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An fMRI investigation of the effects of culture on evaluations of stigmatized individuals

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ABSTRACT

Certain groups (e.g., women, older adults, and the economically disadvantaged) are universally stigmatized. Numerous studies, however, have identified cross-cultural differences in the attitudes expressed toward stigmatized groups. These differences may potentially be due to existing cross-cultural dissimilarities in social status for some groups. The current study used fMRI to examine whether Chinese and Caucasian-American participants engage the same cognitive and affective mechanisms when perceiving stigmatized individuals with similarly low social status in both cultures (homeless individuals), but different cognitive and/or affective processes when evaluating stigmatized individuals whose status differs across cultures (older adults). Using a social neuroscience approach can provide unique insight into this question because the neural regions involved in cognitive and affective evaluations of stigmatized individuals have been well characterized. Results revealed that Chinese participants and Caucasian-American participants engaged similar patterns of negative affective processing associated with disgust (left anterior insula) when evaluating homeless individuals. Moreover, self-reported negative explicit attitudes toward homeless individuals were associated with increased activity in the insula. However, Chinese participants and Caucasian-American participants engaged increased activity in neural regions associated with status (ventral striatum) when they evaluated older adults. Moreover, self-reported attitudes toward older adults and ventral striatal activity were correlated with the extent to which participants reported being affiliated with their respective cultural traditions.

Introduction

Extensive research has demonstrated that certain groups (e.g., older adults and homeless individuals) are universally stigmatized (Chappell, 2003; Cuddy et al., 2008; Cuddy et al., 2005; Cuddy et al., 2009). However, it remains an open question whether the specific attitudes associated with those stigmas are consistent across cultures. Understanding whether culture affects attitudes toward stigmatized individuals is important because it can shed light on stigma formation and the malleability of stigma-related attitudes. The current study examined whether individuals from two different cultures (U.S. and China) have converging or diverging attitudes toward homeless individuals and older adults, and why that might be.

An important factor underlying whether culture impacts attitudes toward homeless individuals and older adults is the respective social status of homeless individuals and older adults in the U.S. and China. Perceived social status reliably predicts prejudice toward specific stigmatized groups (e.g., Cuddy et al., 2007; Fiske et al., 2002). Indeed, the Stereotype Content Model (e.g., Fiske et al., 2002) has demonstrated that the negative attitudes U.S. perceivers have toward stigmatized individuals are modulated by the respective social status of that stigmatized group. According to this model, homeless individuals are amongst the lowest social status stigmatized group, eliciting disgust and contempt from perceivers (see also Harris and Fiske, 2006). Older adults, however, have relatively higher status, and elicit feelings of pity and disrespect from perceivers. In both cases, these groups are stigmatized and elicit generally negative attitudes, but one group (homeless individuals) elicits more negative attitudes than the other (older adults). Thus, if two cultures have greater differences in the status they ascribe to older adults as compared to homeless individuals, then it is likely that their attitudes toward those individuals will differ as a function of their relative status.

One recent study found that homeless individuals have similarly low status across ten non-U.S. countries (Cuddy et al., 2009). However, it has been widely shown that older adults have higher social status in Eastern (e.g., mainland China) as compared to Western (e.g., the U.S.) cultures (Helfrich, 1979; Ikels, 1991; Montepare and Zebrowitz, 1993). With these findings in mind, Chinese and Caucasian-American participants would be expected to have converging attitudes toward homeless individuals, but diverging attitudes toward older adults (with Chinese participants' viewing older adults more favorably than do Caucasian-American participants). An important consideration here, however, is how strongly participants affiliate with their culture. Indeed, cultural affiliation (such

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as endorsing cultural stereotypes) has been widely shown to better predict individual behavior, even when those stereotypes are inconsistent with personal beliefs (for review, see Chiu et al., 2010).

Using strictly behavioral techniques might limit the ability to disentangle why Chinese and Caucasian-Americans have similarly negative attitudes toward homeless individuals, but diverging attitudes toward older adults because disparate behavioral outcomes could stem from different mechanisms. A social neuroscience approach, however, is ideally suited to shed light on these mechanisms because the neural regions involved in evaluating stigmatized individuals (e.g., homeless individuals, older adults; e.g., Harris and Fiske, 2006; Krendl et al., 2006; Krendl et al., 2013; Krendl et al., 2012; Krendl et al., 2009) and social status (Chiao et al., 2009; Ly et al., 2011; Muscatell et al., 2012; Singer et al., 2004; Zink et al., 2008) have been well-characterized. More specifically, evaluating homeless individuals elicits higher negative affective responses (e.g., increased activity in the left anterior insula, a region widely implicated in disgust) and reduced activation in the ventromedial prefrontal cortex (vmPFC) — a region critical for mentalizing and individuation (e.g., Gallagher and Frith, 2003; Harris and Fiske, 2006) as compared to evaluating older adults (Harris and Fiske, 2006; 2007). Moreover, neural activity in response to homeless individuals is often modulated by individual differences in negative attitudes toward that group (e.g., Krendl et al., 2009; 2012). If homeless individuals elicit relatively consistent negative attitudes across cultures (as predicted), Chinese (Eastern) and Caucasian-American (Western) individuals would likely engage similar affective (e.g., heightened insula activity) and reduced cognitive (e.g., reduced vmPFC activity) processes when evaluating these groups (Hypothesis 1a). However, individual differences in explicit bias could modulate the magnitude of the negative affective response (Hypothesis 1b).

If older adults elicit different emotional responses across cultures (as predicted), this may stem from cultural differences in pity or sensitivity to older adults' social status. Cultural differences in pity would likely be reflected in higher engagement of insula and anterior cingulate cortex – which have previously been implicated in empathy (Bernhardt and Singer, 2012; Decety and Jackson, 2006) – for Chinese as compared to Caucasian-American participants (Hypothesis 2). In contrast, if cultural differences in perceived social status underlie Chinese participants' disparate attitudes toward older adults, then one of two patterns would emerge in the ventral striatum and parahippocampal gyrus — regions that have previously been implicated in reward and status (e.g., Ly et al., 2011; Singer et al., 2004; Zink et al., 2008). On the one hand, Chinese participants may drive the effects by having greater activity in these regions as compared to Caucasian-American participants when evaluating images of older as compared to young adults. On the other hand, Caucasian-American participants could drive the effects by showing less activation in these status regions in response to older as compared to younger targets, whereas Chinese participants would not differ in their response in these regions (Hypothesis 3a). Although Hypothesis 2 and 3a are not necessarily mutually exclusive, additional support for Hypothesis 3a would emerge if individual differences in cultural affiliation predicted the magnitude of activation in these regions for Chinese participants, as well as their explicit attitudes (Hypothesis 3b).

An additional consideration in the current investigation is whether the race of the stigmatized groups (Chinese or Caucasian) will affect how they are perceived. Although previous research suggests that status is accurately identified within cultures (e.g., Montepare and Zebrowitz, 1993), status may not necessarily be accurately detected across cultures (Rule et al., 2010). Moreover, cross-cultural fMRI research has identified heightened neural sensitivity to same race social stimuli as compared to other race social stimuli (e.g., Adams et al., 2010; Chiao et al., 2008). Although I did not have specific predictions for how (if at all) target race might affect perceptions of stigma across cultures, I included this as an additional exploratory variable because of previous research on this topic.

Methods

A total of 17 Caucasian-American (M_{age} = 20.9 years, SD = 1.1; 10 male) and 17 Chinese (M_{age} = 21.8 years, SD = 2.7; 6 male) participants completed this study. Participants were all recruited from the greater Boston area. First generation Chinese American individuals were also recruited to participate in a larger study on cross-cultural differences, but their data are reported elsewhere. All participants received $100 for participating. Of the original sample of participants recruited (18 Chinese and 19 Caucasian-American), one Chinese and one Caucasian-American participant were excluded from analyses because they moved more than 2 mm during each functional run. One Caucasian-American participant was also excluded because she did not complete the imaging session due to claustrophobia.

Participant recruitment

Participants were recruited by two Mandarin-speaking research assistants via electronic mailings and flyers. Chinese participants were international university students who were studying in the United States. These individuals were all born in China (or surrounding islands), and had been in the United States for less than one year. Fifteen of the Chinese participants were from mainland China, one was from Singapore, and one was from Taiwan. Caucasian-American participants were also undergraduate students, born in the United States to parents who had also been born and raised in the United States. Special attention was paid to matching the Caucasian-American participants and the Chinese participants for age, and efforts were made to control for gender as well.

Behavioral methods

Participants completed several unrelated fMRI tasks. The data from one of these tasks (stigma perception) is reported here. Tasks were presented in pseudorandom order across participants, and no order effects were found. During the stigma perception study, participants viewed 200 pictures. Of those, 60 depicted homeless individuals (30 Chinese, 30 White), 60 depicted older adults (30 Chinese, 30 White), and the remaining 80 were control images (40 Chinese individuals, 40 White individuals). All images were color photos that were scaled in Adobe Photoshop at 72 pixels/inch resolution with a height of 360 pixels. The images of the homeless individuals were full-body images that were downloaded from various Internet search engines. All images were presented such that the race of the individual in the image was clearly visible. The images of the older adults were face-only shots also collected from various search engines. Using head-only shots ensured the salience of the target's age. The Caucasian and Chinese older adults were all faces that appeared to be similarly old (e.g., at least two experimenters agreed that the individual pictured was between the ages of 60 to 80 years old). Half the control images were matched to the homeless individuals, the other half were matched to the older adults. Thus, the former were full body shots, matched for the proportion of male and female images in the homeless images. The full body shot control images were matched to the homeless images as closely as possible in posture (e.g., individuals were lying down or slouched) and location (e.g., outdoors). The latter were face only shots, also matched in gender to the older adults, but all depicting young adults (see Fig. 1 for example stimuli).

