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Racial Identification Modulates Default Network Activity for Same and Other Races

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Abstract: Racial identification shapes self-concept and how people share in and respond to the emotional states of others around them. Prior neuroimaging studies have demonstrated the role of the neural default network in self-referential and empathic processing. However, how racial identification affects neural processing of social information remains unknown. Here, we examined the effect of racial identification on neural response related to social perception among African American and Caucasian American individuals using functional magnetic resonance imaging. Our results demonstrate that degree of racial identification predicts activity within cortical midline structures of the default network in response to viewing racial ingroup, relative to outgroup members, and activity within the medial temporal lobe subsystem of the default network in response to viewing racial outgroup, relative to ingroup members. Broadly, our findings suggest that the strength of racial identification is associated with differential recruitment of neural and cognitive processes to understand and respond to other people within and outside of one's racial group. *Hum Brain Mapp 33:1883–1893, 2012.*

Key words: racial identity; race; default network; fMRI; medial prefrontal cortex; cortical midline structures

One ever feels his twoness-an American, a Negro; two souls, two thoughts, two unreconciled strivings; two warring ideals in one dark body, whose dogged strength alone keeps it from being torn asunder. - DuBois (1903)

INTRODUCTION

In his novel, *The Souls of Black Folk*, acclaimed African American (AA) scholar, W.E. Du Bois sought to highlight the problem of race in America, in particular, the unique duality of racial identity for AAs, both American and a racial minority, and with often conflicting senses of one's self and one's group. Although much is known about the importance of racial identification on psychological aspects of self-esteem and self-concept [Phinney, 1990; Sellers et al., 1998], little is known about the influence of racial identification on neurobiological mechanisms underlying social interaction, such as the capacity of the self to share and respond to the emotional states of others. Understanding the impact of racial identification on neural processing may illuminate both sources of differential interpersonal behavioral responding as well as downstream outcomes, such as racial disparities in health.

Prior social neuroscience studies have demonstrated that race modulates neural responses underlying social behavior [Eberhardt, 2005; Ito and Bartholow, 2009]. For example, racial majority group members, such as Caucasian Americans (CAs), show greater fusiform and parahippocampal response when perceiving own-race faces [Golby et al., 2001] and either heightened [Cunningham et al., 2004; Lieberman et al., 2005; Phelps, 2001] or attenuated

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[Chiao et al., 2008; Van Bavel et al., 2008] amygdala response to other-race faces, depending on social context and presence of unconscious racial bias. By contrast, members of racial minority groups, such as AAs, typically demonstrate greater fusiform [Golby et al., 2001] as well as amygdala activation to own-race faces [Lieberman et al., 2005], suggesting that intergroup status moderates the direction and magnitude of neural responses to ingroup and outgroup members. Race has also been shown to modulate neural reactivity in response to viewing people in pain [Chiao and Mathur, 2010]. Specifically, neural empathic biases in favor of one's own racial group have been demonstrated in response to both the physical [Xu et al., 2009] and emotional [Mathur et al., 2010] pain of others. Recent evidence further indicates that ingroup biases in empathic neural response are associated with unconscious racial bias [Avenanti et al., 2010; Gutsell and Inzlicht, 2010]. Notably, prior social neuroscience studies of race have primarily focused on the attitudes of majority group members toward minority group members and the influence of such stereotyping and prejudice on neural response to same and other races.

By contrast, little is known about how racial identity or one's own attitudes toward their racial group affects neural response. Racial or ethnic identification refers to the knowledge of one's self that is defined by membership to a social group [Aboud, 1987] as well as the value or emotional significance attached to belonging to that group [Tajfel, 1981]. Racial identification can be a self-claimed group membership distinct from the racial group membership claimed by one's parents [Phinney, 1992] and is often stronger in racial minority members [Phinney, 1992; Rahim-Williams et al., 2007], due to the need to assert one's racial identity relative to the majority culture. The importance of attitudes toward one's own racial group is particularly salient for the psychological functioning of racial minority members, who may encounter conflicting values, beliefs, and practices between their minority culture and mainstream culture, as well as discrimination [Masten et al., 2011], and as a consequence, struggle to understand and cope with their racial identity [Phinney, 1992]. Identifying with one's racial group manifests an enhanced sense of belonging and commitment [Singh, 1977] as well as a sense of similar or shared values and attitudes with other group members [White and Burke, 1987]. Finally, racial identification is a core component in the construction and development of self-concept and can profoundly impact psychological and physical health [Phinney, 1992; Sellers et al., 1998]. Among AAs, heightened racial identification is associated with perceived racial discrimination, global psychological distress [Sellers and Shelton, 2003], and self-esteem [Rowley et al., 1998], affecting a range of real-world consequences, from academic performance [Smith et al., 2009] to risk of cardiovascular disease [Chae et al., 2010]. Although much is known about how racial identity affects psychological and physical well-being, very little is known about how racial identity affects neural mechanisms underlying social cognition, such as how one thinks about one's self and others.

Numerous social neuroscience studies have shown that several aspects of self-concept rely on a discrete system of brain structures, typically referred to as the neural default network. The neural default network is a system of brain areas that are activated when individuals engage in conscious or unconscious self-reflection either while resting or when mind-wandering [Buckner et al., 2008; Christoff et al., 2009; Mason et al., 2007; Raichle et al., 2001]. This neural default network is thought to consist of two often correlated, but functionally independent, subsystems: a *cortical midline system* and a *medial temporal lobe (MTL) system* [Andrews-Hanna et al., 2010; Buckner et al., 2008].

