An fMRI Investigation of Attributing Negative Social Treatment to Racial Discrimination

Carrie L. Masten, Eva H. Telzer, and Naomi I. Eisenberger

Abstract

■ We used fMRI to examine the neural responses that occur during experiences of perceived racial discrimination. Previous neuroimaging studies have focused exclusively on the processes underlying racial bias from the perpetrator's perspective and have yet to examine the processes that occur when individuals are being discriminated against. To extend this work, we examined the neural correlates associated with attributing negative social treatment to racial discrimination to explore the cognitive and affective processes that occur as discrimination is being experienced. To do this, we scanned Black participants while they were ostensibly excluded by Whites and then measured distress levels and race-based attributions for exclusion. In response to being socially excluded by Whites, Black participants who appeared to be more distressed showed greater social pain-related neural activity and reduced emotion regulatory neural activity. In addition, those who attributed exclusion to racial discrimination displayed less social pain-related and more emotion regulatory neural activity. The potential negative impact that frequent negative social treatment and discrimination-related distress regulation might have on individuals' long-term mental and physical health is discussed. ■

INTRODUCTION

Sixty percent of Black Americans perceive racial discrimination on a daily basis (Sellers & Shelton, 2003). Psychologists have long noted that this repeated exposure to discrimination is psychologically harmful for the target and may contribute to well-established health disparities between Black and White individuals (Mays, Cochran, & Barnes, 2007). Surprisingly, however, most research has focused on Whites' negative attitudes toward Blacks (Shelton, 2000), instead of Blacks' experiences as the target of racial bias. Moreover, psychological research that has investigated the experience of discrimination from the target's perspective has been limited by its reliance on self-report or behavioral indices of felt discrimination that are typically measured after the act of racial discrimination has been perceived and processed to some extent. Functional magnetic resonance imaging (fMRI) may be an important complement to these self-report and behavioral assessments of discrimination experiences because fMRI enables the measurement of neural responses to these experiences as they unfold.

Examining on-line neural responses during discrimination may be particularly helpful given the inconsistencies in behavioral research regarding which psychological processes are involved in experiencing discrimination. In other words, although being the target of discrimination is associated with reduced well-being (Major, Quinton, & McCoy, 2002) and long-term negative consequences for physical and mental health (e.g., Landrine & Klonoff, 2000; Krieger & Sydney, 1996; see Mays et al., 2007 for a review), it is not yet clear how attributing negative social treatment to discrimination affects individuals in the moment. For example, some research suggests that attributing negative social treatment to discrimination is distressing because discrimination is due to an internal characteristic of the target (discrimination is due to "my race"), which cannot be changed and might therefore lead to future instances of discrimination (Wirth & Williams, 2009; Schmitt & Branscombe, 2002; Branscombe, 1998). However, other research has suggested that attributing negative social treatment to discrimination may be distress-reducing and provide a buffer if the prejudice is viewed as a characteristic of the perpetrator (discrimination is due to "others being prejudiced"), and the likelihood of self-blame is reduced (Major, Kaiser, & McCoy, 2003; Crocker & Major, 1989). It should be noted that both of these accounts presume that receiving negative social treatment is distressing. What is in question in these two lines of research is whether attributing this negative treatment to discrimination increases or decreases this distress. To extend behavioral research and provide new insight about the processes that occur as individuals attribute negative social treatment to discrimination, we used fMRI to examine the neural correlates associated with the distress of negative social treatment as well as how making discriminatory attributions (attributing negative treatment to racial discrimination) alters Black participants' immediate affective responses to this treatment.

Although neuroimaging research has not examined victims' experiences with discrimination, previous work has established a network of neural regions supporting the experience and regulation of responses to social threats that provides a framework from which to examine racial

University of California, Los Angeles

discrimination. Research has implicated dorsal anterior cingulate cortex (dACC) and anterior insula in the "painful" or distressing aspects of social rejection (DeWall et al., in press; Masten et al., 2009; Way, Taylor, & Eisenberger, 2009; Eisenberger, Lieberman, & Williams, 2003). Research has also suggested that several regions of lateral prefrontal cortex (PFC; ventrolateral, dorsolateral) may play a role in regulating negative affective responses to social or painful threats, as indexed by correlated reductions in dACC and anterior insular activity (Lieberman et al., 2004; Wager et al., 2004; Eisenberger et al., 2003; Petrovic & Ingvar, 2002). Similarly, regions of medial PFC and rostral ACC (rACC) may play a regulatory role as well, as evidenced by their contribution to pain regulation (Petrovic & Ingvar, 2002), extinction of learned fears (Phelps, Delgado, Nearing, & LeDoux, 2004), and positive interpretations of potentially negative stimuli (Kim, Somerville, Johnstone, Alexander, & Whalen, 2003).