A separate group of raters (N = 36) who were all White undergraduates at Indiana University rated the stimuli for attractiveness, familiarity, and likeability (for all 1 = very little, 7 = very much). Subsequent analyses of these ratings demonstrated that the two sets of control images did not differ in their relative attractiveness or familiarity (both $ts < 1$), although the control images for the homeless individuals were rated as being more likeable than the control images for the older adults ($t(34) = 2.28$, $p = .03$, $d = .75$). The images of homeless

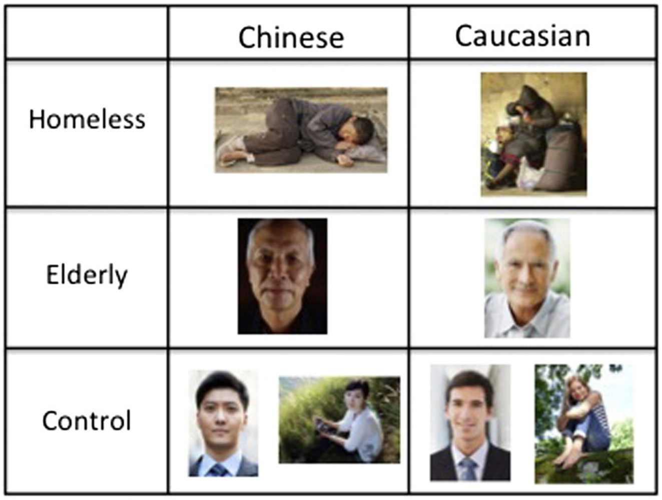

Fig. 1. Examples of images used in the task. Images of homeless individuals and older adults included males and females. Homeless individuals and matched controls varied in age, whereas older adults and matched controls did not. Images were selected to ensure that each individual's ethnicity was clearly visible.

individuals and older adults did not differ in their perceived attractiveness or likeability ($t(34) = 1.26$, $p = .22$, $d = .43$ and $t(34) = 1.66$, $p = .11$, $d = .54$, respectively). However, these images did differ in familiarity, with older adults being rated as being more familiar than homeless individuals ($t(34) = 2.28$, $p = .03$, $d = .89$).

While undergoing fMRI, participants viewed each image for 2000 ms, during which time they were instructed to indicate via button-press whether they liked or disliked the person pictured. Images were presented in an event-related fashion with jittered fixation throughout (0–6000 ms). Images were pseudorandomized such that there were no more than two consecutive presentations of the same type (e.g., no more than two Chinese homeless individuals in a row).

Following the scan, participants completed a series of questionnaires, including a measure that assessed their previous exposure to homeless individuals. This measure was adapted from the Intergroup Contact Scale (Islam and Hewstone, 1993), which assesses previous experience with and one's affect toward Black individuals. In the current measure, the word "Black" was replaced with "homeless", and items either loaded onto the amount of prior experience participants had with homeless individuals (e.g., "The cities I have lived in have had many homeless people"), or the general affect that participants had toward homeless individuals (e.g., "I have had many positive experiences with homeless people"). Responses were scored on a 1 (strongly disagree) to 7 (strongly agree) Likert scale. Items that loaded onto prior experience were summed to create an overall composite score of familiarity with homeless individuals, whereas the items that loaded onto affect were summed to create an overall affective response to homeless individuals.

Participants also completed the East Asian Acculturation Measure (EAAM; Barry, 2001), a 29-item scale that includes four subscales that assess assimilation (e.g., "When I am in my apartment/house, I typically speak English"), separation (e.g., "I prefer going to social gatherings where most of the people are Asian"), integration (e.g., "I feel very comfortable around both Americans and Asians"), and marginalization (e.g., "Sometimes I feel that Asians and Americans do not accept me"). These four subscales assess the extent to which East Asians are: willing to forgo their own cultural identity in order to integrate with their new society (assimilation); maintain their ethnic identity and traditions without incorporating their new culture into their identity (separation); maintain their ethnic identity while also embracing traditions of their new culture (integration); and feel as though they have no cultural or psychological connection with either their traditional or current culture (marginalization).

Finally, all participants completed a modified version of Kogan's (1961) Attitudes Toward the Elderly Scale. The scale was modified to change all references from "old people" to "older adults." No other modifications were made. The scale consisted of 34-items that assessed participants' positive and negative explicit attitudes toward older adults with questions such as, "There are a few exceptions, but in general most older adults are pretty much alike," and "Most older adults are constantly complaining about the behavior of the younger generation." Participants responded to each items using a 1 (strongly disagree) to 7 (strongly agree) Likert scale.

fMRI methods

Anatomical and functional whole-brain imaging was performed on a 3.0 T Siemens Trio Scanner (Trio, Siemens Ltd., Enlargen, Germany) using standard data acquisition protocols. Anatomical images were acquired using a high-resolution 3-D magnetization prepared rapid gradient echo sequence (MP-RAGE; 144 sagittal slices, TE = 7 ms, TR = 2200 ms, flip angle = 7°, $1 \times 1 \times 0.89$ mm voxels). Functional images were collected in two functional runs of 172 time points each, using a fast field echo-planar sequence sensitive to blood-oxygen level-dependent contrast ($T2^*$) (31 axial slices per whole-brain volume, matrix: 72×72, resolution (xyz): $3 \times 3 \times 4$, 0 mm skip, TR = 2000 ms). Data underwent standard preprocessing to remove sources of noise and artifact. Here, voxels were resampled to be $3 \times 3 \times 3$ mm. Functional data were spatially smoothed (6 mm full-width-at-half-maximum [FWHM]) using a Gaussian kernel. I used a general linear model incorporating task effects for the three different image types (homeless, older adult, or control), the two different cultures of the target images (same or different), and 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 each comparison at each voxel and for each subject. Unless otherwise noted, imaging data were extracted at a threshold of $p < .005$, uncorrected. A Monte Carlo conversion script from Slotnick et al. (2003) determined the extent threshold required to convert $p < .005$ uncorrected to $p < .05$ corrected (e.g., Lieberman and Cunningham, 2009). I chose 1000 iterations of the Monte Carlo to select the most conservative threshold (18 contiguous voxels at $p < .005$; see Woo et al., 2014 for discussion on cluster thresholding).

fMRI analyses conducting for hypothesis testing

The fMRI analyses were designed to examine whether Chinese and Caucasian-American participants engaged similar affective and cognitive neural mechanisms when they evaluated homeless individuals (Hypothesis 1a), and the extent to which individual differences in explicit bias would modulate the magnitude of those responses (Hypothesis 1b). With respect to older adults, however, it was predicted that Chinese and Caucasian-American participants would show differing patterns in neural activation when evaluating older adults. This could be due either to disparate affective responses (Hypothesis 2), and/or cultural differences in perceived social status (Hypothesis 3a). Although these two predictions are not necessarily mutually exclusive, in the case of the latter, individual differences in cultural affiliation would predict the magnitude of activation in these regions for Chinese participants, as well as their explicit attitudes (Hypothesis 3b). Unless noted, all significant peaks throughout the results were collected at a corrected threshold of $p < .05$ (see above for details).

Conjunction analyses were conducted in order to identify neural regions that were similarly active for both Chinese and Caucasian-American participants when they evaluated images of stigmatized individuals (e.g., Hypothesis 1a). These analyses used a p-value of .01 (leading to a joint probability of .001 using Fisher's estimate; Fisher, 1950) and a 6-voxel extent (see Adams et al., 2010 for a similar analytical approach). Group differences in neural activation, however, were extracted using between-group *t*-tests (Hypothesis 1a, Hypothesis 2, Hypothesis 3a).[1] In order to control for possible group differences in person perception more generally, the aforementioned analyses were all conducted using the respective stigma condition > control condition contrast (see Adams et al., 2010 for a similar approach). The goal of using these contrasts was to control for any potential baseline differences in how Chinese and Caucasian-American participants form novel impressions.

Individual differences (Hypotheses 1b and 3b) were conducted using data-driven region of interest (ROI) analyses also from the stigma > control contrast. The regions for the ROI analyses were identified from contrasts within the current study, but the specific peaks for the ROI analysis were identified independently from other research. Those peaks were then used to extract parameter estimates from relevant condition > control contrasts in the current task. This approach has been used in other research in order to generate an unbiased measure of mean signal changes to perform offline analyses (e.g., Cloutier and Gyurovski, 2014). ROIs were extracted using the functional ROIs tool in SPM8 (marsbar; Brett et al., 2002). All significant voxels within 8 mm of a peak location were included in each ROI. A peak in the left insula that was implicated by Harris and Fiske (2006; left insula, − 41, 13, 0) in evaluating images of homeless individuals, as well as the peak in the left vMPFC that was implicated as being more active in response to perceiving ingroup (e.g., pride) members (− 2, 48, − 7) were identified to evaluate Hypothesis 1b. The peak for vmPFC relating to the ingroup was selected because it most closely paralleled the design of the current study in which homeless individuals were compared to non-stigmatized control (e.g., ingroup) images. For Hypothesis 3b, peaks in the bilateral ventral striatum and bilateral parahippocampal gyrus were those that were identified by Zink et al. (2008) as being involved in perceiving stable social hierarchies (left ventral striatum: − 3, 15, − 6; right ventral striatum: 6, 18, − 3; left parahippocampal gyrus: − 21, − 27, − 9; and right parahippocampal gyrus: 27, − 24, − 12). These peaks were selected because cultural differences in attitudes toward older adults likely reflect differences in stable social hierarchies. This is because older adults' social status may be viewed as something that cannot be easily changed, which is not necessarily the case with someone who has high social status due to their professional title or monetary worth (either of which he or she could potentially lose at any time). Zink et al. (2008) was one of the few studies on social status that directly dissociated the neural correlates engaged in perceiving stable from unstable social hierarchies, and therefore best suited to represent sustained social hierarchies.

Results

Behavioral results

Behavioral data were analyzed to address whether Chinese and Caucasian-American participants differed on five key points: 1) their previous exposure to and attitudes toward homeless individuals; 2) their prepotent attitudes toward older adults (as measured by the Attitudes Toward the Elderly Scale; Kogan, 1961); 3) the extent to which they affiliated with their culture; 4) their attitudes toward the homeless individuals and older adults that were collected during the scanning session; and 5) the extent to which those attitudes were predicted by their cultural affiliation. The results from these analyses informed the manner in which the fMRI data were analyzed (see fMRI results for details). These data are reported sequentially below.

Previous familiarity with and affect toward homeless individuals

In order to examine whether Caucasian-American and Chinese participants differed in either their familiarity with or affect toward homeless individuals, two independent samples *t*-tests were conducted (one for familiarity, and one for affect). Results revealed no difference between the two groups in familiarity ($t < 1$, $p = .94$, $d = .02$) or affect ($t(32) = 1.44$, $p = .16$, $d = .49$).