The cortical midline system consists of the posterior cingulate cortex (PCC), an anterior portion of the medial prefrontal cortex (MPFC), and anterior cingulate cortex (ACC). Cortical midline structures typically display graded activation associated with self-referential and social cognitive processing [Buckner and Carroll, 2007; Mitchell et al., 2005; Ochsner et al., 2004; Uddin et al., 2007; Wicker et al., 2003]. For instance, activity within the cortical midline system has also been shown to correlate with degree of utilization of introspection, perceived personal significance, and evoked emotion during imaging tasks [Andrews-Hanna et al., 2010]. Additionally, neuroimaging studies have demonstrated overlapping areas of activation within cortical midline structures of the default network associated with evaluative self-related and social cognitive processing [Mitchell et al., 2005; Ochsner et al., 2004; Uddin et al., 2007]. The MTL system includes medial temporal regions such as parahippocampal gyrus (PHG) and hippocampal formation, as well as posterior inferior parietal lobule (IPL) and a subgenual portion of the ventral MPFC. The MTL system is associated with memory-based scene construction and prospective cognition (e.g., thinking about the future). Recent evidence indicates that activity within these regions is associated with individual ratings of use of episodic memory, event imagination, and scene content in making decisions regarding one's future self [Andrews-Hanna et al., 2010].

Recently, activity within the individually defined (resting state for each individual) default network during rest has also been shown to predict later empathic resonance when viewing others in physical pain [Otti et al., 2010], suggesting that resting default network activity is associated with understanding the affective states of others. Despite the growing body of literature describing neural reactivity of the default network during social cognitive processing, how social factors such as race and racial identification affect default network reactivity during social cognition remains unknown.

Here, we use functional magnetic resonance imaging (fMRI) to examine the neural basis of racial identification in members of racial minority and majority groups (e.g., AA and CA individuals). As prior research suggests default network may be involved in understanding the

affective states of others, we used an empathy paradigm in the current study to examine the influence of racial identification on default network activity. First, we test the hypothesis that racial identification is associated with default network activity when empathizing with members of one's own racial group relative to another group. We further predict that increased racial identification is associated with increased recruitment of the default network when empathizing with members of one's own race relative to a different race. Finally, because racial identification is typically stronger for racial minority relative to majority group members, we hypothesized that default network activity would be greater for racial minority relative to majority group members when empathizing with members of one's own group.

METHODS

Participants[1]

Twenty right-handed volunteers, 10 AA (6 female, M = 23.1 years old, SE = 0.72), and 10 CA (9 female, M = 23.3 years old, SE = 1.15), with normal or corrected-to-normal vision participated in this study and were compensated $25 for their time. All AA participants self-identified as either *AA* or *black*, and all CA participants self-identified as either *Caucasian* or *white*. This study was approved by the Northwestern University Institutional Review Board and informed written consent was obtained from each participant before the experiment.

Stimuli

Stimuli consisted of naturalistic visual scenes (640 pixels × 480 pixels) depicting either AA or CA individuals in an emotionally painful (e.g., in the midst of a natural disaster) or neutral (e.g., attending an outdoor picnic) situation (Fig. 1A). There were no significant differences in number of people, gender, or age between Pain and No Pain scenes as well as between CA and AA scenes (all Ps > 0.05). Stimuli were also previously matched for pain, valence, and arousal across races [Mathur et al., 2010].

Procedure

We used a block design consisting of 16 task blocks within a functional run. Each block consisted of six unique trials of that block type. There were four block types depicting either AAs or CAs in pain or no pain scenarios (Fig. 1B). There were four blocks for each condition (AA Pain, AA No Pain, CA Pain, and CA No Pain.) For each trial, a complex visual scene was displayed for 2,500 ms,

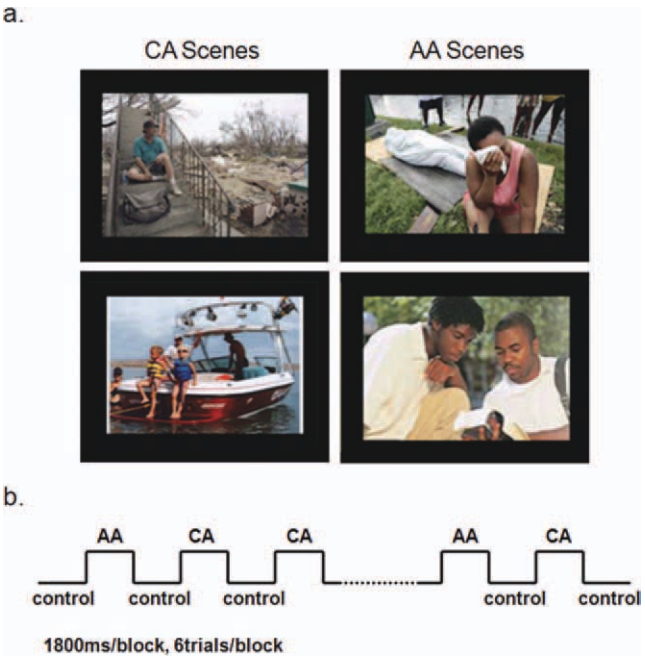

Figure 1.
Study Design: (**a**) Example stimuli; (**b**) schema of experimental block design. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]

followed by a centered fixation cross for 500 ms. Trials were displayed in a fixed random order. Additionally, there were control blocks that served as a baseline condition to subtract common primary processes (e.g., primary visual process and motor response) during which participants pressed a button with their right index finger when a simple gray square appeared.

