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Looking the part (to me): effects of racial prototypicality on race perception vary by prejudice

Brittany S. Cassidy,[1] Gregory T. Sprout,[1] Jonathan B. Freeman,[2] and Anne C. Krendl[1]

[1]Department of Psychological and Brain Sciences, Indiana University, Bloomington, IN, USA and [2]Department of Psychology, New York University, New York, USA

Correspondence should be addressed to Brittany S. Cassidy, Department of Psychological and Brain Sciences, Indiana University, 1101 E 10th St., Bloomington, IN 47405, USA. E-mail: bscassid@indiana.edu.

Abstract

Less racially prototypic faces elicit more category competition during race categorization. Top-down factors (e.g. stereotypes), however, affect categorizations, suggesting racial prototypicality may enhance category competition in certain perceivers. Here, we examined how prejudice affects race category competition and stabilization when perceiving faces varying in racial prototypicality. Prototypically low *vs* high Black relative to White faces elicited more category competition and slower response latencies during categorization (Experiment 1), suggesting a pronounced racial prototypicality effect on minority race categorization. However, prejudice predicted the extent of category competition between prototypically low *vs* high Black faces. Suggesting more response conflict toward less prototypic Black *vs* White faces, anterior cingulate cortex activity increased toward Black *vs* White faces as they decreased in racial prototypicality, with prejudice positively predicting this difference (Experiment 2). These findings extend the literature on racial prototypicality and categorization by showing that relative prejudice tempers the extent of category competition and response conflict engaged when initially perceiving faces.

Key words: race; prejudice; categorization; anterior cingulate cortex

Humans are natural categorizers. Categorization is graded, however, in that some stimuli better represent categories than others (Rosch, 1978). While two exemplars may be similarly categorized (e.g. robins and penguins are birds), classification accuracy decreases for exemplars dissimilar (penguins) to frequently encountered exemplars (robins) (Nosofsky, 1988). These principles extend into social perception. For instance, more racial prototypicality, or how much facial characteristics resemble representations of stereotypical group members (Maddox, 2004), elicits more efficient race categorization (Freeman, *et al.*, 2010), strongly applied stereotypes (Blair, *et al.*, 2004), and negative outcomes such as harsher criminal sentencing (Eberhardt, *et al.*, 2006). Graded social categorization is not uniform across perceivers (Smith and Zarate, 1992). Because stereotypes and attitudes influence the efficiency of categorizing ambiguous exemplars (Freeman and Ambady, 2011), individual differences in prejudice may affect the perception and categorization of faces varying in racial prototypicality.

People varying in racial prejudice have similar stereotype knowledge (Devine, 1989). Higher *vs* lower prejudiced individuals, however, more strongly associate negative attributes with outgroup members (Lepore and Brown, 1997; Wittenbrink, *et al.*, 1997). More prejudiced perceivers also visualize outgroup members in a more negative and stereotypic manner (Dotsch *et al.*, 2008). Given more prototypic representations, faces deviating from expectations may elicit more conflict in higher prejudiced perceivers during categorization. Indeed, more prejudiced perceivers take longer to categorize racially ambiguous faces (Blascovich *et al.*, 1997) and rely more on prototypic cues (e.g. skin color) during categorization (Stepanova and Strube, 2012). The manner in which higher prejudice individuals categorize race is also influenced by the presence of stereotypically

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congruent facial expressions (e.g. a hostile Black face) (Hugenberg and Bodenhausen, 2004). Prejudice (e.g. Castano *et al.*, 2002) may thereby elicit inefficient categorization of less racially prototypic outgroup faces.

Category activation strength varies by exemplar typicality (Locke *et al.*, 2005). However, competition between multiple activated categories underlies categorization (Freeman *et al.*, 2008; Freeman and Johnson, 2016). Rather than weakly activating a single category, less racially prototypic faces trigger multiple categories (e.g. Black and White) gradually stabilizing into judgments (Freeman *et al.*, 2010) and underlying less efficient categorization (e.g. Blair *et al.*, 2002). Highly prejudiced individuals have more prototypic expectations of outgroup faces (Dotsch *et al.*, 2008). Outgroup faces that are less racially prototypic may counter their rigid expectations and elicit more category competition. Indeed, higher prejudiced perceivers are biased toward categorizing Black and White faces by expression in a prototype-consistent way (e.g. Black faces are angry) before stabilization (e.g. the Black face is happy) (Hehman *et al.*, 2014).

We predict that perceivers will have more flexible cognitive representations of racial ingroup members (given more complex knowledge structures of ingroups; Linville and Jones, 1980; Linville, 1982; Park and Judd, 1990), and more rigid representations of outgroup members (whom they view more homogenously; Linville *et al.*, 1989). Less racially prototypic *ingroup* faces should thereby be less prone to category competition given more flexible expectations, whereas less prototypic *outgroup* faces may exacerbate competition because they may counter a more homogeneous template for a target. These effects will likely be pronounced in higher prejudice individuals because prejudice begets inefficient categorization (Blascovich *et al.*, 1997) and heightens prototypic outgroup representations (Dotsch *et al.*, 2008).