Explicit positive and negative attitudes toward older adults

Because the Attitudes Toward the Elderly Scale (Kogan, 1961) is subdivided into positive and negative affect, these subscales were examined separately using independent samples t-tests. For each subscale, larger scores indicating more of that type of affect. Overall, Caucasian-American and Chinese participants did not differ in their positive affect toward older adults ($M_{Caucasian\text{-}American}$: 61.47, SD = 13.23; $M_{Chinese}$: 58.00, SD = 11.63; $t < 1$, $p = .42$, $d = .28$), but Caucasian-American participants had moderately higher negative affect toward older adults as compared to Chinese participants ($M_{Caucasian\text{-}American}$: 105.41, SD = 15.15; $M_{Chinese}$: 94.29, SD = 19.59; $t(32) = 1.85$, $p = .07$, $d = .64$). However, there was low inter-item reliability on these items (Cronbach's $\alpha = 0.54$).

East Asian acculturation measure

Of interest in the East Asian Acculturation Measure (EAAM) was whether Chinese and Caucasian-American participants differed on any of the four subscales (see Methods for details). A Bonferroni correction was applied, resulting in a new threshold of $p < .013$ to reach significance, then independent samples *t*-tests were conducted to examine potential group differences on the subscales. The two participant groups only differed on their assimilation and separation scores (both $ps < .001$). As expected, Chinese participants had less assimilation compared to Caucasian-American participants, ($t(32) = 7.35$, $p < .001$, $d = 2.52$), and indicated less separation from their Asian culture: ($t(32) = 6.41$, $p < .001$, $d = 2.20$). There was no difference in self-reported integration or marginalization ($t < 1$, $p = .78$, $d = .10$; $t(32) = 1.50$, $p = .14$, $d = .51$, respectively). Since there were no group differences on these two subscales, they were not considered further.

Liking ratings

In order to examine whether group differences emerged in Chinese and Caucasian-American participants' liking toward the stigmatized and non-stigmatized individuals, their ratings that were collected during the scan were converted to a proportion score by dividing the total number of times participants indicated that they would like the target image by the total number of images per condition. For instance, if a participant indicated that he or she would like 20 of the 30 Chinese homeless individuals, then his or her overall proportion score for the Chinese homeless individuals would be 0.67. The proportion liking scores (heretofore referred to as their liking ratings) were then entered into a 3 (Image Type: homeless, older adults, control) × 2 (Participant Group: Chinese or Caucasian-American) mixed ANOVA. For all means and SDs, see Table 1. Results revealed a main effect of Image Type ($F(2,64) = 179.07$, $p < .001$, $\eta^2_{partial} = .85$), but no effect of Participant Group ($F < 1$, $p = .93$, $\eta^2_{partial} < .01$) or interaction ($F < 1$, $p = .77$, $\eta^2_{partial} < .01$).

The effect of Image Type emerged because both Caucasian-American and Chinese participants had higher liking ratings for control images than they did for images of the older adults, ($t(33) = 3.10$, $p = .004$,

[1] In order to simplify the presentation of the analyses, the data were analyzed separately for the two stigma conditions (homeless individuals and older adults). This allowed the results to be presented as they related to each hypothesis. However, it is important to note that the results from the 2 (stigma condition: homeless individual or older adult) × 2 (participant group: Chinese or Caucasian-American) mixed-effect ANOVA were consistent with the analyses reported here. For instance, in the stigma × participant group interaction, I found activation in the ventral striatum (9, 21, − 6), and not the left insula. Conversely, heightened activation emerged in the left insula (− 30, 24, 12) for the effect of stigma.

Table 1
Mean proportion liking (0 = highly disliked, 1 = highly liked) by image type for both Caucasian-American and Chinese participants. Proportion liking is shown both collapsed across target culture (overall), as well as by target culture membership (same or different) for SD ().

		Overall	Same culture	Different culture
Caucasian-American participants	Homeless	.25 (.19)	.19 (.21)	.31 (.19)
	Old	.79 (.19)	.78 (.21)	.80 (.19)
	Control	.87 (.11)	.84 (.12)	.89 (.11)
Chinese participants	Homeless	.23 (.21)	.28 (.24)	.19 (.21)
	Old	.82 (.14)	.82 (.17)	.83 (.15)
	Control	.86 (.13)	.87 (.14)	.86 (.14)

d = .34), and, in turn, they had higher liking ratings for the images of older adults as compared to images of homeless individuals ($t(33) = 13.10$, $p < .001$, $d = 3.07$).

Effects of cultural affiliation with attitudes toward the elderly

One prediction in the current study was that individual differences in cultural affiliation would predict Chinese participants' liking ratings for older adults (for review, see Chiu et al., 2010). To examine this, two hierarchical multiple regressions (one for Chinese participants and one for Caucasian-American participants) were conducted to examine whether their self-reported assimilation and separation scores (which were the only two subscales that differed from Caucasian-American participants on the East Asian Acculturation Measure EAAM; Barry, 2001) predicted their liking ratings when controlling for their prepotent attitudes toward the elderly (using their Attitudes Toward the Elderly Scores). Although the model was not significant for Caucasian-American participants ($F(3,16) = 1.59$, $p = .24$), it was significant for Chinese participants ($F(3,16) = 4.94$, $p < .02$). Specifically, results demonstrated that assimilation significantly predicted the liking ratings (ß = − .57 $p = .03$; R^2 change = .32) when controlling for individual differences in attitudes toward the elderly (ß = .74, $p < .005$). Separation scores did not predict liking ratings ($t < 1$, $p = .61$). In other words, less willingness to forgo their Asian traditions (assimilation) was associated with Chinese participants' overall higher liking ratings toward older adults.

Exploratory analysis: effect of target culture and participant group on explicit attitudes toward non-stigma and stigma

In order to examine whether group differences emerged in Chinese and Caucasian-American participants' liking ratings toward the same race and other race stigmatized and non-stigmatized individuals, I conducted a 2 (Target Culture: same culture or different culture) × 3 (Image Type: homeless, older adults, control) × 2 (Participant Group: Chinese or Caucasian-American) mixed ANOVA with liking ratings as the dependent variable. For all means and SDs, see Table 1. Results revealed a main effect of Image Type ($F(2,64) = 179.07$, $p < .001$, $\eta^2_{partial} = .85$). Both Caucasian-American and Chinese participants had higher liking ratings for control images as compared to images of the older adults, ($t(33) = 3.07$, $p = .004$, $d = .34$), and, in turn, they had higher liking ratings for the images of older adults as compared to images of homeless individuals ($t(33) = 13.10$, $p < .001$, $d = 3.07$).

A three-way interaction between Target Culture, Image Type, and Participant group also emerged, $F(2,64) = 6.71$, $p = .002$, $\eta^2_{partial}$ = .17. To unpack this interaction, I conducted two separate 2 (Target Culture: same or different) × 3 (Image Type: homeless, older adults, control) ANOVAS: one for Caucasian-American participants, and the other for Chinese participants. Consistent with the original ANOVA, both groups revealed a main effect of Image Type (both $Fs > 84$, $\eta^2_{partials} > .84$). The Caucasian-American participants also revealed a main effect of Target Culture ($F(1,16) = 7.47$, $p = .02$, $\eta^2_{partial} = .32$) and a Target Culture × Image Type interaction ($F(1,32) = 6.15$, $p = .005$, $\eta^2_{partial} = .28$). However, neither of those effects were significant for the Chinese participants (Target Culture: $F(1,16) = 2.97$, $p = .10$, $\eta^2_{partial} = .16$; Target Culture × Image Type: $F(2,32) = 2.43$, $p = .10$, $\eta^2_{partial} = .13$). There were no other main effects or interactions.

A closer examination of the Caucasian-American participants' data demonstrated that the main effect emerged because Caucasian-American participants overall had higher liking ratings for the different culture as compared to same culture individuals ($t(16) = 2.73$, $p = .02$, $d = .56$). However, this main effect was qualified by an interaction with Image Type, which was driven by the fact that Caucasian-American participants indicated lower liking ratings for the same culture homeless individuals as compared to the different culture homeless individuals ($t(16) = 3.53$, $p = .003$, $d = .60$). See Table 1 for all means.[2]

fMRI results

Hypothesis 1a. Chinese and Caucasian-American participants engage similar affective mechanisms when evaluating homeless individuals.

In order to find similarities in neural activation between Chinese and Caucasian-American participants, a conjunction analysis was conducted on the homeless > control contrasts to identify regions that were more active in response to homeless individuals compared to homeless control images for both participant groups (see Methods for details). Results revealed heightened activation in the left insula (BA 13), as well as in bilateral visual processing regions such as the fusiform gyrus (BA 18/19). The conjunction analysis for the reverse comparison (control > homeless) elicited no overlap in the vmPFC. See Table 2 for complete list of activations.

I next conducted between-group t-tests to examine whether cultural divergence emerged in neural activity in the left insula or vmPFC when Chinese and Caucasian-American participants evaluated homeless > control individuals and control > homeless individuals. For the homeless > control contrast, Chinese participants had greater activation in the left insula compared to Caucasian-American participants, whereas Caucasian-American participants had greater activation in the right superior frontal gyrus (BA 8) and left cingulate gyrus (BA 24) as compared to Chinese participants. Critically, however, there was no difference in the magnitude of vmPFC activity for either group. See Table 3 for complete list of activations.

Hypothesis 1b. Individual differences in liking ratings predict magnitude of activity in the left insula and vmPFC when Chinese and Caucasian-American participants perceive homeless individuals.

In order to better classify these neural responses, a region of interest (ROI) analysis was conducted using peaks in the left insula and left vmPFC that have been previously implicated in evaluating homeless individuals (see Methods for details). These parameter estimates were entered into a 2 (Image Type: homeless or control) × 2 (Participant Group: Chinese or Caucasian-American) ANOVA.