During scanning, participants indicated the extent to which they felt empathy for the person in the target image (e.g., how badly do you feel for this person?) using a four point Likert scale (1 = not at all to 4 = very much) with a simple button press. Before entering the scanner, participants were shown examples of the task and given a practice trial in order to become familiar with the task.

Outside of the scanner, participants completed the Multigroup Ethnic Identity Measure (MEIM[2]) as a measure of level of identification with one's own ethnic or racial group [Phinney, 1992]. The MEIM was chosen as, unlike other measures that focus on identity associated with specific ethnic and racial groups, it was developed and validated for use across diverse groups. This allowed us to use the same measure for both AA and CA participants. The MEIM has

[1]The present analysis represents a subset of participants from a prior data set (Mathur et al., 2010). All participants from the prior data set who completed the MEIM were included in this analysis.

[2]The MEIM has two subscales: *search* and *affirmation* (Phinney, 1992). For the present sample, Total score was so highly correlated with the subscales (search: R = 0.93, P < 0.001; affirmation: R = 0.97, P < 0.001) that we simply report total score in all of our analyses. All ROI correlations performed using the subscales were also significant (all Ps ≤ 0.01).

TABLE I. fMRI results of main effect of racial group (AA > CA) performed on the contrast image [Ingroup (Same race Pain + Same race No Pain) > Outgroup (Other race Pain + Other race No Pain)]

X	Y	Z	Z score	Voxels	BA	Brain area
6	−11	14	4.35	138		Thalamus
0	**−65**	**34**	**4.08**	**169**	**7**	**Precuneus/PCC**
50	43	−5	3.93	18	47	R ventral lateral PFC
0	**54**	**28**	**3.86**	**265**	**9**	**MPFC/ACC**
0	−47	2	3.76	60		Cerebellum
−33	22	−19	3.73	31	47	L ventral lateral PFC
42	−65	−12	3.45	44	19	R Fusiform Gyrus
0	40	50	3.44	57	8	Dorsal MPFC
24	−79	−16	3.38	21		R Cerebellum
−45	46	−15	3.37	12	11	L ventral lateral PFC
0	**−13**	**39**	**3.32**	**12**	**24**	**MCC**

Note: Bold clusters are shown in Figure 2.

12 items (e.g., *I have a strong sense of belonging to my own ethnic group; I understand pretty well what my ethnic group membership means to me*.) In the present sample, the MEIM revealed strong reliability (Cronbach's $\alpha = 0.94$).

Imaging Parameters

Functional whole-brain images were acquired using a 3T Siemens Trio at the Center for Advanced Magnetic Resonance Imaging facility located at the Northwestern University Medical School in Chicago, IL. We acquired functional images by using T2*-weighted, gradient echo, echo planar imaging sequences [repetition time (TR) = 2,000 ms; echo time (TE) = 25 ms; flip angle = 70°; FOV = 20 cm, 64 × 64 matrix; 34 slices; 4-mm slice thickness (no gap); in-plane resolution = 3.0 × 3.0 mm]. A high-resolution anatomical T1-weighted image was also acquired [TR = 2,300 ms; TE = 2.91 ms; flip angle = 9°; FOV = 256 mm; 256 × 256 matrix; 160 slices; voxel size = 1.0 × 1.0 × 1.0 mm] for each participant. All stimuli were presented using Presentation software (Neurobehavioral Systems, Albany, CA) and projected onto a half-transparent viewing screen located behind the head coil.

Imaging Processing

Functional images were analyzed using SPM2 software (Wellcome Department of Imaging Neuroscience, London, UK) implemented in Matlab (Mathworks, Cherborn, MA). The first six volumes were discarded due to unsteady magnetization, and all of the remaining volumes were realigned spatially to the first volume and a mean image was created. After a high-resolution image was coregistered onto the mean image, and all volumes were normalized to the MNI (Montreal Neurological Institute) space using a transformation matrix obtained from the normalization process of the high-resolution image of each individual participant to the MNI template. The normalized images were then spatially smoothed with an 8-mm Gaussian kernel.

After preprocessing, statistical analysis for each individual participant was conducted using the general linear model [Friston et al., 1994]. At the first level, each block of trials was modeled by convolving with a hemodynamic response function. For each participant, a linear regressor was applied to filter noise. In the subtraction analysis, four task conditions [Ingroup Pain, Ingroup No Pain, Outgroup Pain and Outgroup No Pain] were modeled separately, including fixation. Random effects analyses were conducted by averaging the contrast images for each effect of interest.

To identify the main effect of racial group membership on neural response, whole-brain voxel-wise two sample (AA and CA participants) analyses were performed on the

TABLE II. fMRI results of main effect of racial group (CA > AA) performed on the contrast image [Ingroup (Same race Pain + Same race No Pain) > Outgroup (Other race Pain + Other race No Pain)]

X	Y	Z	Z score	Voxels	BA	Brain area
−33	**−47**	**−3**	**5.21**	**2141**	**19**	**L PHG**
62	**−34**	**21**	**5.17**	**2303**	**37**/42	**R PHG**/Superior Temporal Gyrus
−21	−57	−35	3.93	34		L Cerebellum
27	11	38	3.80	216	8	R Middle Frontal Gyrus
−21	50	9	3.66	188	10	L Middle Frontal Gyrus
24	34	−9	3.61	195	47	R Inferior Frontal Gyrus
−42	−54	−33	3.60	11		L Cerebellum
24	−65	−22	3.29	17		R Cerebellum
−24	9	58	3.27	27	6	L Superior Frontal Gyrus
−24	2	30	3.20	156	8	L Middle Frontal Gyrus
36	36	26	3.15	32	9	R Superior Frontal Gyrus
15	−19	31	3.07	23	23	R PCC
30	15	2	2.81	13		R Claustrum

Note: Bold clusters are shown in Figure 3.