Based on this neural framework, we predicted that the distress associated with negative social treatment would be associated with greater activity in regions associated with social distress (dACC, anterior insula), and reduced activity in regions involved in emotion regulation (PFC, rACC). Moreover, we also examined how attributing this negative social treatment to discrimination would relate to these neural responses. Based on previous work, to the extent that attributing negative social treatment to discrimination is personally threatening and distressing in the moment, making discriminatory attributions should be associated with more activity in neural regions underlying distress (dACC, anterior insula) and less activity in regions that regulate these negative experiences (PFC, rACC). Alternatively, to the extent that attributing negative social treatment to discrimination provides a way of coping with negative treatment and reduces distress in the moment, making discriminatory attributions should be associated with less neural evidence of distress and more evidence of regulation.

METHODS

Participants

Eighteen Black individuals (9 women), ranging in age from 19 to 28 years (M = 21.4), participated in the study. Participants consisted of UCLA students and staff, as well as members of the surrounding community who were unaffiliated with the University. Participants were recruited through fliers distributed around the UCLA campus, announcements made in undergraduate classes, postings on student listserves, and on-line advertisements in the community. Race was never mentioned in any of the recruitment materials. All participants completed written consent in accordance with UCLA's Institutional Review Board.

Procedures

To examine how making discriminatory attributions for negative social treatment would impact affective and neural responses to negative social treatment, participants were scanned as they were ostensibly excluded by two White individuals and could thus believe that they were the target of racial discrimination. In order to make race salient and increase the probability that racial discrimination might be considered a viable attribution for being excluded, participants were introduced to two White confederates (1 male, 1 female) prior to scanning. In addition, interviewers and scanning personnel were White. The participant and confederates completed consents together and were told that they would be playing a game together during their scans. They then introduced themselves by stating their name, occupation or year and major in college, and something interesting about themselves. Aside from this visible priming of race, race was not discussed during any part of the experimental session.

fMRI Task

To simulate a real, interactive experience of social exclusion, participants completed an experimental paradigm called "Cyberball" (Williams et al., 2002; Williams, Cheung, & Choi, 2000), in which they were told that they would play a computerized ball-tossing game via the Internet with two other participants in other scanners. In reality, participants played with a computer. Throughout the game of Cyberball, the ball was thrown back and forth among the three players, with the participant choosing the recipient of their own throws, and the throws of the other two "players" determined by the preset program. Participants could see the images representing the other two players on a computer screen, as well as their own "hand" that they controlled using a button-box. During the fMRI scan, participants played two rounds of Cyberball, one in which they were included equally for the whole game and one in which they were excluded after initially being included for 10 throws. This paradigm has been used previously in several behavioral and neuroimaging studies to successfully simulate an experience of social exclusion and produce feelings of distress related to this exclusion (Masten et al., 2009; Eisenberger, Gable, & Lieberman, 2007; Van Beest & Williams, 2006; Zadro, Williams, & Richardson, 2004; Eisenberger et al., 2003).

Following the completion of several postscan measures administered at the end of the fMRI session, participants were given a full debriefing explaining the deception involved in the Cyberball game, including the intentional priming of race, and were thoroughly questioned about their feelings regarding this deception.

Postscan Measures

Following the scan, participants completed self-report measures of social distress and discriminatory attributions (described below). In addition, because self-report bias was of particular concern, given the sensitive nature of discussing one's feelings about being discriminated against, we also examined a nonverbal behavioral measure of distress. Each participant completed a videotaped interview, in which they

were asked to comment on their thoughts/feelings at the time of the exclusion episode. These interviews were later rated by observers for negative affect ("observer-rated distress") as described below.

Self-reported Distress

To measure self-reported distress, participants completed the Need–Threat Scale (Williams et al., 2000, 2002) following completion of the functional scan, and they were explicitly told to answer the questions based on the second round of the game (during which the exclusion occurred). This measure assesses 12 subjectively experienced consequences of being excluded during the game (e.g., "I felt liked," "I felt rejected"), using a 5-point scale ranging from 1 (*not at all*) to 5 (*very much*). Items were reverse-coded appropriately and averaged to create a measure of self-reported distress that was highly reliable ($\alpha = .86$).

Observer-rated Distress

Because of the sensitive nature of this interracial situation and the fact that self-reports of social distress could be tempered or altered due to self-presentational concerns (Henry & Hardin, 2006; Dovidio et al., 1997), we also included a nonverbal, behavioral measure of participants' distress levels. Immediately after the scanning session, each participant was videotaped while completing an interview in which they described their thoughts and feelings during the game. They were asked to discuss the feelings that they had when they were being excluded as well as the reasons for why they might have been excluded; they were not prompted to discuss race. Later, 21 individuals who were blind to the study's purpose observed the videos and rated each clip using a 5-point scale (1 = not at all to 5 = very much) to indicate how upset, sad, rejected, angry, and defeated each participant seemed (e.g., "How upset did the subject seem?"). Ratings for these five emotions were averaged and standardized to create a measure of observer-rated distress (ICC = .91). Previous work has shown that nonverbal measures of behavioral responses, similar to this one, are a better indicator of affect and less influenced by self-presentational biases than self-reports (Kawakami, Phills, Steele, & Dovidio, 2007; Dovidio et al., 1997; Word, Zanna, & Cooper, 1974).