Left insula

The ANOVA revealed a main effect of Image Type ($F(1,32) = 5.07$ $p = .03$, $\eta^2_{partial} = .14$) because the left insula was more active in response to images of homeless individuals as compared to images of control individuals (Fig. 2A). There was no main effect of Participant

[2] Upon examination of the scatterplot in Fig. 4, it was apparent that there was one outlier visible. When removing this outlier from the correlation, the correlation between Chinese participants' self-reported separation and activity in the left ventral striatum remains ($r(16) = -.57$, $p = .02$), and a trend emerges between self-reported assimilation and activity in the left ventral striatum: ($r(16) = -.46$, $p = .07$).

Table 2
Conjunction analysis for Chinese and Caucasian-American participants when they evaluated homeless > control individuals and control > homeless individuals ($p < .05$ corrected). All coordinates MNI.

Region	Coordinates			BA	T	k
	x	y	z			
Homeless > control						
L. dlPFC	45	48	27	46	3.27	8
L. insula	− 36	12	6	13	2.78	6
L. precentral gyrus	− 33	− 15	69	6	3.73	5
L. postcentral gyrus	− 45	− 27	57	2	5.27	88
L. postcentral gyrus	− 33	− 30	72	3	3.57	10
R. cerebellum	18	− 48	− 33	–	4.31	31
R. lingual/fusiform gyrus	21	− 78	− 6	18/19	6.81	627
L. middle occipital gyrus	− 24	− 87	18	18/19	3.31	7
Control > Homeless						
L. cingulate gyrus	− 21	− 45	24	31	4.98	12
R. postcentral gyrus	30	− 24	48	3&4	4.68	88
R. cuneus	3	− 93	21	18	3.62	6
r. parahippocampal gyrus	21	− 45	9	30	3.61	12

Group ($F < 1$, $\eta^2_{partial} < .01$) or interaction ($F < 1$, $\eta^2_{partial} < .01$). To better characterize the nature of the insula response, I next examined whether participants' liking ratings toward homeless individuals (which had been provided during the fMRI task), their self-reported familiarity, or self-reported affect predicted activation in the insula in response to homeless individuals. In order to control for baseline differences in explicit attitudes, each participants' liking rating toward homeless individuals was anchored to their liking rating toward control targets (e.g., proportion liking homeless–proportion liking control), and then correlated with each participants' respective insula response to homeless individuals as compared to control individuals. A marginal negative relationship, $r(34) = -.32$, $p = .07$, suggested that lower liking ratings toward homeless individuals were associated with increased insula activity. There was no relationship between neural activation in the insula and either self-reported familiarity with homeless individuals or self-reported affect toward homeless individuals ($r(34) = .22$, $p = .22$; $r(34) = .05$, $p = .76$, respectively).

Table 3
Results from the between-group *t*-test identifying group differences between Chinese and Caucasian-American participants when they evaluated homeless > controls, and controls > homeless, $p < .05$ corrected. All coordinates MNI.

Region	Coordinates			BA	T	k
	x	y	z			
Homeless > control						
Chinese participants > Caucasian-American participants						
L. precentral gyrus	− 60	0	30	**6**	4.64	39
L. superior frontal gyrus	− 12	− 15	66	6	4.39	39
R. precentral gyrus	60	− 6	36	4&6	4.24	149
L. insula	− 39	− 9	6	13	3.46	28
Caucasian-American participants > Chinese participants						
R. superior frontal gyrus	33	51	45	8	5.1	35
L. cingulate gyrus	− 18	− 12	33	24	3.78	24
Control > Homeless						
Chinese participants > Caucasian-American participants						
R. middle frontal gyrus	45	60	9	10&46	4.13	33
R. superior frontal gyrus	33	51	45	8	5.1	35
L. cingulate gyrus	− 18	− 12	33	24	3.78	24
Caucasian-American participants > Chinese participants						
L. vmPFC	− 18	51	− 24	11	3.27	27
L. precentral gyrus	− 60	0	30	4&6	4.64	39
R. precentral gyrus	60	− 6	36	4&6	4.24	149
L. insula	− 39	− 9	6	13	3.46	28
L. superior frontal gyrus	− 12	− 15	66	6	4.39	39

Coordinates organized from anterior to posterior.

Left vmPFC

The ANOVA revealed a main effect of Image Type ($F(1,32) = 11.35$, $p = .002$, $\eta^2_{partial} = .26$). Consistent with Harris and Fiske (2006), participants had greater vmPFC activation in response to non-homeless control individuals as compared to homeless individuals ($t(33) = 3.36$, $p = .002$, $d = .65$; Fig. 2B). There was also a main effect of Participant Group ($F(1,32) = 4.95$, $p = .03$, $\eta^2_{partial} = .13$) with Caucasian-American participants showing higher activation in vmPFC as compared to Chinese participants, but there was no significant interaction ($F(1,32) = 1.15$, $p = .29$, $\eta^2_{partial} = .04$). Individual differences in liking ratings toward control as compared to homeless individuals did not correlate with the magnitude of the vmPFC response for homeless individuals as compared to control individuals: ($r(34) = -.23$, $p = .19$). The same was true for self-reported familiarity with homeless individuals and self-reported affect toward homeless individuals ($r(34) = .13$, $p = .45$; $r(34) = .23$, $p = .20$, respectively).

Hypothesis 2 & 3a. Chinese and Caucasian-American participants engage disparate neural mechanisms when evaluating older adults.

Next, I tested two competing hypotheses to identify similarities and differences in the neural regions activated by Chinese and Caucasian-American participants in response to evaluating older adults: 1) that group differences would emerge in neural regions associated with pity (Hypothesis 2); or 2) that group differences would emerge in neural regions associated with perceiving social status (Hypothesis 3a).

A conjunction analysis using the older adult > young adult contrasts (see Methods for details) was conducted to identify similarities in neural activity across the two groups. Results revealed no significant activations. Next, in order to resolve Hypothesis 2 and 3a, a between-group *t*-tests was conducted to examine whether cultural divergence emerged between the two groups when they evaluated older adults > young adults and young adults > older adults. For the older adults > young adults contrast, Chinese participants had greater activation in the bilateral ventral striatum and right parahippocampal gyrus as compared to Caucasian-American participants. The Caucasian-American participants did not have any neural regions that were more active than Chinese participants in this contrast. See Table 4 for complete list of activations. These results provided support for Hypothesis 3a — that cultural differences in social status better predicted group differences in negative attitudes toward older adults.

Hypothesis 3b. Individual differences in Chinese participants' cultural affiliation predict magnitude of activity in the bilateral ventral striatum and parahippocampus in response to older adults.

In order to more closely examine the activation in the ventral striatum and parahippocampal gyrus, a region of interest analysis was conducted using peaks in those regions that have been previously implicated in perceiving social hierarchies (see Methods for details and justification). For each peak, these parameter estimates were entered into a 2 (Image Type: older adult or young adult) × 2 (Participant Group: Chinese or Caucasian-American) ANOVA with Image Type as a repeated measure.

ROIs

For the left ventral striatum, the ANOVA revealed an Image Type × Participant Group interaction ($F(1,32) = 5.07$, $p = .03$, $\eta^2_{partial} = .14$), but no main effects (both $Fs < 1$, $\eta^2_{partials} < .02$). In the right ventral striatum, there was also an Image Type × Participant Group interaction: $F(1,32) = 5.21$, $p = .03$, $\eta^2_{partial} = .14$, but no main effect of Participant Group: $F(1,32) = 1.33$, $p = .26$, $\eta^2_{partial} = .04$, or main effect of Image Type: $F < 1$, $\eta^2_{partial} = .03$. Subsequent *t*-tests revealed that although Caucasian-American participants showed greater activation in the left ventral striatum in response to young adults as compared to older adults ($t(16) = 2.37$, $p = .03$, $d = .45$), Chinese participants did not show any

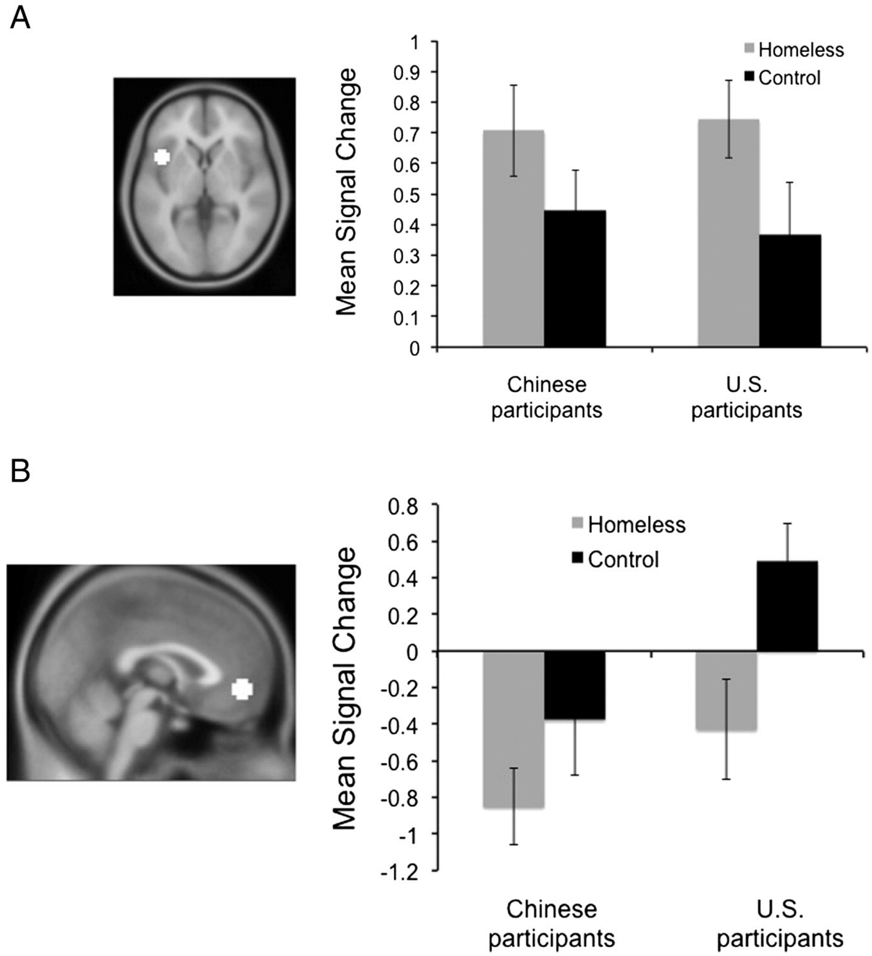

Fig. 2. Spherical ROIs of the A) left insula, and B) left ventromedial prefrontal cortex that were extracted from previous research on evaluating homeless individuals. Graph shows the mean parameter estimates in these regions for Caucasian and Chinese participants when they evaluated images of homeless individuals and control individuals as compared to fixation baseline. Error bars SEM.

difference in the magnitude of neural activity in this region for older adults or young adults ($t(16) = 1.26$, $p = .22$, $d = .44$). See Fig. 3A. A similar pattern emerged for the right ventral striatum, although here the difference between young and older adults for Caucasian-American participants was only marginal ($t(16) = 1.79$, $p = .09$, $d = .30$), whereas it was, again, not significant for Chinese participants ($t < 1$, $d = .09$). See Fig. 3B. For both the left and right parahippocampal gyri, the ANOVAs revealed no main effects or interactions (all *ps* > .16, $\eta^2_{partials} < .06$).