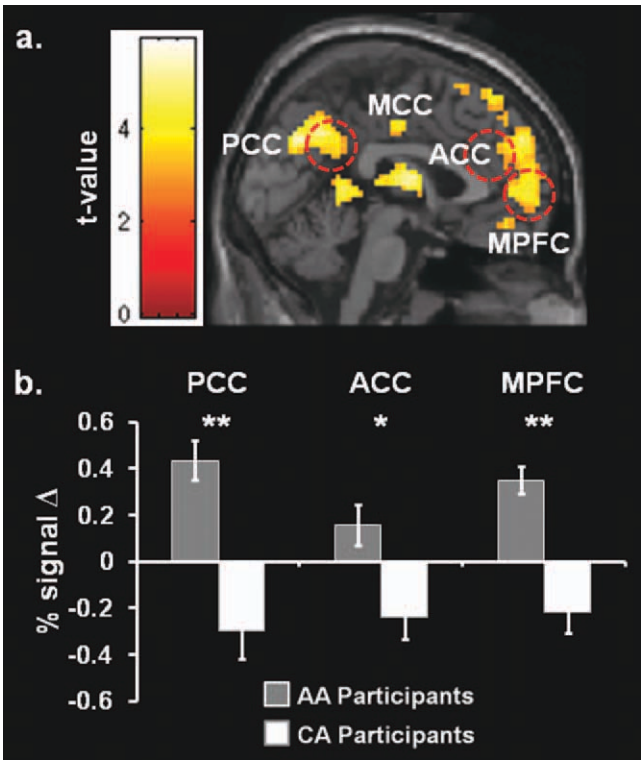

Figure 2.

African-American participants display increased activity within cortical midline regions of the default network when viewing same-race others. (**a**) Whole-brain two-sample comparison [AA participants > CA participants], $x = 0$. Red circles highlight independently defined regions submitted to region of interest analyses. (**b**) Percent signal change extracted from regions of interest [PCC sphere centered on peak voxel: −3, −59, 31; ACC sphere centered on peak voxel: −3, 11, 44; MPFC sphere centered on peak voxel: −2, 50, 10]. Signal change within ROIs extracted from the [Ingroup > Outgroup] contrast image. $^{**}P < 0.001$; $^{*}P < 0.01$. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]

contrast [Ingroup (Pain + No Pain) > Outgroup (Pain + No Pain)] with a threshold of $P < 0.005$, extant threshold = 10 voxels (Tables I and II and Figs. 2 and 3).

Whole-brain regression analyses were performed on the contrast images [Ingroup (Pain + No Pain) > Outgroup (Pain + No Pain)] and [Outgroup (Pain + No Pain) > Ingroup (Pain + No Pain)] using racial identification (MEIM score) as the covariate of interest. To test hypotheses about region-specific covariate effects, the estimates were compared using a linear contrast with significance levels at $P < 0.005$, extant threshold = 10 voxels (Tables III and IV and Figs. 4 and 5).

Region of interest (ROI) analyses were performed on regions-of-interest using MarsBar toolbox in SPM2 [Brett et al., 2002]. Cortical midline ROIs were independently defined a priori as a 8-mm sphere centered on a peak voxels identified by a meta-analysis of self-relevant activation within cortical midline regions of the default network [Northoff et al., 2006: ACC: −3, 11, 44; PCC: −3, −59, 31; MPFC: −2, 50, 10]. Parahippocampal gyri ROIs, for which we did not have a priori predictions, were functionally defined as a 4-mm sphere centered on peak voxels identified by our main effect analysis [Fig. 3: *L* PHG: −33, −47, −3; *R* PHG (PHG-specific subcluster of large cluster centered on peak voxel 62, −34, 21): 30, −44, −8]. Small volume correction for multiple comparisons was performed using 6 mm spheres centered on the peak voxels of a priori