Self-reported Discriminatory Attributions

After completing ratings of self-reported distress, participants indicated the extent to which they thought they were excluded (during the second round of the Cyberball game) because of their race by answering three questions: (1) "How much do you believe the others responded to you during the game because of your race?," (2) "How much did you feel you were discriminated against by the other players during the game?," and (3) "How much do you believe the other players in the game were racist?," using a 5-point scale (1 = not at all to 5 = very much) (Goodwin, Williams, & Carter-Sowell, 2010). Responses to these three questions were averaged to create a composite score of self-reported discriminatory attributions with good reliability ($\alpha = .79$). These questions were imbedded in a larger questionnaire that included distracter items in an effort to reduce suspicion regarding the purpose of the study.

Neuroimaging Procedures

fMRI Data Acquisition

Imaging data were collected using a Siemens Allegra 3-Tesla MRI scanner. An initial 2-D spin-echo image (TR = 4000 msec, TE = 40 msec, matrix size 256 × 256, 4 mm thick, 1 mm gap) in the sagittal plane was acquired to enable prescription of slices obtained in structural and functional scans. In addition, a high-resolution structural T2*-weighted echo-planar imaging volume (TR = 4000 msec, TE = 54 msec, matrix size 128 × 128, FOV = 200 mm, 36 slices, 1.56-mm in-plane resolution, 3 mm thick) was acquired coplanar with the functional scans. Each of the two rounds of Cyberball was completed during a functional scan lasting 2 min 48 sec (echo-planar T2*-weighted gradient-echo, TR = 2000 msec, TE = 25 msec, flip angle = 90°, 64 × 64 matrix, FOV = 200 mm; 36 slices, 3 mm thick, 3 mm^3 voxel size, skip 1 mm).

fMRI Data Analysis

All neuroimaging data were preprocessed and analyzed using Statistical Parametric Mapping (SPM5; Wellcome Department of Cognitive Neurology, Institute of Neurology, London, UK). Images for each participant were realigned to correct for head motion (no participant's motion exceeded 1.5 mm), normalized into a standard stereotactic space as defined by the Montreal Neurological Institute and the International Consortium for Brain Mapping, and smoothed using an 8-mm Gaussian kernel, full width at half maximum, to increase the signal-to-noise ratio.

Cyberball was modeled as a block design. Each round of Cyberball was modeled as a run with periods of inclusion and exclusion modeled as blocks within the runs. The order of blocks was not counterbalanced in an effort to maintain ecological validity and avoid residual brain activation from the exclusion round being confounded with the activation recorded during inclusion. Because the paradigm is self-advancing for each participant, block lengths varied slightly across individuals; however, final rest periods allowed for this variation within a functional scan lasting a set amount of time. After modeling the Cyberball paradigm, linear contrasts were calculated for each planned condition comparison for each participant. These individual contrast images were then used in whole-brain, group-level random-effects analyses across all participants.

Group-level analyses were thresholded at $p < .005$ for magnitude with a minimum cluster size threshold of 10 voxels (Lieberman & Cunningham, 2009), in order to

examine all regions for which a priori hypotheses were made, specifically those involved in the experience of social threat as well as the regulation of these negative affective responses (e.g., dACC, anterior insula, PFC). We used a more conservative threshold of $p < .001$ for magnitude with a minimum cluster size threshold of 20 voxels to examine all other areas of the brain (Lieberman & Cunningham, 2009). All coordinates are reported in Montreal Neurological Institute format.

First, we examined neural activity during exclusion compared to inclusion. Next, to test the primary research questions, we conducted whole-brain regression analyses to examine how each of the following variables correlated with neural activity during exclusion compared to inclusion: (a) participants' self-reported distress scores; (b) observer-rated distress scores; and (c) the degree to which each participant believed that he/she was excluded because of his or her race.

RESULTS

Behavioral Results

Analysis of postscan measures of distress and perceived discrimination demonstrated substantial variability in each of these measures. Self-reported distress among participants ranged from 2.08 to 4.50 on a scale from 1 (*not at all*) to 5 (*very much*), with an average rating of 2.99 ($SD = .68$), whereas observer-rated distress ranged from 1.37 to 3.29 on the same scale, with an average rating of 2.11 ($SD = .55$). Self-reported and observer-rated distress were positively correlated ($r = .50, p < .05$). In terms of participants' perceived discrimination, self-reports of discriminatory attributions ranged from 1 to 4.67 (on a scale from 1 to 5), with a mean rating of 2.13 ($SD = 1.06$); 15 of the 18 (83%) participants reported that they had been excluded because of their race to some degree (ratings above 1 for at least one of the three items). In addition, although participants' self-reported discriminatory attributions correlated positively with their self-reported distress ($r = .51, p < .05$), these attributions did not significantly relate to observer-rated distress ($r = .32$, *ns*).[1]

Neuroimaging Results

Neural Activity during Exclusion versus Inclusion

First, we examined the main effect of experiencing exclusion compared to inclusion. A whole-brain analysis revealed several regions that were significantly more active during exclusion versus inclusion, including both limbic regions previously linked with pain-related processing (e.g., anterior insula) and regions previously linked with emotion regulation (e.g., VLPFC, rACC), consistent with previous studies examining social exclusion (Eisenberger, Gable, et al., 2007; Eisenberger, Taylor, Gable, Hilmert, & Lieberman, 2007; Eisenberger et al., 2003; see Table 1 for a complete list of activations).