One reason for more category competition toward less *vs* more racially prototypic outgroup with increased prejudice is the triggering of response conflict during categorization (Bartholow, 2010). Anterior cingulate cortex (ACC), a brain region implicated in response conflict, engages as race and emotion become less consistent with expectations (Hehman *et al.*, 2014), suggesting its sensitivity toward faces not easily fitting a category. ACC activation reflects conflict monitoring (MacDonald *et al.*, 2000; Botvinick *et al.*, 2001; Pochon *et al.*, 2008) and sensitivity to simultaneously active yet incompatible response tendencies (van Veen and Carter, 2002). Increased prejudice predicts ACC engagement when perceiving Black *vs* White faces (Richeson *et al.*, 2003), potentially reflecting conflict. ACC may be most responsive to less racially prototypic Black faces if they yield the most competition during categorization. If prejudice underlies category competition toward less *vs* more prototypic Black faces as anticipated, prejudice may also elicit greater ACC response toward Black *vs* White faces decreasing in prototypicality.

We examined racial prototypicality effects from the lens of prejudice. First, we tested for more category competition for less *vs* more prototypic Black faces relative to White faces, and if prejudice intensified this pattern in Black faces. Second, we tested if more ACC activity emerged toward prototypically decreasing Black *vs* White faces, and if prejudice intensified this pattern.

Experiment 1

Decreasing racial prototypicality elicits category competition (Freeman *et al.*, 2010). We sought to replicate and extend this finding in two ways. Given more stereotypically homogeneous expectations of outgroup *vs* ingroup faces (Linville *et al.*, 1989), we expected more category competition for prototypically low *vs* high Black relative to White faces. Because prejudice engenders more stereotypic outgroup representations (Lepore and Brown, 1997) influencing categorization (Hehman *et al.*, 2014), we expected prejudice to underlie competition for prototypically low *vs* high Black faces.

Method

Participants. 194 White right-handed adults (M_{age}=37.43, SD=11.37, 109 female) recruited from Amazon Mechanical Turk each provided informed consent and were compensated \$.50. Power analyses (G*Power; Faul *et al.*, 2007) using f^2=.15 and alpha=.05 targeted an N of 119 for 95% power. The Indiana University IRB approved all studies.

Stimuli. Forty Black and 40 White young neutrally expressive male faces were drawn from the Eberhardt Face Database (http://www.stanford.edu/group/mcslab/cgi-bin/wordpress/examine-the-research/). This database contains ratings for stimulus selection. We used the ratings of 19 individuals who rated Black faces and 19 who rated White (e.g., "How stereotypically Black does this person look?"; 1 = not at all stereotypically Black to 7 = extremely stereotypically Black) to select 20 prototypically high and 20 low faces of each race. A 2 (Race: Black, White) x 2 (Prototypicality: low, high) ANOVA on ratings revealed a Prototypicality effect, F(1,76)=661.36, p<.001, η_p^2=.90. Prototypically low faces (M = 3.22, SD=.49) were less prototypic than prototypically high faces (M = 5.38, SD = .20). There were no other significant prototypicality effects, ps>.17, and no attractiveness effects, ps>.16.

Procedure. Participants categorized faces as Black or White in a mouse-tracking paradigm used to measure category competition (e.g., Freeman *et al.*, 2010). On each trial, participants clicked a "start" button at the bottom-center of the screen and a face would appear in its place. Participants categorized faces by clicking the "White" or "Black" category labels in the top-left or top-right corners of the screen, for 80 trials. Category label placement was counterbalanced across participants, with faces randomly presented. Like prior work (Freeman and Ambady, 2009), a message encouraging quicker categorization would appear for movements not initiated within 400ms. Participants completed eight practice trials where they categorized four Black and four White female faces. During categorization, we recorded the x and y coordinates of mouse movements (sampling rate = 70hz). The MouseTracker software package (Freeman and Ambady, 2010) recorded and analyzed trajectory data based of these coordinates.

After the task, participants completed the Attitudes Toward Blacks scale (ATB; Brigham, 1993), which measures explicit attitudes toward Black individuals (higher scores indicate increased explicit prejudice) and the Internal (IMS) and External (EMS) Motivation to Respond Without Prejudice questionnaire (Plant and Devine, 1998), which assesses how motivated people are by internal and external, respectively, sources to appear non-prejudiced (higher scores indicate increased motivation). We chose an explicit prejudice measure because related work (Blascovich *et al.*, 1997; Hehman *et al.*, 2014) assessed prejudice effects on categorization using measures like ATB. We included IMS and EMS given their connection to controlled processing (e.g., Amodio *et al.*, 2003). See Table 1 for scores and correlations.

Table 1. Behavioral data summary (*M*, *SD*)

	Experiment 1	Experiment 2
ATB	52.36 (23.09)	43.52 (12.15)
IMS	33.88 (7.42)	38.28 (6.10)
EMS	25.15 (8.68)	29.66 (9.94)
ATB-IMS *r*	–0.74**	–0.72**
ATB-EMS *r*	0.17*	0.27
IMS-EMS *r*	–0.02	–0.08

*P < 0.05;
**P < 0.001; ATB, Attitudes Toward Blacks; IMS, Internal Motivation to Respond Without Prejudice; EMS, External Motivation to Respond Without Prejudice.

Mouse trajectory preprocessing. For each trial, MouseTracker software (Freeman and Ambady, 2010) computed area under the curve (AUC), defined as the area between each observed trajectory and a straight-line trajectory drawn from the start and end points (for details, see Freeman and Ambady, 2010). Trajectories were remapped rightward for comparison. Trials with initiation times over 400ms and response times (RTs) over 2000ms were excluded, removing 7.73% of trials. Larger AUCs reflect greater attraction to opposite race categories during categorization, suggesting multiple category activation.