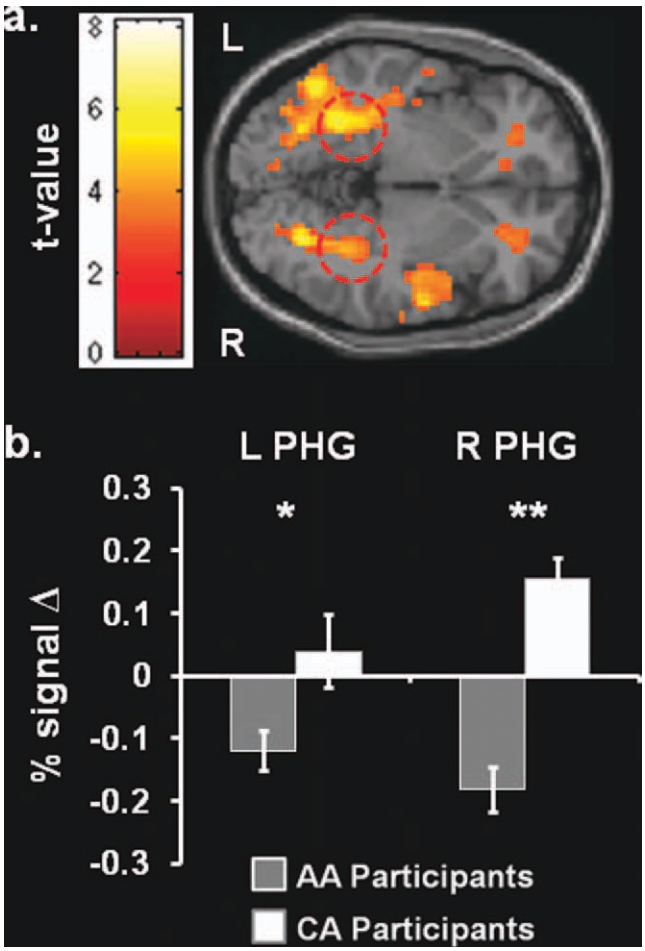

Figure 3.

Caucasian American participants display increased activity within bilateral parahippocampal gyrus when viewing same-race others. (**a**) Whole-brain two-sample comparison [CA participants > AA participants], $z = -3$. Red circles highlight functionally defined regions submitted to region of interest analyses. (**b**) Percent signal change extracted from regions of interest [L PHG sphere centered on peak voxel: −33, −47, −3; R PHG sphere centered on subcluster peak voxel: 30, −44, −8]. Signal change within ROIs extracted from the [Ingroup > Outgroup] contrast image. $^{**}P < 0.001$; $^{*}P < 0.05$. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]

regions of interest within the default network, namely MPFC, ACC, and PCC. MNI coordinates were converted to Talairach using a nonlinear transformation (http://imaging.mrc-cbu.cam.ac.uk/imaging/MniTalairach). Brodmann areas and brain regions were identified based on the Talairach Atlas [Talairach and Tournoux, 1988].

RESULTS

Behavioral Results

Racial identification

Independent-sample *t*-tests conducted on behavioral exit surveys after scanning showed that AA participants ($M = 3.34$, SE = 0.12) reported greater identification with their own racial group (MEIM) than CA participants ($M = 2.24$, SE = 0.15), t (18) = 5.71, $P < 0.001$. This is consistent with prior findings that young AA adults tend to score higher on this measure than young CA adults [Phinney, 1992; Rahim-Williams et al., 2007].

Empathy

A three-factor repeated measures ANOVA [participant race: AA or CA × target race: AA or CA × pain: pain or no pain) revealed a main effect of pain $F(1, 18) = 305.82$, $P < 0.001$, such that participants rated Pain stimuli as evoking more empathy than No Pain stimuli. No other interactions or main effects in empathy ratings were significant (all Ps > 0.05).

fMRI Results

Effects of racial group membership on neural response

Whole-brain, two-sample, voxel-wise analyses revealed differential neural response to ingroup, relative to outgroup, members based on self-identified racial group membership. Specifically, AA participants show increased activation within the MPFC[3], ACC, mid-cingulate cortex (MCC), PCC[3] and ACC[3], and precuneus in response to ingroup, relative to outgroup, others (Fig. 2a and Table I). Additional analyses using independently defined regions of interest in the cortical midline subsystem of the default network, specifically within the MPFC (−2, 50, 10), ACC (−3, 11, 44), and PCC (−3, −59, 31) (Fig. 2b) further confirm results from whole-brain analyses, such that AA participants showed significantly greater reactivity to ingroup relative to outgroup members within cortical midline structures relative to CA participants [MPFC: $t(18) = 4.99$, $P < 0.001$; ACC: $t(18) = 3.13$, $P = 0.006$; PCC: $t(18) = 5.45$, $P < 0.001$].

By contrast, CA participants showed increased activation within the medial temporal subsystem of the default network, specifically the left PHG, bilateral prefrontal cortex, PCC, and superior temporal gyrus (Table II and Fig. 3).

Three-factor, 2 (*participant race:* AA, CA) × 2 (*target*: ingroup, outgroup) × 2 (*valence*: Pain, No Pain) repeated measures analysis of variance was conducted on percent signal change within the independently defined cortical midline ROIs (MPFC, ACC, and PCC).

MPFC. Within the MPFC, there was a significant interaction between target race and target pain, $F(1,18) = 4.84$, $P = 0.04$. Although not statistically significant, simple effects analyses revealed that the nature of this interaction is such that participants revealed greater MPFC activity in

TABLE III. fMRI results of whole-brain regression analysis of group contrast image [Ingroup (Same race Pain + Same race No Pain) > Outgroup (Other race Pain + Other race No Pain)] with individual differences in racial identification

X	*Y*	*Z*	*Z* score	Voxels	BA	Brain area
0	**−10**	**39**	**4.51**	**97**	**24**	**MCC**
−3	**−50**	**47**	**3.72**	**115**	**7**	**Precuneus/PCC**
−6	**52**	**−3**	**3.62**	**77**	**10**	**MPFC**
−6	−8	9	3.56	69		Thalamus
−3	20	60	3.54	13	6	Superior Frontal Gyrus
−3	**25**	**29**	**3.19**	**44**	**32**	**ACC**
0	40	50	3.18	13	8	Superior Frontal Gyrus
−3	**−49**	**8**	**3.17**	**38**	**29**	**PCC**

Note: Bold clusters are shown in Figure 4.