Table 4
Results from the between-group *t*-test identifying group differences between Chinese and Caucasian-American participants when they evaluated older adults > young adults, and young adults > older adults, $p < .05$ corrected. All coordinates MNI.

Region	Coordinates			BA	T	k
	x	y	z			
Older adults > Young adults						
Chinese participants > Caucasian-American participants						
R. ventral striatum	3	9	6	–	3.78	41
L. subcallosal gyrus	− 6	3	− 15	25	4.07	43
L. precentral gyrus	− 66	0	15	6	4.33	23
R. parahippocampal gyrus	36	− 21	− 27	36	5.31	20
Caucasian-American participants > Chinese participants						
No significant clusters						
Young adults > Older adults						
R. precentral gyrus	30	− 24	63	4	12.55	33
Older adults > Young adults *t*-tests						
Chinese participants > Caucasian-American participants						
No significant clusters						
Caucasian-American participants > Chinese participants						
Ventral striatum	3	9	6	–	3.78	41
L. subcallosal gyrus	− 6	3	− 15	25	4.07	43
L. precentral gyrus	− 66	0	15	6	4.33	23
R. parahippocampal gyrus	36	− 21	− 27	36	5.31	20

Coordinates organized from anterior to posterior.

Correlations with cultural affiliation

In order to examine whether the ventral striatal response to older adults was predicted by individual differences in how strongly participants affiliated with their respective cultural traditions, neural activity in the left ventral striatum and right ventral striatum was correlated with participants' self-reported assimilation and separation (both measures of cultural affiliation) on the East Asian Acculturation Measure (Barry, 2001). Analyses were conducted separately for Chinese and Caucasian-American participants to ensure that the baseline group differences observed in their assimilation and separation scores did not account for any effects that might emerge. On these measures, a higher assimilation score denotes greater willingness to forego one's own cultural traditions, whereas a lower separation score denotes greater commitment to one's Asian identity. It is important to note that the acculturation measures for the Caucasian-American participants should be interpreted with caution given that, unlike the Chinese participants, the Caucasian-American participants had not been immersed in a new culture. Parameter estimates were extracted to measure the magnitude of ventral striatal activity using the older adult > control contrast. Thus, a positive difference score in neural

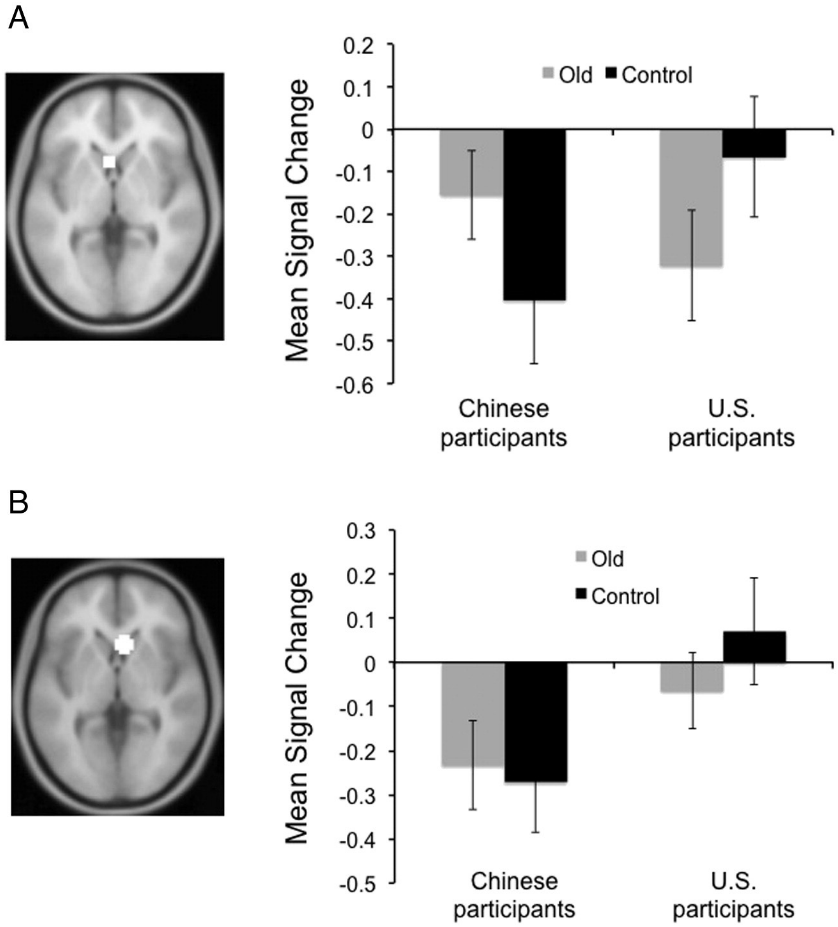

Fig. 3. Spherical ROIs of the A) left ventral striatum, and B) right ventral striatum that were extracted from previous research on evaluating social status. Graph shows the mean parameter estimates in these regions for Caucasian and Chinese participants when they evaluated images of older adults and young adults as compared to fixation baseline. Error bars SEM.

activity means more activity for older as compared to young adults, whereas a negative difference score means more activity for young adults as compared to older adults.

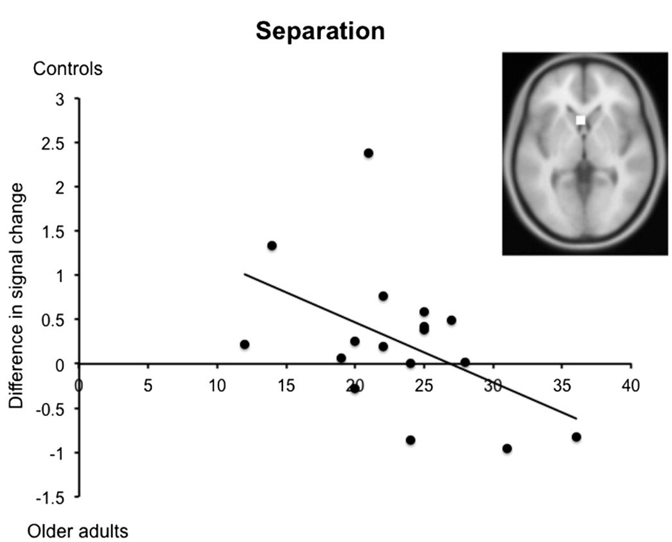

Fig. 4. Correlation between Chinese participants' separation scores on the East Asian Acculturation Measure and the difference in their neural activity in response to images older adults and control images in the left ventral striatum. A higher separation score denotes less commitment to one's Asian identity. A positive difference score in neural activity means more activity for older as compared to young adults, whereas a negative difference score means more activity for young adults as compared to older adults.

For both Caucasian-American and Chinese participants, self-reported assimilation scores did not predict neural activity in the left or right ventral striatum (Caucasian-American: both *r*s < .18, *ps* > .49; Chinese: both *r*s < .18, *ps* > .49). Separation scores did not predict neural activity in the left or right ventral striatum for Caucasian-American participants, but it did predict activity in the left striatum for Chinese participants: ($r(17) = -0.48$, $p = .05$). See Fig. 4.[3] The correlation did not reach significance in the right ventral striatum ($r < 0.10$, $p > .90$).

Exploratory analysis: effect of target culture and participant group on neural correlates underlying evaluation of non-stigma and stigma

An additional consideration in the current investigation is whether the nationality of the stigmatized groups (Chinese or Caucasian-American) will affect how they are perceived. Although previous research suggests that status is accurately identified within cultures

[3] The behavioral results revealed cultural differences between Caucasian-American and Chinese participants in their self-reported liking of same race as compared to other race homeless individuals. Given this finding, it is possible that any neural differences that arose between the two groups could be attributable to these baseline differences in attitude. In order to examine this potential limitation more closely, I collected additional data from 36 White undergraduates at Indiana University who were all Caucasian-Americans. Participants rated the same images of the older adults, homeless images, and control images that were used in the fMRI study on their likeability, attractiveness, and familiarity using a 1 (not at all) to 7 (very much) scale. Consistent with the original Caucasian-American participants, these participants rated the Chinese homeless images as being more likeable than the White homeless images ($p < .02$), but they did not differ in how attractive or familiar they reported either image type to be (both *ps* > .21). These participants did, however, rate White older adults to be more familiar, likeable, and attractive than the Chinese older adults (all *ps* < .001).

Table 5
Results from the whole-brain voxelwise 2 (Target Culture: same or different) × 2 (Participant Group: Chinese or Caucasian-American) ANOVA, $p < .05$ corrected. Results show: (A) all significant voxels resulting from main effects and interactions for same culture and other culture control images, and (B) relevant t-tests. All coordinates MNI.