Results

Multiple category activation. We entered AUCs into a 2 (Race: Black, White) x 2 (Prototypicality: low, high) ANOVA (Figure 1). A Prototypicality effect emerged, $F(1,193)=101.67$, $p<.001$, $\eta_p{}^2=.35$. AUCs were larger for prototypically low ($M=.89$, $SD=.32$) *vs* high ($M=.71$, $SD=.36$) faces, indicating more category competition for less prototypic faces. The expected Race x Prototypicality interaction emerged, $F(1,193)=28.39$, $p<.001$, $\eta_p{}^2=.13$. AUCs were larger for prototypically low ($M=.81$, $SD=.46$) *vs* high ($M=.73$, $SD=.43$) White faces, $F(1,193)=12.71$, $p<.001$, $\eta_p{}^2=.06$. This was pronounced among prototypically low ($M=.97$, $SD=.51$) *vs* high ($M=.69$, $SD=.42$) Black faces, $F(1,193) = 101.53$, $p< .001$, $\eta_p{}^2=.35$. No Race effect emerged, $p=.14$.

Prejudice and multiple category activation. We used hierarchical linear regression to assess if prejudice affects category competition (AUC) for prototypically low *vs* high Black faces (See Table 2 for statistics). We first included IMS and EMS in the model, which was non-significant, $F(2,191)=1.26$, $p=.29$. We next entered ATB into the model. This model was significant, $F(3,190)=2.70$, $p=.047$, accounting for more variance over the first model (R^2change=.03). As predicted, prejudice positively predicted AUC differences for prototypically low *vs* high Black faces (i.e., category competition). EMS negatively predicted AUC differences for prototypically low *vs* high Black faces, whereas IMS marginally and positively predicted differences. Alone, ATB ($r(192)=.08$, $p=.25$), IMS ($r(192)=.01$, $p=.89$), and EMS ($r(192)=-.11$, $p=.11$) did not correlate with category competition. There was thus no apparent direct effect of prejudice on AUC differences. However, when accounting for variance explained by IMS and EMS in a regression, ATB did predict AUC differences. To demonstrate the overlap between IMS, EMS, and ATB, we conducted a regression in which we predicted ATB from IMS and EMS. As expected, the model was significant, ($F(2,191)=130.33$, $p<.001$, $R^2=.57$), and showed that IMS ($\beta=-.74$, $t=15.72$, $p<.001$) negatively predicted and EMS ($\beta=.16$, $t=3.32$, $p=.001$) positively predicted ATB. Importantly, 43% of the variance in ATB was unexplained by IMS and EMS, which suggests that although ATB, IMS, and EMS measure overlapping constructs, ATB measures additional aspects of prejudice that uniquely predict AUC differences. Examining AUC differences between prototypically low *vs* high White faces yielded no positive ATB effect, and no IMS or EMS effects (see Supplemental Materials).

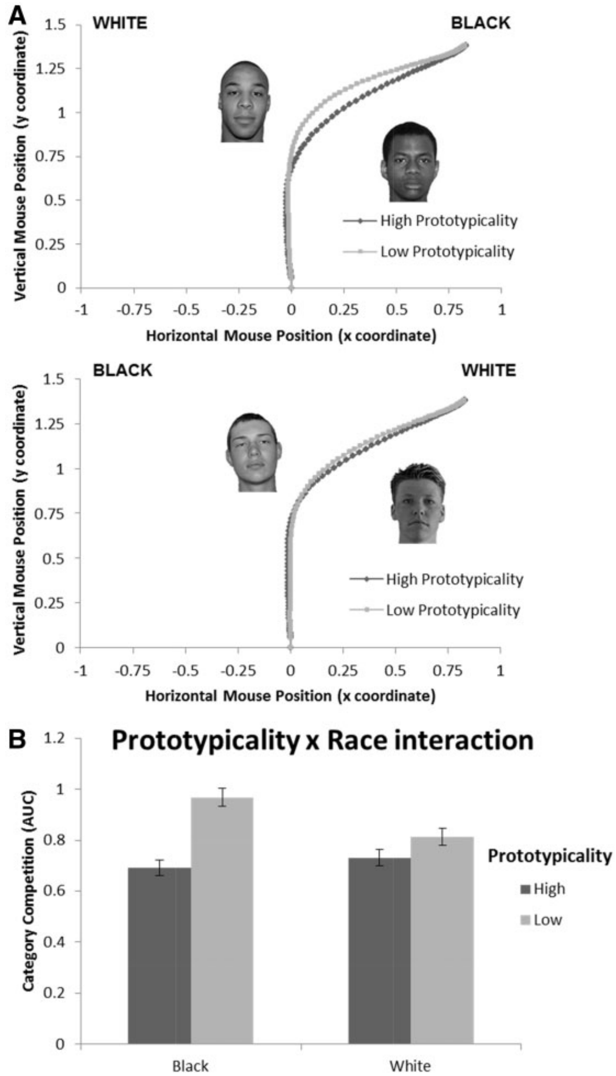

Fig. 1. Motor trajectories (A) revealed more pronounced category competition for prototypically low *vs* high Black relative to White faces (B).

Table 2. Summary of regression predicting category competition (AUC) for low vs high prototypicality Black faces

Variable	ß (standardized)	t	R	R^2
Step 1			0.11	0.01
IMS	0.008	0.11		
EMS	–0.11	–1.59		
Step 2			0.20	0.04
IMS	0.20	1.84+		
EMS	–0.15	2.11*		
ATB	0.26	2.35*		

+P<0.10;
*P < 0.05; ATB, Attitudes Toward Blacks; IMS, Internal Motivation to Respond Without Prejudice; EMS, External Motivation to Respond Without Prejudice.