TABLE IV. fMRI results of whole-brain regression analysis of group contrast image [Outgroup (Other race Pain + Other race No Pain) > Ingroup (Same race Pain + Same race No Pain)] with individual differences in racial identification

X	*Y*	*Z*	*Z* score	Voxels	BA	Brain area
65	−31	24	4.19	34	40	R Inferior Parietal Lobule
−33	**−50**	**−3**	**3.79**	**55**	**19**	**L PHG**/Fusiform
−27	−44	49	3.58	48	7	L Precuneus
65	−7	25	3.57	20	4	R Precentral Gyrus (SSI)
33	**−44**	**−5**	**3.57**	**48**	**19**	**R PHG**/Fusiform
−27	−59	42	3.47	13	7	L Superior Parietal Lobule
−36	−37	21	3.05	20		L Insula
21	−48	25	2.97	19	31	R PCC
27	14	38	2.85	20	8	R Middle Frontal Gyrus
27	−60	25	2.81	11	7	R Precuneus

Note: Bold clusters are shown in Figure 5.

[3]Small-volume correction for multiple comparisons was performed using a sphere with a 6-mm radius for the a priori regions of interest within the default network, namely MPFC, ACC, and PCC. Activity within the MPFC and PCC survived a threshold of $P < 0.05$, correction for multiple comparison.

response to AA targets in pain, relative to AA targets in no pain [$t(19) = 1.60$, $P > 0.05$]; and greater MPFC activity in response to CA targets in no pain, relative to CA targets in pain [$t(19) = -0.69$, $P > 0.05$]. There was also a significant main effect of target race, $F(1,18) = 24.92$, $P < 0.001$. Paired sample t-tests revealed that, on average, participants showed a significantly greater signal change within the MPFC ROI in response to CA ($M = -0.45$, SE = 0.12), relative to AA ($M = -0.09$, SE = 0.11) scenes (Pain + No Pain), $t(19) = 5.01$, $P < 0.001$. No other comparisons were significant (all Ps > 0.05).

When MEIM scores were entered as a covariate in this model, these effects were attenuated. The target race by target pain interaction was no longer significant $F(1,17) = 1.15$, $P = 0.30$. Controlling for ethnic identification appeared to control for the effect of target race on MPFC response as well, $F(1,17) = 3.56$, $P = 0.08$.

ACC. Within the ACC ROI, only the main effects of target race [$F(1,18) = 9.81$, $P = 0.006$] and target pain [$F(1,18) = 16.39$, $P = 0.001$] were significant. Paired sample t-tests revealed that, on average, participants showed a significantly greater signal change within the ACC ROI in response to AA ($M = 0.55$, SE = 0.07), relative to CA ($M = 0.35$, SE = 0.06) scenes (Pain + No Pain) [$t(19) = 3.18$, $P = 0.005$]; and in response to Pain ($M = 0.68$, SE = 0.10), relative to No Pain ($M = 0.22$, SE = 0.06) [$t(19) = 4.12$, $P = 0.001$]. No other comparisons were significant (all Ps > 0.05).

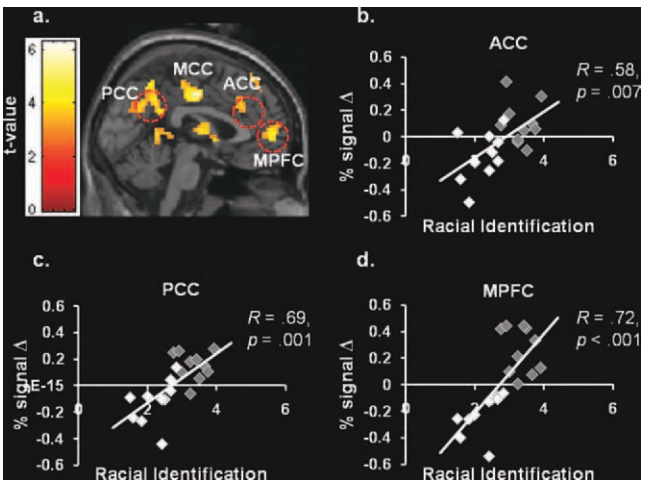

Figure 4.

Racial identification positively predicts activity within cortical midline regions of the default network when viewing same-race others. (**a**) Whole-brain regression analysis of group contrast image [Ingroup (Same race Pain + Same race No Pain) > Outgroup (Other race Pain + Other race No Pain)] with individual differences in racial identification as the covariate, $x = 0$. Red circles highlight independently defined regions submitted to region of interest analyses. (**b–d**) Independent regression analyses [(b) ACC regression centered around peak voxel: −3, 11, 44; (c) PCC regression centered around peak voxel: −3, −59, 31; (d) MPFC regression centered around peak voxel: −2, 50, 10]. Signal change within ROIs extracted from the [Ingroup > Outgroup] contrast image. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]

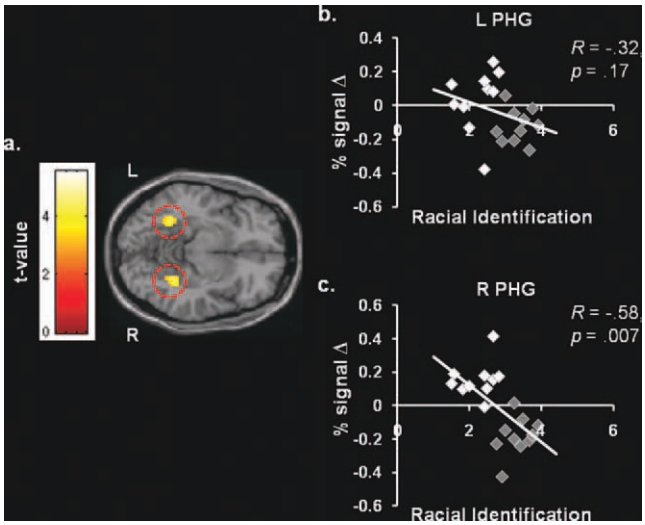

Figure 5.