Associations between Distress and Neural Activity during Exclusion versus Inclusion

To examine how distress was related to neural activity, we correlated neural activity during exclusion versus inclusion with: (a) participants' self-reported distress resulting from exclusion and (b) observer-rated distress resulting from exclusion. Whole-brain regression analyses (during exclusion vs. inclusion) revealed that self-reported distress did not correlate positively with the limbic regions that have previously been seen in studies examining the experience of social threats (e.g., dACC, anterior insula), but did correlate negatively with PFC activity (Table 2A). Thus, this self-report measure may have assessed something other than social distress as it is typically measured, which is not surprising in this sensitive, interracial situation.

Correlations with observer-rated distress, however, revealed a neural network consistent with previous studies examining social distress and the regulation of this distress (see Table 2B). Participants with higher observer-rated distress displayed greater activity in dACC (Figure 1A) and anterior insula (Figure 1B), reduced activity in ventrolateral PFC (VLPFC) and anterolateral PFC (ALPFC), regions involved in emotion regulation, and reduced activity in dorsomedial PFC (DMPFC; Table 1B), a region which has been linked with perspective-taking and mentalizing about others (Mitchell, Macrae, & Banaji, 2006), as well as emotion regulation (Ochsner, Bunge, Gross, & Gabrieli, 2002). In other words, individuals who were rated by outside observers as appearing more distressed during their postexclusion interviews showed greater neural activity in regions associated with social distress and reduced activity in regions associated with emotion regulation while they were being socially excluded.[2] As such, this nonverbal behavioral measure of distress may provide an index that is more in line with what has been observed in previous studies of rejection-related distress.

Associations between Perceived Discrimination and Neural Activity during Exclusion versus Inclusion

Next, to examine how attributing social exclusion to discrimination related to neural activity, we correlated neural activity during exclusion versus inclusion with the extent to which participants reported that they were excluded because of their race (self-reported discriminatory attributions). Interestingly, neural responses indicated that making discriminatory attributions for social exclusion was associated with less activity in neural regions associated with distress and threat perception and greater activity in neural regions associated with emotion regulation (see Table 3). Thus, in contrast to the relationship between observer-rated distress and neural activity, the more participants felt that they were excluded because of their race, the less activity they displayed in areas responsive to social threats, including dACC (Figure 2A), and the more activity they displayed

Table 1. Regions Activated during Exclusion versus Inclusion

Anatomical Region	*BA*		*x*	*y*	*z*	*t*	*k*	*p*
Exclusion > Inclusion								
Anterior insula		R	46	24	−10	4.47	212	<.0005
Anterior insula		R	42	22	0	4.13	212	<.0005
rACC/VMPFC	11	R	4	44	−10	4.59	58	<.0005
VLPFC	45	R	58	30	6	3.75	445	<.001
LPFC	44/45	R	44	12	24	5.58	445	<.0001
LPFC	44/45	L	−50	12	24	3.92	138	<.001
DMPFC	8	R	0	42	44	5.07	182	<.0001
Premotor cortex†	6	R	52	4	50	4.65	115	<.0005
MTG†	21	L	−50	−18	−8	6.86	30	<.0001
ITG†	20	R	48	−22	−18	5.53	35	<.0001
STG†	22	L	−58	−54	16	5.13	84	<.0001
Occipital cortex†	19	L	−44	−80	28	5.97	38	<.0001
Occipital cortex†	19	R	38	−78	44	5.81	79	<.0001
Occipital cortex†	19	L	−28	−84	36	4.58	39	<.0005
Cerebellum†		R	34	−70	−14	5.65	25	<.0001

Regions marked with a cross (†) are those that were not the primary focus of this investigation but that were still significant at $p < .001$, 20 voxels (k-values listed for these were taken from the thresholding map at $p < .001$). All other regions (e.g., limbic, prefrontal) are listed at $p < .005$, 10 voxels. BA refers to putative Brodmann's area; L and R refer to left and right hemispheres; x, y, and z refer to MNI coordinates; t refers to the t score at those coordinates (local maxima); k refers to the number of voxels in each significant cluster. rACC = rostral anterior cingulate cortex; VMPFC = ventromedial prefrontal cortex; VLPFC = ventrolateral prefrontal cortex; LPFC = lateral prefrontal cortex; DMPFC = dorsomedial prefrontal cortex; MTG = middle temporal gyrus; ITG = inferior temporal gyrus; STG = superior temporal gyrus.

in regions associated with regulation of threat responses, specifically rACC (Figure 2B; see Table 3).

DISCUSSION

This study is the first to examine the neural correlates of racial bias from the victim's point of view. As such, two sets of findings emerged as particularly novel and informative for our understanding of experiences with racial discrimination: (1) those who appeared to be more distressed by the exclusion episode showed greater social pain-related neural activity and reduced emotion regulatory neural activity; and (2) attributing this negative social treatment to discrimination was associated with the reverse pattern-reduced social pain-related neural activity and greater regulatory activity.

