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# Does context matter in evaluations of stigmatized individuals? An fMRI study

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**The manner in which disparate affective responses shape attitudes toward other individuals has received a great deal of attention in neuroscience research. However, the malleability of these affective responses remains largely unexplored. The perceived controllability of a stigma (whether or not the bearer of the stigma is perceived as being responsible for his or her condition) has been found to polarize behavioral affective responses to that stigma. The current study uses functional magnetic resonance imaging to identify the neural correlates underlying the evaluation of stigmatized individuals (people who are homeless) when perceptions of the controllability of their condition are altered. Results demonstrated that perceivers engaged neural networks implicated in inferring intentionality (e.g. the medial prefrontal cortex) when they evaluated a homeless individual who was described as being responsible for becoming homeless. Conversely, neural networks associated with resolving strong affective responses (e.g. insula) were engaged when evaluating a homeless individual who was described as not being responsible for becoming homeless.**

**Keywords:** controllability; stigma; fMRI; insula

While it has been widely demonstrated that stigmatized individuals elicit negative attitudes, the degree of negativity attached to specific stigmatized conditions is highly variable (Goffman, 1963). A critical component underlying these differences is the perceived controllability of the stigma (whether or not the bearer of the stigma is perceived as being responsible for his or her condition; Weiner, 1996). Although emerging social neuroscience research has identified a network of neural regions that is engaged when individuals evaluate stigmatized targets (Richeson *et al.*, 2003; Amodio *et al.*, 2004; Cunningham *et al.*, 2004; Harris and Fiske, 2006; Krendl *et al.*, 2006, 2009), it has not examined the effects of the perceived controllability of the stigma on these attitudes. It therefore remains an open question as to why differences in perceived controllability sway affective responses to stigma. The current study uses functional magnetic resonance imaging (fMRI) in concert with behavioral methods to investigate this question.

A key finding that has emerged from the extant social neuroscience research is that members of different stigmatized groups (e.g. people who are homeless, drug addicts, people with disabilities) elicit different neural (and subsequently affective) responses (Harris and Fiske, 2006; Krendl *et al.*, 2006, 2009). For instance, Harris and Fiske (2006) examined how perceivers evaluated individuals with non-race stigmas (e.g. homelessness, people with disabilities). They found that the medial prefrontal cortex (mPFC), which is engaged in inferring intentionality and forming impressions of others (Gallagher *et al.*, 2002; Gallagher and Frith, 2003; Mitchell *et al.*, 2005), was less active when participants evaluated images of 'extreme outgroup members' (e.g. homeless individuals) as compared to images of other stigmatized group members (e.g. older adults, disabled people). However, the left anterior insula, which has been implicated in affective processing such as disgust (e.g. Phillips *et al.*, 1997; Wright *et al.*, 2004), was more active during these evaluations. The authors argued that their finding suggested less willingness by participants to represent extreme outgroup members as unique individuals (dehumanization) as compared to other outgroup members. Moreover, the authors suggested that their results indicate that extreme outgroup members elicit powerful negative affective responses such as disgust. However, this increased dehumanization toward extreme outgroup members may only occur during non-directed evaluations. Indeed, Harris and Fiske (2007) found that when participants were asked to make direct evaluations of extreme outgroup members' preferences, participants demonstrated heightened activity in the dorsal mPFC. Harris and Fiske's (2006, 2007) findings therefore suggest that participants mentalize about extreme outgroup members only when task demands explicitly require it.

While perceptions of controllability impact perceivers' affective responses to different stigmas, the mechanism of this effect remains unclear. Our goal in the current study was to explore the neural mechanisms underlying evaluations of stigmatized individuals depending on the perceived controllability of the stigma by using fMRI. Specifically, how might manipulating the origin of a stigma condition to be controllable or uncontrollable modulate the neural mechanisms responsible for representing stigmatized individuals?

One possibility is that perceived controllability may affect the extent to which the mPFC is engaged during evaluations of stigmatized targets, which would suggest that controllability affects how perceivers form impressions or infer intentionality about the stigmatized individual. Numerous studies have identified the mPFC as playing a central role in social evaluative tasks in which individuating information is provided about the targets (Mitchell *et al.*, 2002; Harris and Fiske, 2007; Todorov *et al.*, 2007; Spreng *et al.*, 2009; Cloutier *et al.*, 2011a,b). Moreover, recent research suggests that the mPFC is more active when perceivers make individuating evaluations of extreme outgroup members such as homeless individuals (Harris and Fiske, 2007).