Racial identification negatively predicts activity within medial temporal regions of the default network viewing same-race others. (**a**) Whole-brain regression analysis of group contrast image [Outgroup (Same race Pain + Same race No Pain) > Ingroup (Same race Pain + Same race No Pain)] with individual differences in racial identification as the covariate. (**b, c**) Independent regression analyses [(b) L PHG regression centered around peak voxel: −33, −47, −3; (c) R PHG regression centered around peak voxel: 30, −44, −8]. Signal change within ROIs extracted from the [Ingroup > Outgroup] contrast image. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]

Controlling for ethnic identification suppressed these effects [*Target Race:* $F(1,17) = 0.46$, $P = 0.51$; *Target Pain:* $F(1,17) = 0.05$, $P = 0.38$].

PCC. Within the PCC ROI, only the main effect of target race was significant, $F(1,18) = 29.68$, $P < 0.001$. A paired sample t-test revealed that participants showed a significantly greater signal change within the PCC ROI in response to AA ($M = 0.37$, SE = 0.17), relative to CA ($M = 0.08$, SE = 0.16) scenes (Pain + No Pain) [$t(19) = 5.37$, $P < 0.001$]. No other comparisons were significant (all Ps > 0.05).

Controlling for ethnic identification attenuated the effect of target race, though it remained statistically significant $F(1,17) = 5.33$, $P = 0.03$.

Relationship between racial identification and neural response

Consistent with our predictions, degree of racial identification (MEIM score) significantly and positively predicted

activity within the cortical midline subsystem of the default network (e.g. MPFC, ACC, MCC, and PCC) in response to viewing racial ingroup members across conditions [Ingroup > Outgroup] (Fig. 4a and Table III). Activity within independently defined regions of interest within the MPFC[3] (−2, 50, 10), ACC (−3, 11, 44), and PCC[3] (−3, −59, 31) were positively and significantly correlated with MEIM scores[4] (Fig. 4b–d).

Additionally, degree of racial identification significantly and positively predicted activity within the MTL subsystem of the default network (e.g., bilateral fusiform gyri and PHG, right IPL, PCC, and precuneus) in response to viewing racial outgroup members across conditions [Outgroup > Ingroup] (Table IV and Fig. 5a–c).

Relationship between empathy ratings and neural response

Empathy ratings were not correlated with neural response within default network regions of interest (all *P*s > 0.05).

DISCUSSION

The present results demonstrate that racial identification elicits differential response within subsystems of the neural default network. Here, we show that when thinking about members of their own racial group, AAs preferentially activated areas within the cortical midline subsystem of the default network, whereas our CAs preferentially recruited areas within the MTL subsystem of the default network [Andrews-Hanna et al., 2010; Buckner et al., 2008]. Critically, racial differences in default network response to same and other races were associated with racial differences in the extent to which racial majority and minority group members identified with their group. Specifically, neural response to ingroup relative to outgroup members within cortical midline structures (MPFC, ACC, and PCC) was positively and significantly correlated with degree of racial identification, whereas neural activity within medial temporal and parietal lobe structures (bilateral fusiform gyri, PHG, right IPL, PCC, and precuneus) was negatively and significantly correlated with degree of racial identification.

Neural activity within independently defined regions of MPFC, ACC, and PCC previously associated with social cognitive processing revealed discriminate directionality between African and CAs, such that percent signal change within these areas was significantly different between African and CAs when perceiving racial ingroup relative to outgroup others. Activity within the cortical midline subsystem has been previously associated with self-referential processing [Buckner and Carroll, 2007; Mitchell et al., 2005; Ochsner et al., 2004; Uddin et al., 2007; Wicker et al., 2003] and, more specifically, has been shown to correlate with introspection, perceived personal significance, and evoked emotion [Andrews-Hanna et al., 2010]. Hence, our findings suggest that AAs in the current study likely reflect upon their own thoughts and feelings when empathizing with racial ingroup members, find the situations of racial ingroup members more personally relevant, and experience an automatic neural affective response toward ingroup members to a greater extent relative to CAs.

Interestingly, our results indicate that CAs preferentially activate areas within the temporal lobe that have been associated with the MTL subsystem of the default network [Andrews-Hanna et al., 2010; Buckner et al., 2008]. Specifically, greater activity within the left PHG and bilateral lateral temporal cortex, as well as within default network core structure PCC, was observed among CAs while empathizing with ingroup relative to outgroup members in either emotionally painful or neutral situations. The MTL subsystem has previously been associated with decision making involving simulation based on memory [Andrews-Hanna et al., 2010]. Therefore, it is possible that CAs, likely due to their relatively lower levels of racial identification, rely on memories of oneself in a situation similar to that of an ingroup target to make empathic judgments, whereas AAs, who tend to strongly identify with their racial group, could more easily use self-relevant affective processes in empathic responding. Future studies are needed to further determine the causes and consequences of differential recruitment of default network subsystems during social cognition across racial groups.