First, although Black participants' self-reported distress was not associated with greater activity in regions previously linked to social distress, observer-rated distress was associated with greater activity in these neural regions. This is consistent with previous research indicating that nonverbal measures of behavioral responses provide a better index of affective experience than self-reports (Kawakami et al., 2007; Dovidio et al., 1997; Word et al., 1974) and suggests that these nonverbal behavioral measures may provide a better index of neural responding as well. These findings also highlight the distress associated with negative social treatment in general and suggest that Black individuals, who may face negative social treatment more frequently, may unfortunately experience this distress more often. Given that experiences of negative social treatment have been linked to increased physiological stress responding (Eisenberger, Taylor, et al., 2007; Dickerson & Kemeny, 2004) and negative mental health outcomes (Slavich, Thornton, Torres, Monroe, & Gotlib, 2009), it is likely that repeated experiences with these negative events take a cumulative toll.

Second, our neural findings demonstrated that Black participants who attributed exclusion to racial discrimination showed less activity in distress-related regions and more activity in regions previously linked with emotion/pain regulation. This provides support for the notion that making discriminatory attributions may buffer against negative emotions as the perceived discrimination is taking place. These findings extend previous behavioral work suggesting that when individuals make discriminatory attributions in situations of negative social treatment, blame for the negative treatment is attributed externally (discrimination is due to "others being prejudiced"), thus reducing negative affect and self-blame (Major et al., 2003; Crocker & Major, 1989). Thus, although other research has suggested that making discriminatory attributions may increase

Table 2. Correlations with Social Distress

Anatomical Region	*BA*		*x*	*y*	*z*	*t*	*r*	*k*	*p*
(A)									
Positive Associations with Self-reported Distress									
subACC	25	L	−12	16	−8	3.41	.65	10	<.005
Negative Associations with Self-reported Distress									
DMPFC	8	L	−8	42	44	3.34	−.64	16	<.005
Premotor cortex†	6	L	−24	4	54	4.77	−.75	111	<.0005
(B)									
Positive Associations with Observer-rated Distress									
dACC	32	R	2	20	32	3.47	.66	19	<.005
Anterior insula		L	−40	14	−16	3.94	.70	17	<.001
VMPFC	11	R	4	48	−18	3.24	.63	20	<.005
DMPFC	8	L	−6	54	48	4.58	.70	23	<.001
Negative Associations with Observer-rated Distress									
VLPFC	45	R	48	32	8	3.38	−.65	15	<.005
ALPFC	10	L	−20	44	4	3.84	−.69	31	<.001
DMPFC	8/9	L	−12	42	42	3.90	−.70	61	<.001
Somatosens. cortex†	1/2/3	R	34	−34	74	6.95	−.87	50	<.0001
Cerebellum†		L	−22	−50	−46	6.49	−.85	33	<.0001
IPL†	40	L	−38	−52	40	6.42	−.85	44	<.0001
Precuneus†	4	R	10	−36	70	6.28	−.84	132	<.0001
Somatosens. cortex†	1/2/3	L	−22	−34	58	6.06	−.83	94	<.0001

Regions activated during exclusion versus inclusion that correlated significantly with: (A) self-reported distress and (B) observer-rated distress resulting from exclusion.

Regions marked with a cross (†) are those that were not the primary focus of this investigation but that were still significant at $p < .001$, 20 voxels (k-values listed for these were taken from the thresholding map at $p < .001$). All other regions (e.g., limbic, prefrontal) are listed at $p < .005$, 10 voxels. BA refers to putative Brodmann's area; L and R refer to left and right hemispheres; x, y, and z refer to MNI coordinates; t refers to the t score at those coordinates (local maxima); r refers to the correlation coefficient representing the strength of the association between each regressor and activity in the specified region; k refers to the number of voxels in each significant cluster. subACC = subgenual anterior cingulate cortex; DMPFC = dorsomedial prefrontal cortex; dACC = dorsal anterior cingulate cortex; VMPFC = ventromedial prefrontal cortex; VLPFC = ventrolateral prefrontal cortex; ALPFC = anterolateral prefrontal cortex; somatosens. cortex = somatosensory cortex; IPL = inferior parietal lobule.

negative affect in the face of negative treatment (Wirth & Williams, 2009; Schmitt & Branscombe, 2002; Branscombe, 1998), our examination of the underlying neural processes associated with perceived discrimination suggests that making race-related discriminatory attributions may facilitate regulation of negative affective responses as negative treatment is occurring, and provide a temporary coping mechanism in such situations.

Although making discriminatory attributions may, in some cases, be distress-reducing in the short term, these findings should not be taken to imply that being the target of discrimination has no negative consequences. Many behavioral studies have suggested otherwise, and additional studies using novel levels of analysis will continue to elucidate these consequences. For example, as mentioned previously, facing repeated negative social treatment as the target of discrimination may increase stress-related physiological responding or lead to long-term mental and physical health problems (Mays et al., 2007). In addition, the frequent need to regulate one's response to negative social treatment (either through external attributions for negative treatment or other means) may interfere with one's ability to cope with other stressors. For example, research on ego depletion has shown that exerting self-control or emotion regulatory processes can impair one's ability to engage these processes subsequently (Baumeister, Vohs, & Tice, 2007).