A						
Region	Coordinates			BA	F	k
	x	y	z			
Main effect of participant group						
No significant clusters						
Main effect of target culture						
L. anterior PFC	− 9	66	15	10	26.73	42
L. Middle frontal gyrus	− 30	60	12	10	17.71	46
L. superior frontal gyrus	− 18	57	42	8/9	30	221
R. medial frontal gyrus	12	54	6	10	28.47	21
L. vmPFC	− 9	51	− 9	10	28.57	44
R. middle frontal gyrus	45	48	21	10	17.35	20
R. dmPFC	9	45	39	8/9	24.39	86
L. rectal gyrus	− 3	39	− 24	11	23.01	47
R. inferior frontal gyrus	33	33	− 15	11/47	26.39	39
L. superior frontal gyrus	− 27	30	51	8	24.5	56
l. inferior frontal gyrus	− 30	27	− 6	47	21.45	40
R. superior frontal gyrus	12	12	66	6	16.17	18
R. cingulate gyrus	15	6	33	24/33	25.55	40
l. cingulate gyrus	− 12	6	45	24	21.91	22
R. inferior frontal gyrus	48	3	27	9	19.1	25
L. middle temporal gyrus	− 57	3	− 18	21	18.49	24
R. inferior temporal gyrus	45	− 6	− 15	21	27.83	25
L. insula	− 33	− 9	18	13	24.67	64
L. parahippocampal gyrus	− 18	− 9	− 27	35	21.68	21
R. insula	33	− 12	21	13	27.22	41
L. precentral gyrus	− 36	− 12	66	4/6	17.71	22
R. postcentral gyrus	63	− 18	51	2	44.72	112
R. precentral gyrus	18	− 27	51	4	19.04	36
L. inferior parietal sulcus	− 42	− 36	36	40	24.85	29
L. hippocampus	− 24	− 39	− 3	–	21.04	48
R. inferior parietal sulcus	36	− 48	36	40	19	24
L. cerebellum	0	− 54	− 45	–	14.57	66
L. middle temporal gyrus	− 45	− 54	6	39	21.2	23
R. precuneus	6	− 54	57	7	13.56	25
L. superior occipital gyrus	− 39	− 78	33	19	14.05	20
L. cuneus	− 12	− 81	30	18	24.92	34
R. cuneus	15	− 81	33	19	16.92	49
Participant group × target culture						
L. middle frontal gyrus	− 30	42	18	10	16.23	56
R. middle frontal gyrus	21	36	39	8	16.65	39
L. superior frontal gyrus	− 18	30	48	8	30.54	185
L. inferior frontal gyrus	− 48	18	− 3	47	21.27	45
R. insula	42	15	6	13	40.65	424
L. superior temporal gyrus	− 18	12	− 39	38	38.59	107
L. lentiform nucleus	− 12	9	− 6	Putamen	50.41	471
R. inferior frontal gyrus	54	6	15	44	30.03	–
R. middle frontal gyrus	27	3	45	6	19.32	19
L. middle frontal gyrus	− 36	3	48	6	17.51	19
L. precentral gyrus	− 51	0	15	6	29.18	89
R. middle temporal gyrus	57	− 3	− 9	21	53.52	61
R. precentral gyrus	39	− 6	36	6	18.73	28
L. inferior temporal gyrus	− 57	− 9	− 21	20	31.17	62
L. insula	− 39	− 9	0	13	20.35	42
R. thalamus	21	− 18	15	–	25.7	31
L. cingulate gyrus	− 12	− 24	45	31	24.27	31
L. brainstem*	0	− 24	− 9	Red nucleus	18.54	26
L. postcentral gyrus	− 39	− 27	57	3&5	52.18	2053
R. superior temporal gyrus	45	− 27	6	41	16.28	18
R. inferior parietal lobule	42	− 30	39	40	17.04	21
L. inferior parietal lobule	− 42	− 36	36	40	44.21	–
L. parahippocampal gyrus	− 33	− 42	− 9	37	28.14	281
R. parahippocampal gyrus	30	− 48	− 6	19	53.42	1164
L. inferior temporal gyrus	− 45	− 54	− 3	19	11.78	18
L. precuneus	− 15	− 57	21	31	27.78	317
R. middle temporal gyrus	42	− 60	18	39	23.97	40
R. superior parietal lobule	36	− 72	54	7	15.2	26
L. cerebellum	− 27	− 75	− 36	–	38.64	230
R. middle temporal gyrus	48	− 75	12	39	21.47	33
R. cerebellum	30	− 81	− 30	–	24.31	211
R. middle occipital gyrus	30	− 81	15	19	12.65	33

Table 5 (*continued*)

A						
Region	Coordinates			BA	F	k
	x	y	z			
L. lingual gyrus	− 15	− 84	− 9	17/18	49.09	
L. cuneus	− 30	− 87	36	19	21.11	209
L. middle occipital gyrus	− 15	− 99	18	18	15.37	40
Coordinates organized from anterior to posterior						

Region	Coordinates			BA	T	k
	x	y	z			
Table 5A: Same culture t-tests						
Chinese same culture > Caucasian-American same culture						
R. parahippocampal gyrus	21	− 33	− 3	27	3.31	28
R. cerebellum	3	− 54	− 42	–	3.49	22
R. cerebellum	54	− 57	− 21	–	3.47	32
Caucasian-American same culture > Chinese same culture						
R. superior frontal gyrus	36	57	30	10	4.96	37
L. superior frontal gyrus	− 27	42	39	8/9	4.94	96
R. caudate	18	36	− 3	–	3.78	61
L. caudate	− 15	24	− 6	–	3.98	62
L. postcentral gyrus	− 39	− 33	63	2	3.48	18
L. inferior parietal lobule	− 42	− 60	42	40	3.65	25
L. cuneus	30	− 81	30	19	4.33	274
Table 5B: Other culture t-tests						
Chinese other culture > Caucasian-American other culture						
R. cerebellum	39	− 6	39	6	3.62	24
R. thalamus	18	− 18	15	–	3.95	32
R. inferior occipital gyrus	30	− 51	42	7	3.77	28
R. superior parietal lobe	54	− 54	− 21	–	4.04	37
R. Precentral Gyrus	30	− 96	− 3	18	3.79	48
Caucasian-American other culture > Chinese other culture						
R. cuneus	− 12	48	− 15	11	4.23	18
L. Superior Parietal Lobe	− 60	− 45	− 12	20	3.58	25
L. superior frontal gyrus	12	− 66	− 3	–	4.09	77
R. cerebellum	− 39	− 72	45	7	4.24	186
L. Cuneus	− 12	− 90	33	19	3.2	28
L. Middle Temporal Gyrus	12	− 93	27	19	6.21	543

Coordinates organized from anterior to posterior.

(e.g., Montepare and Zebrowitz, 1993), status may not necessarily be accurately detected across cultures (Rule et al., 2010). Moreover, some fMRI research has identified heightened neural sensitivity to same race social stimuli as compared to other race social stimuli (e.g., Adams et al., 2010; Chiao et al., 2008), whereas other fMRI research suggests the opposite (that is, heightened neural sensitivity to other race as compared to same race social stimuli; Derntl et al., 2009; Lieberman et al., 2005). Thus, I did not have specific predictions for how (if at all) target culture might affect perceptions of stigma across cultures. I included this as an additional exploratory variable because of previous research on this topic.

In order to examine this third question, I conducted three separate 2 (Target Culture: same or different culture) × 2 (Participant Group: Chinese or Caucasian-American) whole-brain voxelwise ANOVAs: one for all non-stigmatized control individuals, one for homeless individuals, and one for older adults. For the non-stigmatized control images, I used the condition > baseline contrasts in the ANOVA. Results revealed no main effect of Participant Group. However, the Participant Group × Target Culture interaction revealed widespread activation throughout the brain, including bilateral middle frontal gyrus (BA 6), bilateral inferior temporal gyrus (BA 20), bilateral occipital gyrus (BA 18/19), bilateral precuneus (BA 31), bilateral parietal cortex (BA 40), bilateral insula (BA 13), bilateral parahippocampal gyrus, and bilateral caudate. See Table 5. A closer examination of the activation in these areas revealed that the group differences were primarily driven by Caucasian-American participants. Specifically, Caucasian-American participants showed greater activation in the fronto-parietal attention network as compared to Chinese participants when they evaluated same culture non-stigmatized individuals (see Fig. 5A). Moreover, Caucasian-American participants had heightened activation in visual processing regions compared to Chinese participants when evaluating other culture non-stigmatized individuals (see Fig. 5B). See Table 5 for complete list of activations.

Next, I examined whether target culture affected perceptions of stigmatized individuals. Since cultural differences emerged in the perceptions of non-stigmatized individuals, I used the respective stigma > control contrasts in order to control for baseline perceptual differences between the Eastern and Western participants. There were no significant voxels in the main effect of Target Culture. However, a Participant Group × Target Culture interaction emerged primarily in regions associated with visual processing (e.g., bilateral precuneus; BA 7/31), left lingual gyrus (BA 17), left superior occipital gyrus (BA 19), and right cuneus (BA 18), as well as heightened activation in the right inferior frontal gyrus (BA 44) and right inferior parietal cortex (BA 7/40). See Table 6 for complete list of activations. A closer examination of the interaction revealed that Chinese participants had greater activation in the right insula (BA 13) and left precuneus (BA 7) as compared to Caucasian-American participants in response to same culture homeless individuals. However, Caucasian-American participants had heightened activation in the bilateral parahippocampal gyrus (BA 37) and bilateral cuneus (BA 17/18). However, when evaluating other culture homeless individuals, Chinese participants had greater activation in the bilateral parahippocampal gyrus (BA 37) as compared to Caucasian-American participants, whereas Caucasian-American participants had heightened activation in the fronto-parietal attention network as compared to Chinese participants. See Table 6 for complete list of activations.

The results from the ANOVA using the older adults > young adults contrasts revealed minimal group differences. There was a main effect of Target Culture only in the left cingulate gyrus (BA 31), and a Participant Group × Target Culture interaction emerged only in the right precentral gyrus (BA 4). See Table 7 for complete list of activations.

Discussion

The purpose of the current study was to examine whether individuals from two different cultures (U.S. and China) have converging or diverging attitudes toward homeless individuals and older adults, and why that might be. There were several key findings in the current study. First, Chinese and Caucasian-American participants had similarly negative liking ratings toward homeless individuals, but their self-reported negative affect toward older adults diverged, albeit in subtle ways. Interestingly, the patterns of divergence were correlated with individual differences in self-reported cultural affiliation. Second, Chinese and Caucasian-American participants showed similar patterns of neural activation in regions associated with processing negative affect when evaluating homeless individuals, whereas the two groups elicited differential neural responses when perceiving older adults. With respect to the latter, Chinese participants showed heightened activation in regions associated with social status as compared to Caucasian-American participants when evaluating older adults. Taken together, these findings suggest that culture influences the affective responses that individuals elicit toward certain stigmatized groups.