Reaction time. Category competition may reflect response conflict with less prototypicality. Given that slower RTs reflect more conflict (e.g., Stroop, 1935), we entered categorization RTs (ms) into a 2 (Race: Black, White) x 2 (Prototypicality: low, high) ANOVA. A Prototypicality effect emerged, $F(1,193)=183.50$, $p<.001$, $\eta_p^2=.49$. RTs were slower for prototypically low ($M=982.68$, $SD=161.44$) *vs* high ($M=917.65$, $SD=159.29$) faces. RTs were marginally slower for Black ($M=956.61$, $SD=172.95$) *vs* White ($M=943.72$, $SD=155.30$) faces, $F(1,193)=3.34$ $p=.07$, $\eta_p^2=.02$. A Race x Prototypicality interaction emerged, $F(1,193)=43.97$, $p<.001$, $\eta_p^2=.19$. RTs were slower for prototypically low ($M=960.17$, $SD=166.22$) *vs* high ($M=927.27$, $SD=151.48$) White faces, $F(1,193)=44.92$, $p<.001$, $\eta_p^2=.19$. This was pronounced for prototypically low ($M=1005.19$, $SD=185.09$) *vs* high ($M=908.02$, $SD=179.59$) Black faces, $F(1,193)=136.87$ $p<.001$, $\eta_p^2=.42$.

RT and multiple category activation. To show that slower RTs, potentially reflecting conflict, corresponded with category competition, we correlated RT and AUC differences between prototypically low *vs* high faces Larger AUC differences corresponded with larger RT differences, $r(192)=.33$, $p<.001$.

Discussion

Replicating prior work (e.g., Freeman *et al.*, 2010), more category competition emerged when categorizing prototypically low *vs* high Black and White faces by race. Extending this work, an intensified pattern emerged among Black faces. Prejudice exacerbated this pattern. With less complex knowledge structures of outgroup *vs* ingroup members (e.g., Park and Judd, 1990), people have more rigid and homogeneous conceptions of outgroup members (Linville *et al.*, 1989). Consistent with work showing that prejudice increases the difficulty of categorizing faces countering race-based expectations (e.g., Blascovich *et al.*, 1997; Hehman *et al.*, 2014), prejudice positively correlated with category competition among prototypically low *vs* high Black faces. Although IMS marginally also predicted this difference in our second model (as might be expected, see Chen *et al.*, 2014), this relationship only emerged when including ATB. This suggests a critical role of explicit prejudice in predicting category competition for prototypically varying Black faces. However, ATB only predicted category competition when accounting for variance explained by IMS and EMS. This is a critical consideration because ATB, IMS, and EMS are overlapping constructs representing separable aspects of prejudice. Indeed, our finding that IMS was marginally related to category competition suggests motivation may play at least a marginal role in category competition when considered separately from explicit prejudice. Future work may focus on disentangling the unique roles of IMS and EMS in this effect.

Because retrieved exemplars on which to base categorization are group-typical (Rothbart *et al.*, 1996), it may be more difficult to categorize faces for which retrieved exemplars are less prototypically diverse. The enhanced pattern in prototypically varying Black and White faces suggests more category competition with more rigid conceptions of group members. Supporting the possibility of more conflict and complementing work showing that decreased racial prototypicality reduces category accessibility (Blair *et al.*, 2002), categorization RTs mirrored the motor trajectory pattern.

Experiment 2

Experiment 1 suggests that more category competition for less racially prototypic Black and White faces may trigger response conflict. Because prejudice enhances category competition for less *vs* more prototypic Black faces, prejudice may also enhance response conflict toward Black faces. Experiment 2 examined a potential response conflict mechanism's engagement when perceiving less prototypic Black *vs* White faces and if engagement varies by prejudice. With well-characterized correlates of response conflict and race perception, fMRI can elucidate potential mechanisms operating when perceiving prototypically varying Black and White faces. While we were interested in broadly identifying brain regions responsive to less racially prototypic Black *vs* White faces, we were specifically interested in ACC given its role in response conflict (Botvinick *et al.*, 2001; Pochon *et al.*, 2008). We expected ACC responses toward prototypically decreasing Black *vs* White faces that would be exacerbated by increased prejudice.

Method

Participants. Thirty right-handed White adults ($M_{age}=21.27$, $SD=2.38$; 17 female) from Indiana University participated and provided informed consent. This sample size was derived on the basis of past neuroimaging studies on race perception (see Amodio, 2014). Participation was completed over pre-testing and scanning days approximately one week apart (see Cassidy and Krendl, 2016).

Procedure. In pre-testing, participants completed a screening questionnaire, measures related to race perception, and unrelated tasks. Relevant here, participants completed the ATB and IMS/EMS scales (Table 1). We were unable to obtain questionnaire data from one participant, who was included in whole-brain analyses. Participants then completed the described fMRI study and an unrelated study. Study order was counterbalanced across participants.

fMRI stimuli. Ninety Black and 90 White male faces were drawn from the Eberhardt Face Database. The Black ($M=4.81$, $SD=1.01$; range $=$ 2.00-6.11) and White ($M=4.34$, $SD=1.05$; range $=$ 2.05-6.11) faces were prototypically varied. Levene's test for homogeneity of variances was non-significant, $F(1,178)=.87$, $p=.35$. Similar variance among the Black and White faces suggests neural activation differences based on these values would not emerge via differences in stimulus variability. Because the Black faces were more racially prototypic than White faces, $t(178)=3.05$, $p=.003$, we used z-scored prototypicality ratings in parametric modulation analyses to control for potential effects of this difference. The Black and White were similarly attractive, $p=.76$.