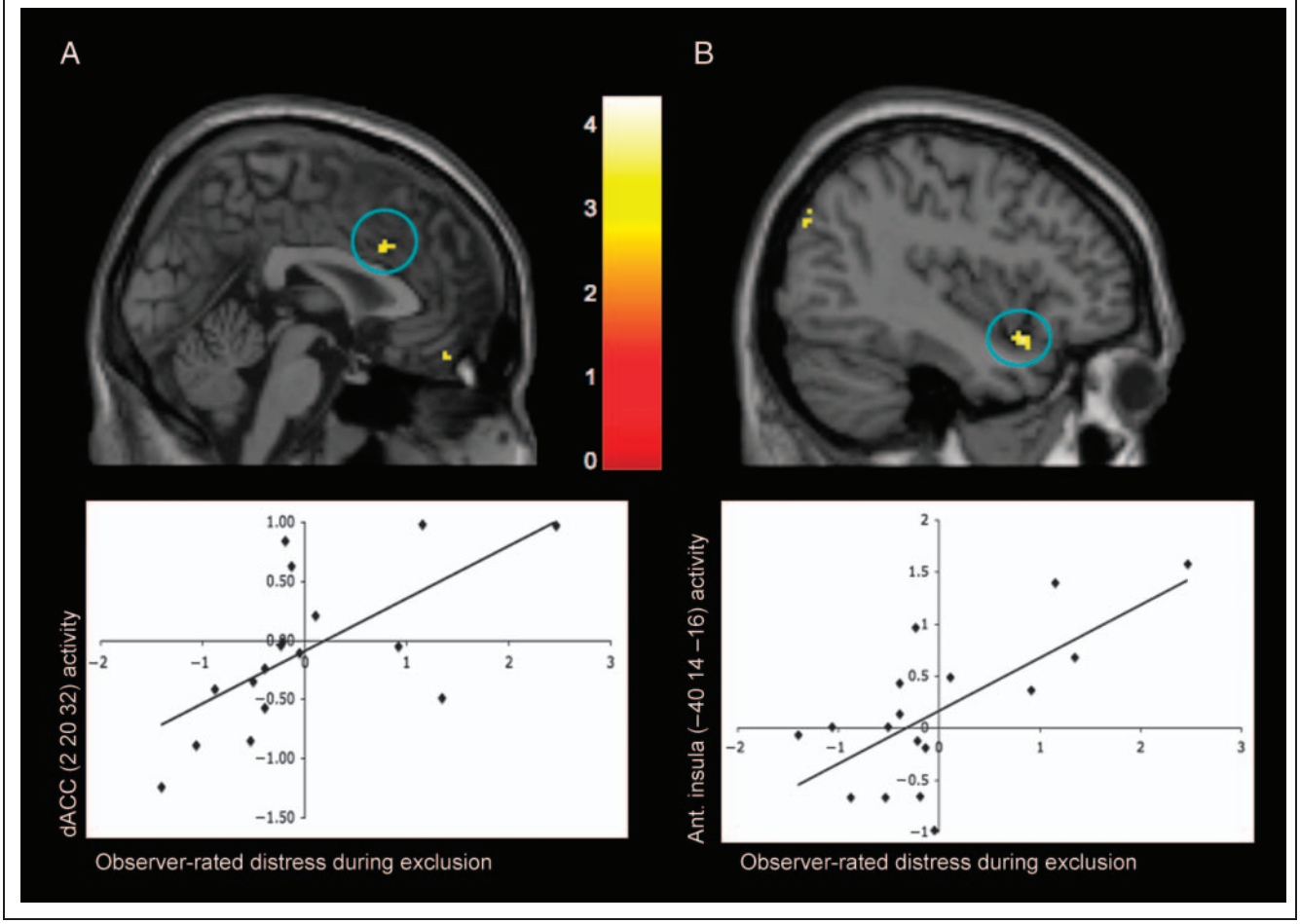

Figure 1. Activity during exclusion versus inclusion that correlated positively with observers' ratings of participants' distress in the (A) dACC and (B) anterior insula.

Table 3. Correlations with Discriminatory Attributions

Anatomical Region	*BA*		*x*	*y*	*z*	*t*	*r*	*k*	*p*
Positive Associations with Attributing Exclusion to Race									
rACC	32	R	8	38	−6	3.36	.64	11	<.005
Lat. temp. cortex†	21	L	−46	−10	−22	5.64	.82	47	<.0001
Brainstem†		R	2	−38	−48	4.88	.77	24	<.0001
Negative Associations with Attributing Exclusion to Race									
dACC	6/32	R	6	8	50	4.01	−.71	45	<.001
Motor cortex†	4	L	−46	−6	56	4.27	−.73	62	<.0005
Motor cortex†	4	R	50	−12	38	5.58	−.81	534	<.0001

Regions activated during exclusion vs. inclusion that correlated significantly with participants' self-reported ratings of discriminatory attributions.