Behavioral results for evaluating homeless individuals

These behavioral findings contribute to the growing literature on the effects of culture on attitudes toward stigmatized individuals. Consistent with previous research (Cuddy et al., 2009), both Chinese and Caucasian-American participants in the current study rated homeless individuals as being less likeable as compared to older adults and non-stigmatized control individuals. Notably, there were no cultural differences in self-reported familiarity with homeless individuals.

Neuroimaging results in response to evaluating homeless individuals

Having demonstrated that culture is not associated with divergent attitudes toward homeless individuals, but is associated with reduced negative attitudes toward older adults, the next question is why that might be. My first hypothesis – that homeless individuals would elicit similar patterns of affective and cognitive responses amongst Eastern and Western participants – was partially supported. Consistent with previous research with U.S. participants (Harris and Fiske 2006; 2007), both Chinese and Caucasian-American participants had heightened activation in the left insula (which has been implicated in negative affective processing) in response to homeless individuals as compared to control individuals. However, it is important to note that group differences emerged in another peak in the left insula (− 39, − 9, 6). Here, Chinese participants had greater activation to homeless individuals as compared to Caucasian-Americans. Puzzlingly, Caucasian-Americans had greater activation as compared to Chinese participants in that same peak in response to control images. Although it is difficult to interpret why the same peak responded to different stimuli for each participant group, speculatively this activation may reflect group differences in the insula's role in emotion integration (e.g., Kurth et al., 2010). Critically, the analysis in the peak of the left insula that has specifically been implicated in negative affect to homeless individuals (− 41, 13, 0) - revealed no participant group difference or interaction between participant group and image type, suggesting that the negative affective response to homeless individuals in the insula did not differ between groups.

Previous research with Caucasian-American participants has also found suggestive evidence that they dehumanize homeless individuals (Harris and Fiske, 2006; 2007). Specifically, Caucasian-Americans have been previously shown to have significantly greater activity in the vmPFC – a region broadly implicated in mentalizing – when evaluating non-homeless controls compared to evaluating homeless individuals. Although I replicated this finding with Caucasian-American participants in the current study, this finding did not extend to Chinese participants. Instead, I found that Chinese participants had similar patterns of activity in the vmPFC in response to homeless individuals and non-homeless controls. Thus, one possible interpretation of this finding is that Caucasian-Americans may have more pride for non-homeless control individuals as compared to homeless individuals, whereas Chinese participants may not dissociate between the two groups to the same extent. Such a finding would suggest that some cultural variations emerged in how non-homeless individuals as compared to homeless individuals are perceived. However, this difference should be interpreted with caution given that no significant interaction emerged in this region.

One possibility for the group differences in vmPFC response to non-homeless as compared to homeless individuals may be due to cultural disparities in attributions made about homelessness. For instance, previous cross-cultural research suggests that Westerners tend to make more dispositional (blaming the individual) as compared to situational (blaming the situation or context) attributions about behavior, whereas Easterners behave in the opposite manner (Choi et al., 1999; Miller, 1984; Morris et al., 1995; Morris and Peng, 1994). However, because making more dispositional attributions is related to higher levels of prejudice (Crandall and Eshleman, 2003; Hegarty and Golden, 2008; Rodin et al., 1989), one would expect the two groups to differ in their levels of negative affect toward homeless individuals. This was not the case.

Thus, an alternate explanation for why Caucasian-American participants had heightened vmPFC activation in response to non-homeless individuals, whereas Chinese participants did not, could be due to cultural disparities in how the individual versus the group is viewed. That is, because individuals in Western cultures tend to individuate targets more than do individuals in Eastern cultures (e.g., Markus and Kitayama, 1991), Caucasian-American participants might have

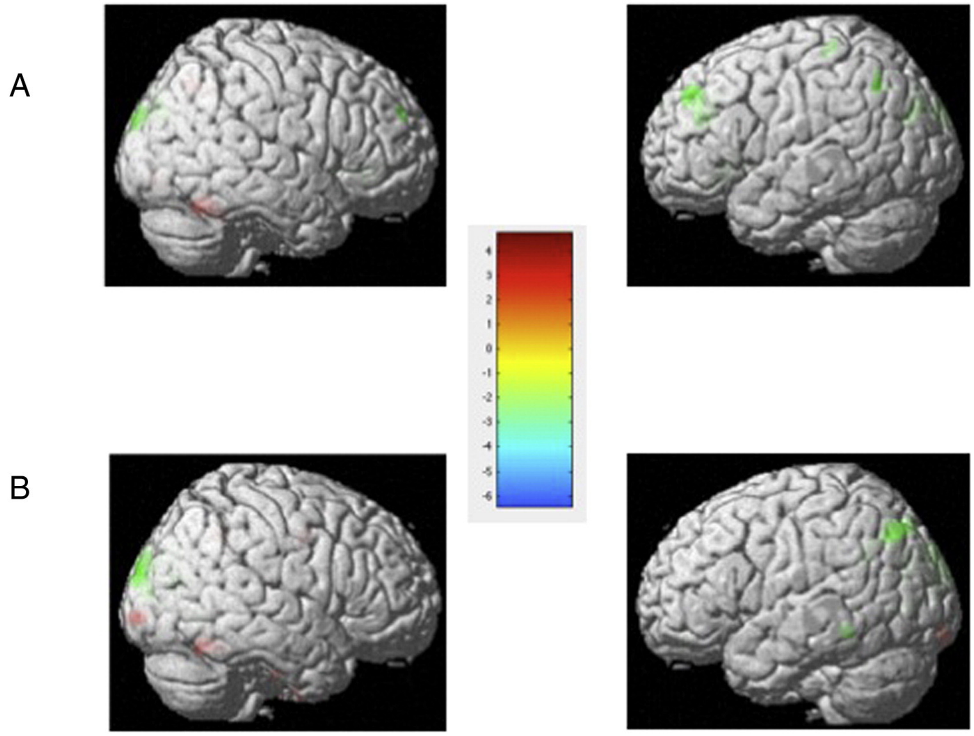

Fig. 5. Activations in the left and right hemisphere resulting from t-tests comparing cultural differences in the neural mechanisms engaged when perceiving (A) same culture non-stigmatized individuals and (B) other culture non-stigmatized individuals. For both, Chinese > Caucasian-American participants in warm colors, Caucasian-American > Chinese participants in cool colors; $p < .05$, corrected.

viewed the in-group (non-stigmatized individuals) and the out-group (homeless individuals and older adults) as being more distinct from one another than did Chinese participants. Consistent with this interpretation, a recent study across 10 non-U.S. countries (seven Western cultures, and three Eastern cultures: Hong Kong, Japan, and South Korea) found that individuals in Eastern cultures did not perceive their in-group members to be higher social status as compared to out-group members, whereas individuals in Western cultures did (Cuddy et al., 2009). Future research should examine this possibility.

Behavioral results for evaluating older adults

Although Chinese and Caucasian-American participants had similarly negative liking ratings toward homeless individuals, the two groups differed in the magnitude of their negative attitudes (as measured by the attitudes toward the elderly scale) toward older adults, with Chinese participants demonstrating marginally less negative attitudes than Caucasian-American participants. Interestingly, the extent to which Chinese participants expressed less negative attitudes toward older adults than did Caucasian-American participants was correlated with individual differences in self-reported cultural affiliation (suggesting that individuals who were less affiliated with Asian cultures had more negative attitudes toward the elderly). This finding is consistent with emerging research that individual differences in how strongly one endorses cultural stereotypes may better predict individual behavior, even when those stereotypes are inconsistent with personal beliefs (for review, see Chiu et al., 2010).

The behavioral results on Chinese and Caucasian-American participants' self-reported attitudes toward older adults may shed light on the mixed results from previous research (e.g., Cuddy et al., 2005; Cuddy et al., 2009; Harwood et al., 1996; Helfrich, 1979; Ikels, 1991; Koyano, 1989; Levy and Langer, 1994; Montepare and Zebrowitz, 1993). Specifically, although no group difference in liking ratings toward older adults emerged, group differences did emerge on the attitudes toward elderly scale, but only on self-reported negative attitudes. The fact that group differences in self-reported attitudes toward older adults emerged only in negative, but not positive, attitudes may be attributable to the fact that older adults elicit relatively positive (pity) and negative (disrespect) attitudes from both perceiver groups (e.g., Cuddy et al., 2005). Thus, the two groups may have had similar positive attitudes toward older adults (resulting in similar liking and positive affect), but differed in their levels of negative attitudes. This finding is consistent with previous research that has found cultural differences in the magnitude of attitudes expressed toward older adults. For instance, Montepare and Zebrowitz (1993) found that Western participants perceived nonverbal cues associated with aging as being more negative than cues associated with youth, whereas Eastern participants did not show any differences in their ratings as a function

Neuroimaging results in response to evaluating older adults

The neuroimaging results demonstrated that although Chinese and Caucasian-American participants showed different patterns of activation in response to elderly individuals in regions associated with social status, these differences were driven by the Caucasian-American participants. Specifically, Caucasian-American participants showed heightened activation in the bilateral ventral striatum and bilateral parahippocampal gyrus when they evaluated images of young adults as compared to older adults, whereas Chinese participants showed no difference in neural activity in these regions when evaluating young and older adults. These findings are consistent with previous behavioral research examining cross-cultural differences in perceived social status of older adults (e.g., Montepare and Zebrowitz, 1993). Importantly, the extent to which the neural activity in the bilateral ventral striatum dissociated between young and older adults was correlated with separation (suggesting that individuals who were less separated from their Asian heritage had less disparity in their ventral striatal response to young as compared to older adults). These region, with the removal of one outlier, moderately correlated with participants' self-reported affiliation with the Asian culture (suggesting that individuals who were

Table 6
Results from the whole-brain voxelwise 2 (Target Culture: same or different) × 2 (Participant Group: Chinese or Caucasian-American) ANOVA, $p < .05$ corrected. Results show all significant voxels resulting from main effects and interactions for homeless > control images, as well as relevant t-tests. All coordinates MNI.