fMRI task. The task was modeled as an event-related design over two runs lasting 3 min (90 TRs) each. Participants viewed randomly presented images (45 Black and 45 White faces in each run, as well as 15 instances of a black and white checkered visual noise image) for 1 sec each. The noise image was included for the option of comparing face-related activity to non-face visual activity, but was not relevant here. In each trial, participants categorized faces as younger or older than 24 years old. These categorizations identified regions engaged when participants made non-race evaluations about Black and White faces. Participants were unaware of our interest in assessing responses to faces varying in racial prototypicality. People naturally categorize race (Macrae and Bodenhausen, 2001), and the fMRI literature uses similar judgments in race perception tasks (e.g., Hart et al., 2000; Richeson et al., 2003; Cunningham et al., 2004) so that participants evaluate faces without explicitly thinking about race. Assessing age is one such task (e.g., Wheeler and Fiske, 2005; Ronquillo et al., 2007). With a task necessitating attention to faces, but not race, we can isolate naturally occurring neural activity varying by racial prototypicality.

Periods of jitter, indicated by a fixation cross at the center of the display, ranged from 1 to 7 s and were pseudorandomly presented. There were five one-second fixations, six three-second fixations, four five-second fixations and two-seven second fixations in each run ($M_{jitter} = 3.35$ s; $SD = 2.03$), with 8 s of fixation at the beginning and 10 s at the end, for 75 s of fixation and 105 s of stimuli in each run. A random number generator determined the stimulus and fixation order. No faces of the same race appeared more than three consecutive times. Four initial dummy scans allowed for scanner signal stabilization and were not analyzed.

Suggesting attention to the task, participants had an average response rate of 95.35% ($SD = 4.62\%$). Participants responded that a face was younger than 24 an average of 93.27 times ($SD = 21.08$) and 78.37 times ($SD = 20.45$) that a face was older than 24. Before scanning, participants practiced making age categorizations of five Black and five White female faces.

Data acquisition and analysis. Whole-brain imaging was performed on a Siemens 3.0T TIM Trio MRI scanner at the Indiana University Imaging Research Facility. Anatomical images were acquired with a high-resolution 3-D magnetization prepared rapid gradient echo sequence (224 slices, TE = 3.02 ms, TR = 2200 ms, flip angle = 9°, .8x.8x.8 mm voxels). Functional images were collected over two runs of 90 timepoints each, using a fast field echo-planar sequence sensitive to blood oxygen level dependent contrast (T2*; 32 slices with 3.5 mm thickness and 3.5 mm skip, TR = 2000 ms, TE = 30 ms, flip angle = 70°).

Preprocessing and analyses of functional data were conducted in SPM8 (Wellcome Trust Centre for Neuroimaging, London, UK). Images were slice-time corrected, realigned to correct for motion, normalized to the MNI (Montreal Neurological Institute) template and smoothed using an 8 mm FWHM isotropic Gaussian kernel. Data were resampled to 3 mm-isotropic voxels in a 96 x 96 matrix. Using custom artifact detection software to detect motion artifact (http://www.nitrc.org/projects/artifact_detect), runs were analyzed on a participant-by-participant basis to detect outlier time points. We excluded volumes during which head motion exceeded 1 mm and volumes in which the overall signal for that time point fell three standard deviations outside the mean global signal for the entire run. Outlier time points were excluded from GLM analyses via the use of participant-specific regressors of no interest.

We created two GLM models for each participant that incorporated either the White or Black face condition and the z-scored racial prototypicality ratings as a parametric modulator, as well as covariates of no interest (a session mean, a linear trend, and six movement parameters derived from realignment corrections) to compute parameter estimates (β) and t-contrast images (containing weighted parameter estimates) for comparison at each voxel. We modeled event duration as 1s to account for the entire stimulus presentation.

To elucidate neural responses to prototypically decreasing Black and White faces, we created first-level contrasts [Decreasing prototypicality: Black] and [Decreasing prototypicality: White]. These contrasts reflect areas of linearly increasing neural response to Black and White faces, respectively, as they linearly decreased in racial prototypicality. First-level [Decreasing prototypicality: Black] and [Decreasing prototypicality: White] images were submitted to second-level paired-sample *t*-tests. The contrast [Decreasing prototypicality: Black > Decreasing prototypicality: White] revealed increasing responses to decreasing racial prototypicality heightened for Black *vs* White faces. The contrast [Decreasing prototypicality: White > Decreasing prototypicality: Black] revealed responses to decreasing prototypicality greater for White *vs* Black faces.

Peak coordinates were identified by an extent threshold of 15 contiguous voxels (re-sampled) exceeding a voxel-wise threshold of $P < 0.005$. One-thousand Monte Carlo simulations indicated this provided a corrected experiment-wise threshold of $P < 0.05$ (for details, see Slotnick *et al.*, 2003). We identified the anatomical location and Brodmann area of emergent regions using the AAL atlas (Tzourio-Mazoyer *et al.*, 2002) within MRIcron (Rorden and Brett, 2000).

To assess the role of prejudice in ACC response to prototypically decreasing Black *vs* White faces, we conducted an independently defined ACC region of interest (ROI) analysis based on reverse inference Neurosynth (Yarkoni *et al.*, 2011) meta-analysis (search term: conflict; peak MNI coordinates: –8, 16, 37). We averaged parameter estimates from an 8 mm sphere surrounding these coordinates and correlated extracted estimates with questionnaire scores. This represents an unbiased method to localize a brain region associated with response conflict in the literature, even though response conflict was not explicitly manipulated in our task.