Regions marked with a cross (†) are those that were not the primary focus of this investigation but that were still significant at $p < .001$, 20 voxels (k-values listed for these were taken from the thresholding map at $p < .001$). All other regions (e.g., limbic, prefrontal) are listed at $p < .005$, 10 voxels. BA refers to putative Brodmann's Area; L and R refer to left and right hemispheres; x, y, and z refer to MNI coordinates; t refers to the t score at those coordinates (local maxima); r refers to the correlation coefficient representing the strength of the association between each regressor and activity in the specified region; k refers to the number of voxels in each significant cluster. rACC = rostral anterior cingulate cortex; lat. temp. cortex = lateral temporal cortex; dACC = dorsal anterior cingulate cortex.

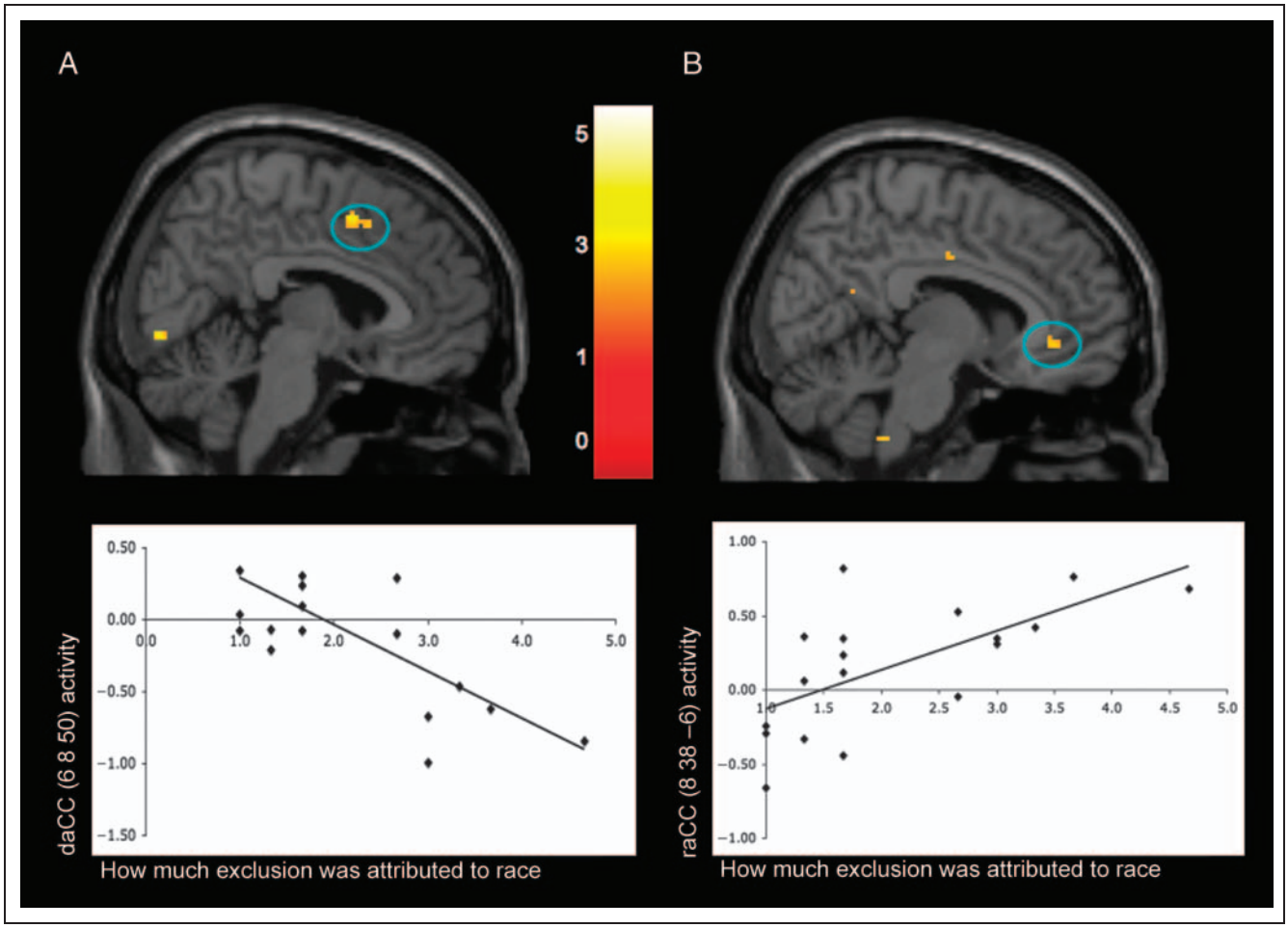

Figure 2. Correlations between neural activity and self-reported discriminatory attributions. (A) dACC activity during exclusion versus inclusion that correlated negatively with the degree to which participants believed their exclusion was related to their race. (B) rACC activity during exclusion versus inclusion that correlated positively with the degree to which participants believed their exclusion was related to their race.