Our findings complement psychological theories that emphasize racial identification as an important component of one's self-concept. Phinney [1992] described racial identity as including self-identification as a racial group member, sense of belonging, commitment to that group, and attitudes toward that group. Supporting this view, he found that racial identity positively correlated with self-esteem among minority high school and college students (even among white students who were in the minority at their school) but not students in the majority [Phinney, 1992]. Other theories have focused on the unique qualitative meaning associated with specific racial group membership. For instance, Sellers' Multidimensional Model of Racial Identity among AAs focuses on the importance of race in one's self-perception and perceptions of meaning associated with group membership [Sellers et al., 1998]. Both theories support the notion that heightened racial identity should increase perceived similarity with, and perhaps the extent to which one uses self-referential processing to understand, one's racial ingroup. Integration of one's group into one's self concept is likely evolutionarily beneficial [Efferson et al., 2008] as enhanced self-referential processing triggered by members of one's one group may lead to increased altruistic responding to group members in need [Cialdini et al., 1997; Hamilton, 1964].

Although prior social neuroscience research on race and the brain has primarily focused on how racial group

[4]Adapted from Mathur et al. (2010).

membership affects neural processing [Chiao et al., 2008; Golby et al., 2001; Herrmann et al., 2007; Krill and Platek, 2009; Lee et al., 2008; Lieberman et al., 2005; Xu et al., 2009], prior psychological and physiological research has shown that racial group differences in psychological and physical well-being can be explained as a function of group differences in racial identification. For instance, AAs and Hispanics frequently show lower cold and heat pain tolerances compared to non-Hispanic White Americans [Rahim-Williams et al., 2007]. However, such racial group differences in pain sensitivity are predicted by group differences in racial identification (MEIM scores) among African and Hispanic Americans [Rahim-Williams et al., 2007], and, when racial identification is controlled for, racial differences in pain sensitivity are either attenuated or eliminated. Other social neuroscience studies have manipulated or measured familiarity of other-race individuals and found modulation of neural response to people from racial outgroups. For example, social contact with other race individuals, which presumably decreases perceptions of dissimilarity with racial outgroups, has also been shown to attenuate race-based differences in neural processing [Walker et al., 2008]. Similarly, another study found that when other race-faces were morphed with one's own face, thus making them perceptually similar to the self, amygdala reactivity was similar to that in response to a same-race other, thus attenuating the "race effect" seen in amygdala activity in response to other-race faces [Platek and Krill, 2009]. Finally, one recent study examined the main effect of group-identifiers versus nonidentifiers in a minimal group paradigm. The experimenters found that participants who identified with their novel group, relative to those participants who did not internalize their group membership, displayed greater MPFC activity when allocating resources to ingroup members at a cost to outgroup members [Volz et al., 2008].

Although prior studies have not investigated racial group effects on default network responding, some researchers have suggested that the cortical midline structures of the default network constantly monitor the psychological self as well as the mental states of others in one's social world [Mitchell et al., 2005; Ochsner et al., 2004; Uddin et al., 2007]. The overlapping neural representations for these processes support the theory that people use their own experiences to predict, understand, and react to the mental states of others [Mitchell et al., 2005; Ochsner et al., 2004]. Uddin and colleagues suggest that the default network uses evaluative mental-state simulation to understand and react to the mental states of others in a manner similar to how the mirror-neuron system uses motor simulation to understand and react to the physical actions of others [Uddin et al., 2007]. Furthermore, such self-reflective processes are more likely to be used to understand the mental states of others that one perceives as similar to one's self [Mitchell et al., 2005].

Our results found degree of racial identification to be predictive of activity within cortical midline structures of the default network in response to viewing racial ingroup, relative to outgroup members, and activity within the MTL subsystem of the default network in response to viewing racial outgroup, relative to ingroup members. This suggests that the strength of racial identification is associated with differential recruitment of neural and cognitive processes to understand the mental states of other people within one's racial group. Specifically, the more strongly people identify with their racial group, the more they may rely on self-reflective and evoked affective processing to determine empathic response. With decreasing strength of individual racial identification, people may rely more on memory driven simulation to determine empathic response.

Here, we propose that the relationship between default network reactivity and racial identification can be thought of from at least two perspectives. First, as people more strongly identify with their racial group, they perceive other people of their racial ingroup as more similar to themselves. This increased perceived similarity leads to increased introspective self-reflective and/or automatic affective processing in order to understand the mental states of racial ingroup members. Second, people who highly identify with their racial group may be chronically primed to process the affective and mental states of ingroup members in a self-referential way. Relatedly, it is also possible that people who are predisposed to use self-relevant processing via recruitment of cortical midline structures to understand the mental states of others are also predisposed to more strongly identify with the groups to which they claim membership. Future studies are needed to tease apart the directionality of the relationship. Additionally, given the known importance of racial identification for mental and physical health outcomes, future studies are needed to further understand the downstream neural and behavioral consequences of increased neural default network activity in racial minorities, who typically display enhanced ethnic identification.

In summary, the current findings demonstrate for the first time the importance of racial identification on neural default network responding to same- and other-races as well as provide a foundation for future research examining the consequences of racial identification on biobehavioral processes underlying psychological and physical well being in majority and minority racial group members.

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