Results

Whole-brain analysis. We assessed regions responsive to the decreasing prototypicality of Black *vs* White faces using the contrast [Decreasing prototypicality: Black > Decreasing prototypicality: White] (Table 3A). This contrast revealed predicted ACC engagement as well as ventrolateral prefrontal and middle frontal gyrus activity (Figure 2A). These areas activated more for prototypically decreasing Black *vs* White faces. [Decreasing prototypicality: White > Decreasing prototypicality: Black] revealed postcentral gyrus, orbitofrontal gyrus and primary visual cortex activity (Table 3B). These regions activated more for prototypically decreasing White *vs* Black faces.

Prejudice and ACC response to prototypically decreasing black* vs *white faces. Prejudice elicits more category competition for less *vs* more prototypic Black faces (Experiment 1). Because people engage response conflict to resolve inconsistency during categorization (Bartholow and Dickter, 2008) and ACC to resolve conflict (Carter *et al.*, 1999), more prejudice may beget ACC activity while perceiving prototypically decreasing Black *vs* White faces. We correlated parameter estimates from the [Decreasing prototypicality: Black > Decreasing prototypicality: White] contrast for each participant extracted from a conflict-responsive ACC seed (see above) with questionnaire scores. Higher prejudice (ATB) corresponded with more ACC response for prototypically decreasing Black over White faces, $r(27) = 0.43$, $P = 0.02$ (Figure 2B). IMS ($r(27) = -0.31$, $P = 0.10$) and EMS ($r(27) = 0.04$, $P = 0.82$) were non-significantly correlated with ACC activity.

Prototypicality and categorization reaction time. Although participants categorized age, we tested if less prototypicality corresponded with slower RTs, reflecting conflict. We averaged RTs to

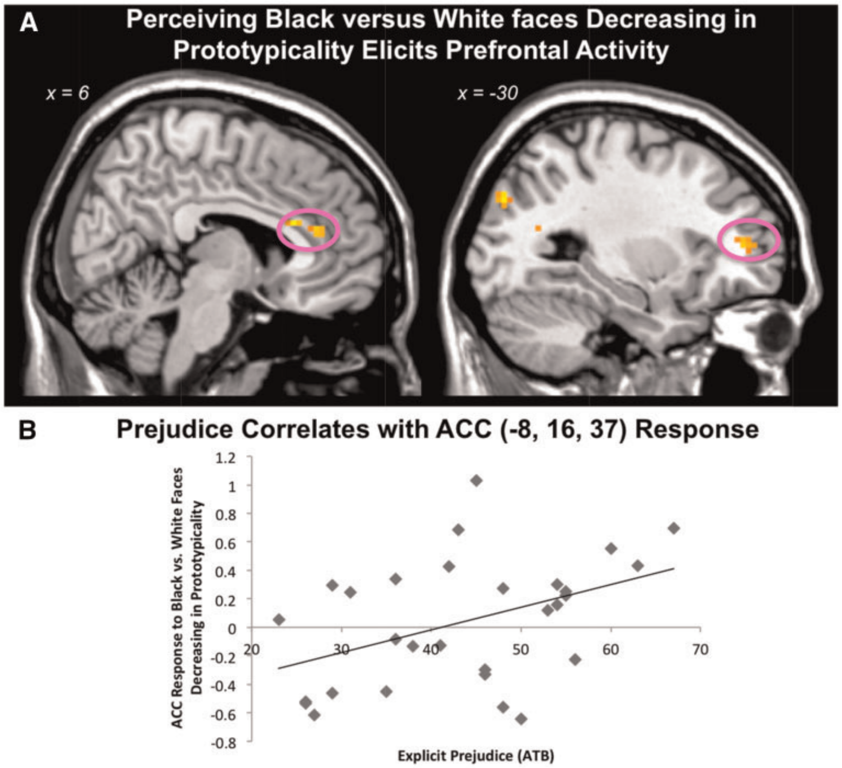

Fig. 2. Perceiving the decreasing prototypicality of Black *vs* White elicited activation in prefrontal regions (A), including ACC (left) and ventrolateral prefrontal cortex (right). Explicit prejudice corresponded with increased ACC response to the decreasing prototypicality of Black *vs* White faces (B).

each face across participants and correlated these averages with the prototypicality ratings used in the parametric modulation analyses. Less prototypicality related to slower RTs, $r(178) = -0.15$, $P = 0.04$.

Discussion

Experiment 2 revealed more activation in ACC, a region involved in response conflict broadly (Botvinick *et al.*, 2001; Pochon *et al.*, 2008) and in race perception (Amodio *et al.*, 2004; Amodio *et al.*, 2008) toward prototypically decreasing Black *vs* White faces. Complementing the relationship between prejudice and category competition in Experiment 1, increased prejudice exacerbated this pattern. This analysis was based on an ACC region defined by conflict (Yarkoni *et al.*, 2011) and comparable to regions found in related race perception tasks (e.g. Cunningham *et al.*, 2004). With more stereotypic visualizations (Dotsch *et al.*, 2008) and less efficient categorization given countered race-based expectations (Blascovich *et al.*, 1997; Hehman *et al.*, 2014), prototypically decreasing Black *vs* White faces may be particularly expectation-inconsistent for higher prejudice perceivers, triggering enhanced response conflict via ACC activation. This ACC pattern suggests response conflict potentially activating without explicit race categorization, providing nuance to our understanding of how the brain dynamically perceives race.

General discussion

While showing that lower racial prototypicality enhances category competition for Black relative to White faces both at the behavioral (Experiment 1) and neural (Experiment 2) levels, we reveal that increased explicit prejudice exacerbates these effects. Prejudice affects a dynamic model of categorization (Freeman *et al.*, 2010), informing how racial biases affect initial of social perception with myriad potential behavioral consequences (e.g. Blair *et al.*, 2002; Eberhardt *et al.*, 2006).