One implication of this is that having to cope with or regulate the stress of discrimination may affect one's ability to cope with or regulate subsequent stressors (Baumeister, Faber, & Wallace, 1999). Thus, it is possible that, for individuals who experience discrimination frequently, making discriminatory attributions may help reduce distress at the time of the experience, but may also leave these individuals ego-depleted—decreasing their ability to cope with subsequent stressors and thus increasing psychological and physical stress over time. Although we have shown that making discriminatory attributions during the unfolding of a negative social event is associated with less distress-related neural activity and heightened activity in regulatory regions, the cumulative toll that making these attributions and regulating distress has over time remains unclear and will be an important topic of future research.

It is not clear in this study why discriminatory attributions correlated negatively with distress-related neural activity but positively with self-reported social distress. One possibility is that the self-report measure of social distress and the distress-related neural activity reflect somewhat different affective consequences of perceiving discrimination. For example, Major et al. (2003) have shown that making discriminatory attributions for negative social treatment may attenuate self-directed emotions (e.g., depressed, worthless), but not necessarily other-directed emotions (e.g., angry, mad). Thus, it is possible that the self-report measure and the neural measure were assessing slightly different features of affective experience. Another possibility is that making discriminatory attributions may have different effects on immediate affective experience (which might be better captured by the neural responses) versus reflective affective experience (which might be better captured by the self-report measures) (Redelmeier & Kahneman, 1996). Given that the self-report measure of social distress did not demonstrate typical patterns of correlations with neural activity, it is not clear what this measure was assessing in the current study. Future research will be needed to more fully examine this as well as to delineate the effects of making discriminatory attributions on the neural correlates of self- versus other-directed emotions and immediate versus reflective affective responses following negative social treatment.

In addition, future studies should also examine other contextual factors that might have influenced the findings reported here. For example, one limitation of the current

study is that the researchers and interviewers who asked participants about their exclusion experience were White. Although this likely boosted the implicit priming of race (i.e., all the individuals interacting with the participant prior to the scan were White), it is also possible that the participant acted differently during their interview than they would have if a Black experimenter conducted the interview—particularly given that race was a frequent topic of discussion raised by the participants. It would be useful for future work to specifically examine the impact of interacting with either racial ingroup or outgroup members after a discrimination experience. An additional limitation of the current study is that we did not have a videotaped interview before participants were scanned, and thus, we do not have a baseline for participants' affect prior to the experimental manipulation. This would be a useful addition in future studies. Lastly, in interpreting our neuroimaging results, some inferences were based on previous research linking specific regions and behavioral functions. The ability to judge with certainty the meaning of activation in a particular region is limited, given the multiple functions that a region may be involved in (Poldrack, 2006), and future work directly testing these inferences will be useful in providing additional support for our proposed interpretations.

Finally, it is worth noting that although we did find greater activity in the anterior insula in the direct comparison of exclusion versus inclusion, we did not find greater activity in dACC as previous research typically has, reflecting the distress that participants feel as they are being excluded (e.g., DeWall et al., in press; Way et al., 2009; Eisenberger, Gable, et al., 2007; Eisenberger, Taylor, et al., 2007; Eisenberger et al., 2003). Given that one of our hypotheses was that attributing negative social treatment to race might reduce the negative consequences of social exclusion, it is not too surprising that the previously observed main effect of dACC activity during social exclusion compared to inclusion did not replicate. In fact, if it is the case that making discriminatory attributions is pain-reducing, and the experimental situation (being excluded by outgroup members) elicited a high frequency of discriminatory attributions, it would follow that certain types of pain-related neural activity might not be observed during social exclusion.

To conclude, the findings reported here provide new insight into the underlying processes that occur when individuals perceive racial discrimination. Although the long-term negative consequences of discrimination are undeniable, these findings suggest one possible mechanism whereby individuals who deal with negative social treatment on a regular basis are able to cope with these experiences as they occur. As such, this study is the first to provide neural evidence that discriminatory attributions may help reduce immediate negative affect among stigmatized groups in situations of negative treatment and provides new insight into the experiences of those targeted by racial bias. Future work will be needed to examine the long-term consequences of these processes.

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Reprint requests should be sent to Naomi I. Eisenberger, 1285 Franz Hall, Box 951563, Los Angeles, CA 90095-1563, or via e-mail: neisenbe@ucla.edu.

Notes

1. One participant was found through visual inspection to be a multivariate outlier across all behavioral (self-report) correlational analyses. Further analysis of the standardized residuals and Cook's Distance for each of these behavioral analyses confirmed that this participant's data was disproportionately influential on the regression line for the majority of these analyses, and this participant was excluded as a result. Given that this participant was not an outlier on any single scale, this participant was included in all neuroimaging analyses, which included only one behavioral variable in any given regression analysis. It is worth noting, however, that none of the neuroimaging findings showed any meaningful differences when this participant was excluded from analyses.
2. To ensure that the observed correlations with observer-rated distress were not simply due to individual differences in the tendency to experience negative affect, we examined correlations with neuroticism. Participants completed the neuroticism subscale of the Eysenck Personality Questionnaire (EPQ; Eysenck & Eysenck, 1975). There was no relationship between neuroticism scores and observer-rated distress ($r = -.003$, *ns*), and controlling for neuroticism did not change the associations between observer-rated distress and neural activity during observed exclusion versus inclusion.

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