Region	Coordinates			BA	F/T	k
	x	y	z			
Homeless > control ANOVA						
Main effect of participant group						
R. superior frontal gyrus	33	51	45	8	21.51	34
L. precentral gyrus	− 60	0	30	6	15.39	23
R. precentral gyrus	60	− 6	36	6	13.46	28
R. postcentral gyrus	45	− 18	57	3	16.08	54
Main effect of target culture						
No significant clusters						
Participant group × target culture						
R. inferior frontal gyrus	60	15	15	44	16.2	18
R. inferior parietal cortex	33	− 36	39	7&40	15.87	49
R. postcentral gyrus	42	− 39	66	5	14.93	48
L. cerebellum	− 27	− 45	− 12	-	60.25	242
R. parahippocampal gyrus	30	− 54	− 6	19	48.55	202
R. precuneus	24	− 60	24	31	14.08	19
L. precuneus	− 21	− 81	48	7	14.22	27
L. Cerebellum	− 39	− 81	− 33	-	13.82	30
L. superior occipital gyrus	− 36	− 84	30	19	16.32	53
L. lingual gyrus	− 12	− 90	0	17	21.07	61
R. cuneus	18	− 96	6	18	18.08	41
Same culture homeless t-tests						
Chinese participants > Caucasian-American participants						
R. insula	42	0	0	13	3.51	21
R. postcentral gyrus	51	− 21	60	1/2/5	3.94	241
L. precuneus	− 30	− 45	42	7	3.56	23
Caucasian-American participants > Chinese participants						
L. parahippocampal gyrus	− 15	− 36	− 12	37	3.09	138
R. parahippocampal gyrus	24	− 36	− 12	36/37	4.92	134
L. superior occipital gyrus	− 36	− 87	27	19	3.98	26
R. cuneus	18	− 93	9	17/18	3.39	22
L. Cuneus	− 18	− 99	0	17/18	2.89	36
Other culture homeless t-tests						
Chinese participants > Caucasian-American participants						
L. superior frontal gyrus	− 36	30	57	8	3.68	22
L. middle frontal gyrus	− 42	3	54	6	3.07	19
L. claustrum	− 30	− 6	12	-	3.22	18
L. fusiform gyrus	− 54	− 9	− 24	20	3.69	18
R. Parahippocampal Gyrus	33	− 42	− 12	37	4.86	87
L. parahippocampal gyrus	− 27	− 45	− 12	37	6.64	191
Caucasian-American participants > Chinese participants						
R. middle frontal gyrus	48	57	9	46	4.77	24
L. superior frontal gyrus	− 39	51	15	10	4.2	27
R. superior frontal gyrus	30	51	42	8	4.14	52
L. anterior cingulate	− 3	30	21	24	3.57	35
L. cingulate gyrus	− 3	− 21	33	23	3.49	18
R. inferior parietal lobule	36	− 36	39	40	4.14	20
L. postcentral gyrus	− 3	− 54	66	7	3.41	23
R. inferior temporal gyrus	42	− 63	− 3	37	4.41	36

Coordinates organized from anterior to posterior.

less affiliated with Asian cultures had higher neural activity in the ventral striatum in response to young as compared to older adults). This result suggests that cultural affiliation may predict the extent to which activity in the ventral striatum is modulated by culture-specific differences in status.

Why might culture affect attitudes toward older adults, but not toward homeless individuals? One possibility is that attitudes toward older adults are more malleable than attitudes toward homeless individuals because of the types of affective responses that the two groups elicit (e.g., Fiske et al., 1999; Fiske et al., 2002). Homeless individuals have been widely shown to elicit highly negative affective responses (e.g., disgust and dehumanization) from both individuals in U.S. (e.g., Fiske et al., 2002; Harris and Fiske, 2006) as well as from individuals in Eastern cultures (e.g., Cuddy et al., 2009). However, evaluating older adults has been widely shown to elicit a highly ambivalent affective response (e.g., pity and disrespect; Fiske et al., 2002) in individuals in both Eastern and Western cultures (Cuddy et al., 2005). Because previous research suggests that, with sufficient motivation, ambivalent attitudes may be more malleable than highly negative attitudes (Fiske, 2012; Leippe and Eisenstadt, 1994), ambivalent attitudes toward older adults may be easier to alter than highly negative attitudes toward homeless individuals.

Exploratory results: effects of target culture on neural activity to stigma and non-stigma

An exploratory question in the current study was whether Eastern and Western individuals would dissociate between the same culture as compared to other culture stigmatized individuals. This question stemmed from previous research that has identified disparate patterns in neural sensitivity to the same culture social faces (Adams et al., 2010; Chiao et al., 2008; but see Derntl et al., 2009; Lieberman et al., 2005). Although the neural networks engaged by Caucasian-American participants have been widely documented in person perception (Cloutier et al., 2011; Macrae and Bodenhausen, 2000; Mitchell et al., 2005; Schiller et al., 2009), this is the first study to examine how culture affects person perception. With respect to cultural differences in evaluating non-stigmatized same culture individuals, these results demonstrated that Caucasian-American participants showed heightened activation in the fronto-parietal network (e.g., bilateral superior frontal cortex and parietal cortex) as compared to Chinese participants. The fronto-parietal network is a higher level cognitive process engaged in tasks that demand heightened attention (for review, see Corbetta and Shulman, 2002). It is interesting to note that when evaluating other culture non-stigmatized individuals, Caucasian-American participants did not show increased activation in this network, and instead, only showed heightened activation in visual processing regions.

In contrast, there were relatively few regions that were more active for Chinese as compared to Caucasian-American participants in response to evaluating non-stigmatized same and different culture individuals. Specifically, Chinese participants showed heightened activation in right-lateralized regions involved in perceptual processing (e.g., lingual gyrus, parietal cortex, and parahippocampal gyrus) as compared to Caucasian-American participants when evaluating different culture non-stigmatized controls. However, there were relatively few regions that were more active for Chinese participants as compared to Caucasian-American participants when they evaluated same culture non-stigmatized individuals. Thus, Caucasian-American participants showed overall increased activation when evaluating same and different culture non-stigmatized controls as compared to Eastern participants. One possible explanation for these findings is that Easterners may use more simplified strategies when forming impressions of non-stigmatized individuals as compared to Westerners. Indeed, Easterners have been shown to rely less on categorization in their thinking as compared to Westerners (Chiu, 1972; Choi et al., 1997; Norenzayan et al., 2002), and categorization is a key aspect of person

Table 7
Results from the whole-brain voxelwise 2 (Target Culture: same or different) × 2 (participant group: Chinese or Caucasian-American) ANOVA, $p < .05$ corrected. Results show all significant voxels resulting from main effects and interactions for older adults > young adults. All coordinates MNI.

Region	Coordinates			BA	T	k
	x	y	z			
Older adults > Young adults ANOVA						
Main effect of participant group						
L. ventral striatum	− 3	15	0	-	11.35	21
L. precentral gyrus	− 60	3	15	6	13.67	19
Main effect of target culture						
L. cingulate gyrus	− 18	− 51	33	31	16.95	27
Participant group × target culture						
R. precentral gyrus	30	− 24	63	4	12.55	33

Coordinates organized from anterior to posterior.

perception (e.g., Macrae, and Bodenhausen, 2000). This interpretation is also consistent with previous research by Norenzayan et al. (2002) that demonstrated that Easterners use fewer categories when forming impressions of non-stigmatized individuals as compared to Westerners. However, an important caveat to this finding is that both the participants' ratings of perceived likeability of the images as well as additional testing with a separate group of Caucasian-American participants revealed differences in self-reported liking as a function of the target's culture. It is therefore possible that these differences may have at least contributed to the group differences observed here, and these findings should therefore be interpreted with caution. Future research should more closely examine these possibilities.

Limitations

Due to lack of behavioral evidence, there are several limitations that must be considered in the current study. First, it was stipulated that cultural differences in neural responses to older adults might stem from differences in perceived status. This assertion stemmed from previous research that has demonstrated that older adults have higher social status in Eastern (e.g., mainland China) as compared to Western (e.g., the U.S.) cultures (Helfrich, 1979; Ikels, 1991; Montepare and Zebrowitz, 1993). However, because no measures of perceived status for older adults were collected in the current study, this interpretation must be taken with caution. Second, Chinese participants' duration of stay in the U.S. may have affected both their neural activity and self-report measures (e.g., Derntl et al., 2009). However, despite the fact that Chinese participants were recruited for the current study only if they had been in the U.S. for less than one year, the number of months they had been in the U.S. was unavailable. It is therefore possible that duration of stay may have mediated perceived cultural affiliation or separation, but this possibility cannot be assessed with the current data.

There are also several limitations to the stimuli used in the current study that should be considered. For instance, although the results suggest that homeless individuals elicit a similarly negative affective response in both Chinese and Caucasian-American participants, it is unclear why that might be. It has been widely demonstrated that Westerners focus more on objects (e.g., central cues) whereas Easterners attend more to peripheral cues (e.g., Gutchess et al., 2006; Nisbett and Masuda, 2003; Nisbett et al., 2001). The images of homeless individuals were full body images that also include peripheral cues (e.g., garbage cans nearby) to make the individual's homelessness salient (unlike the head-shots of young and older adults). Thus, it is possible that Caucasian-American participants attended disproportionately more to central cues in the homeless images (the homeless individual) than did the Chinese participants, whereas the latter attended disproportionately more to the peripheral cues (the environment). However, these perceptual differences would account for group differences, not similarities, between image types. Moreover, both groups did report greater liking for older adults as compared to the homeless individuals, which suggests that both groups were dissociating these images from one another. Nevertheless, future research may incorporate eyetracking to investigate this question more carefully. Finally, a separate group of participants evaluated the control images for the homeless individuals as being significantly more likeable than the control images for the older adults. Since these ratings were not collected from the original group of participants who participated in the fMRI study, it is difficult to know whether these differences polarized their evaluations of the images. These results should therefore be interpreted with that caveat in mind.

Together these findings suggest that the affective mechanisms underlying perceiving and evaluating highly negative stigmatized are consistent across Chinese and Caucasian-American participants. However, older adults, who elicit ambivalent affective responses, may elicit more malleable responses across cultures because of their culture-specific status. Culture may influence the attitudes that individuals have to stigmatized individuals that elicit ambivalent attitudes, but only when individuals strongly affiliate with their culture.

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