Reflecting work showing that White perceivers rate Black faces more homogeneously than White faces (Cassidy and Krendl, 2016), our results suggest that people perceive less racially prototypical outgroup faces more homogeneously than they do ingroup faces. Lower racial outgroup prototypically may engender more category competition and conflict than more flexibly represented ingroup faces because representations of outgroup *vs* ingroup members are less complex (Linville and Jones, 1980; Linville, 1982; Park and Judd, 1990). Although lower prototypicality pronounced category competition for Black over White faces overall, increased prejudice exacerbated competition for prototypically low *vs* high Black faces, extending work on how prejudice affects the perception of race-ambiguous cues. More prejudiced individuals more readily perceive race cues consistent with their expectations (Hugenberg and Bodenhausen, 2004), exhibiting attraction toward categorizing cues in a prototype-consistent manner (e.g. the Black faces is angry, not happy) (Hehman *et al.*, 2014). Beyond expression-based expectations, neutrally expressive outgroup faces elicit more category competition (Experiment 1) and response conflict (Experiment 2) with racial prototypicality.

More prejudiced perceivers have more stereotypic visualizations of how they expect outgroup faces to appear (Dotsch *et al.*, 2008), suggesting these typify exemplars ‘coming to mind’ when presented with category labels (Rothbart *et al.*, 1996). Given more prototypic expectations of racial outgroup faces, more category competition may be expected for more prejudiced

Table 3. Increased neural responses to racial prototypicality varying by race

Region	BA	*k*	*t*	MNI coordinates
A. Decreasing prototypicality: Black > Decreasing prototypicality: White				
Frontal lobe				
R anterior cingulate gyrus	24	15	3.77	6, 24, 21
R middle frontal gyrus	45	22	3.53	36, 45, 21
R anterior cingulate gyrus	24	19	3.42	6, 36, 18
L ventrolateral prefrontal cortex	47	26	3.39	−30, 45, 9
L ventrolateral prefrontal cortex	45	16	3.34	−60, 24, 12
Temporal lobe				
R temporoparietal junction	39	26	3.32	42, −60, 21
Parietal lobe				
L inferior parietal gyrus	40	43	4.39	−60, −36, 48
R precuneus/superior occipital gyrus	7/19/23	26	3.59	21, −66, 33
Occipital lobe				
L middle occipital gyrus	19/18/39	124	3.93	−36, −78, 33
B. Decreasing prototypicality: White > Decreasing prototypicality: Black				
Frontal lobe				
L orbitofrontal gyrus	11	28	3.82	−15, 60, −6
Parietal lobe				
L postcentral gyrus	3	45	4.39	−24, −27, 45
Occipital lobe				
R primary visual cortex	17	31	3.37	21, −102, 0
C. Decreasing prototypicality: Black				
Temporal lobe				
L middle temporal gyrus	21	25	4.78	−69, −6, −9
R middle temporal gyrus	19/37	47	3.38	42, −69, 0
Occipital lobe				
L middle occipital gyrus	19	74	3.79	−36, −78, 30
D. Decreasing prototypicality: White				
Frontal lobe				
L precentral gyrus	4	30	3.72	−39, −21, 66
Temporal lobe				
R fusiform gyrus	37	63	4.40	39, −51, −15
L fusiform gyrus	37	20	3.82	−42, −48, −24
Parietal lobe				
R postcentral gyrus	3	41	4.41	63, −9, 45
L postcentral gyrus	4	23	3.48	−54, −12, 45
Occipital lobe				
L inferior occipital gyrus	19	270	4.90	−42, −78, −9
R inferior occipital gyrus	19	178	4.11	42, −75, −6

individuals, consistent with Experiment 1 and suggesting less efficient categorization of prototypically low outgroup member faces. More heterogeneously perceived White faces, (Linville *et al.*, 1989), may not beget similar inefficiency. Higher prejudice individuals may have less efficient outgroup categorization when targets counter a more rigid template, thereby eliciting more category competition.

Categorization becomes more difficult in the presence of category-inconsistent information (Livingston and Brewer, 2002; Richeson and Trawalter, 2005). Response conflict engages in these instances to make accurate categorizations (Bartholow and Dickter, 2008; Bartholow, 2010). Consistent with this work and complementing Experiment 1, perceivers broadly activated ACC more toward prototypically decreasing Black *vs* White faces. These findings emerged without explicitly categorizing race, consistent with work showing ACC activity toward Black *vs* White faces while merely perceiving them (Richeson *et al.*, 2003; Cunningham *et al.*, 2004). Slower RTs for age categorizations of prototypically decreasing Black and White faces also emerged in Experiment 2, supporting the possibility of more response conflict when categorizing faces less prototypically representative of a group.

