CFS experiment reduced the influence of such memory- and response-related effects. First, the participants only localized the objects, without the need to identify the object. Second, the localization responses (top/bottom) were not associated with the primes (Black/ Asian faces). Therefore, the current results suggest that the basic perceptual processing of guns and tools is not influenced by race priming.

With a sample size of 84 participants, the evidence presented here is robust. The effect sizes of the key interaction terms that reflect race bias in the identification task for RTs ($\eta_p^2 = .30$) and accuracy ($\eta_p^2 = .18$) are in line with estimations of these effect sizes from a recent meta-analysis (Rivers, 2017), with the effect size for the RT analysis exceeding the reported estimate. At the same time, the Bayesian evidence for the absence of race bias in the b-CFS task was moderate to strong (Kass & Raftery, 1995), indicating that the current sample provides enough information to accept with relative certainty that race primes do not influence how quickly guns and tools enter awareness. Note, however, that these results are based on standard repeated-measures ANOVAs, which may inflate false-positive rates (Judd et al., 2012). Although linear mixed-effects analyses, which take into account variability within and across participants and stimuli simultaneously, yielded similar results, these had lower statistical power so that our failure to obtain b-CFS priming effects in these analyses is more likely to reflect a false negative. At the same time, however, also linear mixed-effects analyses revealed robust priming effects in the standard identification task.

The WIT represents a particularly strong paradigm within research on racial biases and reliably shows effects of race on RTs and accuracy (Kidder et al., 2018; Mekawi & Bresin, 2015; Rivers, 2017). The absence of a perceptual base of race-induced shifts in behavior in the WIT may thus have implications that reach further than just this task. Perhaps other instances of racial bias in identification tasks, for example, in emotion identification (Bijlstra et al., 2014; Hugenberg & Bodenhausen, 2003; Otten & Banaji, 2012), may similarly reflect post-perceptual factors related to memory or responding, which would argue against theories stating that social knowledge directly affects perceptual processes (Bach & Schenke, 2017; Balcetis & Cole, 2013; Freeman & Johnson, 2016; Otten et al., 2017; Xiao et al., 2016). Instead, it would suggest that top-down social knowledge can only influence the processing of these stimuli after initial perceptual processing has finished (Firestone & Scholl, 2016; Pylyshyn, 1999). Indeed, a number of b-CFS studies show that entry into awareness is not affected by social knowledge related to facial dominance and trustworthiness (Stein et al., 2018) or by affective learning about faces (Rabovsky et al., 2016; Stein et al., 2017).

Given this lack of effects of social context on b-CFS, one might conclude that perhaps the b-CFS paradigm is simply not sensitive to top-down/contextual modulation. A number of b-CFS studies showing the opposite counter this argument. A range of experiments demonstrated faster breakthrough of invisible information that is consistent with (nonsocial) primes (Costello et al., 2009; Lupyan & Ward, 2013; Stein et al., 2015), the content of working memory (Gayet et al., 2013; van Moorselaar et al., 2018), the focus of spatial and content-based attention (Pinto et al., 2015; Stein & Peelen, 2015; Zhang et al., 2012), fear conditioning (Gayet et al., 2016), or contextual information presented through other senses, such as audition, touch, and smell (Alsius & Munhall, 2013; Lunghi et al., 2017; Zhou et al., 2010). Together, this suggests that the b-CFS paradigm is suitable to study the interplay between perceptual processing and top-down/contextual effects (for reviews see Gayet et al., 2014; Stein, 2019). It thus seems unlikely that the null effect presented here reflects a lack of sensitivity of the b-CFS paradigm.

Other potential explanations for the null effect in our b-CFS experiment could be two design choices that diverge from the standard WIT. First, in our study, Black face primes were compared with Asian rather than White baseline prime faces. This was done to reduce potential differences in familiarity, which might have led to differential processing (such as an own-race bias, Stein et al., 2014) independent of the actual prime-target relationship. Second, the experiments also included randomly occurring "prime checks" to ensure that participants were paying attention to the primes. However, our results show that the these modifications did not influence the standard WIT identification task in any relevant way. We obtained clear differences between Asian and Black face primes on RT and accuracy. Moreover, shapes or colors held in working memory actually foster faster entry into awareness of objects sharing these features in b-CFS (Gayet et al., 2013; van Moorselaar et al., 2018). Therefore, instructing participants to pay attention to the face prime and to keep them in working memory, should, if anything, have amplified the priming effect in b-CFS.

The current experiment shows that although Black faces (compared with Asian faces) reduce response times to guns, and make it more likely to misidentify a gun as a tool, these effects are unlikely to be the result of prime-induced shifts in early perceptual processing of guns and tools. The presence of a Black face prime, compared with an Asian prime, did not affect entry into awareness of guns and tools. This suggests that social biases influence post-perceptual processes related to memory, interpretation, and response selection and execution, but not the early stages of visual perception.

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