Higher prejudice elicited more category competition for less *vs* more prototypic Black, but not White, faces in Experiment 1. In complement, higher prejudice elicited more ACC activity toward prototypically decreasing Black *vs* White faces in Experiment 2. For more prejudiced perceivers with more prototypic conceptions of outgroup faces (Dotsch *et al.*, 2008; Stepanova and Strube, 2012), merely perceiving faces countering expectations may trigger conflict-related ACC activity. Indeed, increased prejudice enhances ACC responses to Black *vs* White faces during perception (Richeson *et al.*, 2003), exacerbates unstable perceptual experiences (Freeman *et al.*, 2016) and reduces fluid face processing (Lick and Johnson, 2013). Notably, participants did not explicitly categorize race in Experiment 2, instead categorizing faces by age. Because people do not typically evaluate race explicitly in everyday life, our task captured naturally occurring ACC activity toward prototypically varying Black *vs* White faces. However, making race-based evaluations may change neural activity toward faces, potentially enhancing an effect of IMS (*vs* prejudice) on ACC activity (e.g., Amodio *et al.*, 2004). Future work using race-based evaluations should examine this possibility. Future work may also examine how implicit prejudice affects response conflict and category competition given that implicit prejudice can affect categorization (Hugenberg and Bodenhausen, 2004) and because implicit and explicit attitudes do not always align (Dovidio *et al.*, 2002).

Although we did not measure behavioral response conflict in Experiment 2, Experiment 1 suggests that less prototypic Black *vs* White faces elicit more competition. ACC has been well-characterized in race perception (Amodio, 2014) and response conflict (Botvinick *et al.*, 2001; Kerns *et al.*, 2004; Carter and van Veen, 2007; Pochon *et al.*, 2008). However, ACC response is implicated in other processes. Supporting our interpretation, race-stereotypic inconsistency created by varying the expression of Black and White faces elicits ACC engagement (Hehman *et al.*, 2014). ACC may be sensitive to conflict between a category (e.g. Black) and associated stereotypes (e.g. the extent of prototypic facial features). That prejudice exacerbates ACC activation toward prototypically decreasing Black *vs* White faces fits with work showing that higher prejudiced individuals more strongly associate negative stereotypic attributes with outgroup category labels (Lepore and Brown, 1997; Wittenbrink *et al.*, 1997). For these individuals, conflict may be enhanced through ACC activation because facial features counter their more stereotypic representations of Black faces.

Although ACC activity for prototypically decreasing Black over White faces is consistent with response conflict associated with category competition, category competition may stem more broadly from cognitive control processes (i.e. general processes allowing for adaptive behaviors to facilitate goals; MacDonald *et al.*, 2000). This possibility is supported by more ACC and ventrolateral prefrontal activity toward less prototypic Black *vs* White faces. Indeed, people broadly engage prefrontal regions associated with control when perceiving expectation-violating individuals (Cloutier *et al.*, 2011). Beyond response conflict (Bartholow and Dickter, 2008), widespread prefrontal activity may emerge upon perceiving less prototypic Black *vs* White faces. Future work explicitly manipulating control can disentangle the nature of these activations. Moreover, prototypically decreasing Black *vs* White faces elicited middle occipital gyrus activity. The occipital face area localizes to middle occipital gyrus (Schiltz and Rossion, 2006), with activation representing initial face perception (Pitcher *et al.*, 2011). Speculatively, more activation toward prototypically decreasing Black faces may suggest that these faces require additional resources in the initial stages of perception, although future research should more directly examine this possibility.

It might seem plausible that lower prejudice perceivers would have more category competition toward less prototypic Black faces as a means to reduce prejudice. Indeed, higher IMS perceivers (who often have lower explicit prejudice; Table 1) more likely categorize racially ambiguous faces as multiracial, *vs* using mono-racial categorization (Chen *et al.*, 2014). Although explicit prejudice corresponded with category competition and ACC activity in the current research, IMS, which is associated with controlling race-biased responses (Amodio *et al.*, 2003), marginally corresponded with category competition, but not ACC activity. Potentially explaining these marginal effects, IMS may better influence categorization with the option to adopt a novel racial category, or may more weakly affect mono-racial categorization than prejudice. Speculatively, lower prejudice individuals may rather have more flexible representations of Black faces, more easily categorizing them. Although work on ACC and race has connected IMS to ACC activity reflecting stereotype inhibition (Amodio *et al.*, 2008), we reveal prejudice-related ACC activity when perceiving (and ostensibly categorizing) faces varying in racial prototypicality, suggesting a multifaceted role of ACC in race perception.

Notably, prejudice involves several social constructs including its explicit expression (ATB) and motivation to control it (IMS/EMS). While these constructs are certainly related (Plant and Devine, 1998), we find that they do not have a one-to-one mapping. ATB may therefore capture unique aspects of prejudice that contribute to category competition and potentially response conflict. For instance, whereas ATB measures explicit racial attitudes self-reported by individuals that impact perceptions of their own behavior (Dovidio *et al.*, 2002), IMS and EMS measure the roles of internal and external motivation in regulating biased responding (Plant and Devine, 1998). Although correlated, high IMS individuals may not always express less explicit prejudice; their expression of prejudice also depends on other factors (Devine *et al.*, 2002). The present work had an a priori focus on explicit prejudice and provides initial evidence for its influence on race categorization and response conflict. However, it will be important for future work to disentangle the processes underlying contributions of separable aspects of prejudice to more fully understand their effects on race perception. Using the present work as a basis, future research must make direct connections between prejudice, mental representations of outgroup members, elicited stereotypes, and processes related to category competition.

Prototypically low Black individuals do not face the harsh consequences of categorization to the same extent as more prototypic individuals (e.g. Blair *et al.*, 2004). Notably, disfluent processing underlies negative evaluations of outgroup members (Lick and Johnson, 2015). That increased prejudice elicits less trust perceived in Black outgroup faces (Stanley *et al.*, 2011) suggests that harsher and unfair behaviors regardless of racial prototypicality and stemming from prejudice may link to more category competition during perception. It will be critical for future work to explore this possibility in order to more comprehensively understand how prejudice translates into behavior.

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Supplementary data

Supplementary data are available at *SCAN* online.

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