In addition to the mPFC, we also examined whether perceived controllability impacted neural activity in affective regions such as the insula, which has been previously implicated in evaluating extreme outgroup members such as the homeless (Harris and Fiske, 2006). The predictions for the expected patterns of neural activation in the insula are less straightforward. The insula has been implicated both in disgust (Phillips *et al.*, 1997; Wright *et al.*, 2004) as well as empathy (Singer *et al.*, 2004, 2009; Jabbi *et al.*, 2007; Saarela *et al.*, 2007; Ochsner *et al.*, 2008). Since the extant behavioral research on controllability has

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demonstrated that controllable stigmatized conditions are viewed with greater disgust as compared to uncontrollable stigmatized conditions (Weiner *et al.*, 1988; Zucker and Weiner, 1993; Deaux *et al.*, 1995), one possibility was that the insula would be more active in the controllable as compared to the uncontrollable condition. However, uncontrollable stigmatized conditions are also viewed with more pity as compared to controllable stigmatized conditions (Weiner *et al.*, 1988; Zucker and Weiner, 1993; Deaux *et al.*, 1995). Thus, an alternate possibility would be that the insula would be more responsive in the uncontrollable as controllable condition.

The current study presented participants with images of stigmatized targets along with information about how those individuals became stigmatized. Our main question was to identify the neural mechanisms engaged when people evaluated someone who was stigmatized due to a controllable or an uncontrollable situation. In order to isolate the effects of controllability on affective responses, we chose to focus on one stigmatized group—homeless individuals. This manipulation served several purposes. First, by only evaluating one stigmatized group in this study, we could be confident that any differences observed in neural activity would be unique to the manipulation of controllability and not due to differences in attitudes individuals may have towards different stigmatized groups. Second, homelessness is a stigmatized condition that lends itself well to convincing and ecologically valid manipulations of controllability (e.g. 'he became homeless after being laid off in the bad economy'). Finally, the neural correlates engaged during passive evaluations of homelessness have been well-characterized across numerous studies in social neuroscience (Harris and Fiske, 2006, 2007; Krendl *et al.*, 2009; Cikara *et al.*, 2010), thereby providing a solid foundation for examining how evaluations of stigmatized individuals are affected by differences in perceived controllability.

## METHODS

A total of 18 neurologically normal right-handed adults ($M_{age} = 21.6$ years, 10 females) were recruited from the greater Boston area to participate in this study for monetary compensation. Two participants were excluded due to excessive movement during the scanning session (>2 mm over the course of one functional run), leaving 16 remaining participants. Anatomical and functional whole-brain imaging was performed on a 3.0T Siemens Trio Scanner (Trio, Siemens Ltd., Erlangen, Germany) at Harvard University using standard data acquisition protocols. Anatomical images were acquired using a high-resolution 3D magnetization prepared rapid gradient echo sequence (MP-RAGE; 144 sagittal slices, TE = 7 ms, TR = 2200 ms, flip angle = $7^{\circ}$, $1 \times 1 \times 0.89$ mm voxels). Functional images were collected in three functional runs of 140 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, 3 mm in-plane resolution, 4-mm thickness, 0 mm skip, TR = 2000 ms). Data were resampled to 3 mm × 3 mm × 3 mm voxels in a 72 × 72 matrix.

All imaging data reported were calculated at $P < 0.005$ uncorrected. We used a Monte Carlo conversion script from Slotnick and colleagues (2003) to determine the extent threshold required to convert $P < 0.005$ uncorrected to $P < 0.05$ corrected (e.g. Lieberman and Cunningham, 2009). We chose 1000 iterations of the Monte Carlo to select the most conservative threshold (18 resampled voxels extent threshold). The corrected results ($P < 0.05$ corrected, 13 cluster extent threshold) are reported here.

### Behavioral tasks

#### *Implicit association test*

Prior to beginning the MRI task, participants completed an Implicit Association Test (IAT; Greenwald *et al.*, 1998) to measure their implicit attitudes toward homeless individuals (see Supplementary Materials for details).

#### *Imaging task*

During the scanning session, participants were presented with short sentences for 4 s. Each sentence described someone who had become homeless. Following the sentence, we included a variable ISI of 0–4s during which time a fixation cross appeared on the screen. Following the fixation cross, participants then saw a picture of the individual described in the sentence for 2 s. They were instructed to form an impression of the individual based on the information given in the sentence, and indicate via button press once their impression of had been formed. ITI ranged from 0 to 6s.

We presented individuals with a total of 80 scenarios: 40 described a controllable origin to homelessness (e.g. 'lost his money after he was caught embezzling') while the other 40 described an uncontrollable origin to homelessness (e.g. 'lost his job when his company downsized'). See Supplementary Methods section for more examples of the types of scenarios included. The 80 sentences were selected from pilot testing in which participants were asked to evaluate how responsible they would perceive someone as being for becoming homeless based on a given sentence (1 = not at all, 7 = very much). They also rated how positive or negative they found each sentence to be (1 = very negative, 7 = very positive). Based on these ratings, we selected 40 scenarios that were rated as being the least responsible for causing someone to become homeless as the uncontrollable scenarios ($M_{controllability} = 2.74$, s.d. = 0.43), and the 40 scenarios rated as being the most responsible for causing someone to become homeless as the controllable scenarios ($M_{controllability} = 5.66$, s.d. = 0.25). Both the controllable and uncontrollable scenarios were viewed to be similarly negative (uncontrollable: $M_{valence} = 1.91$, s.d. = 0.33; controllable: $M_{valence} = 1.98$, s.d. = 0.31) [$t(78) = 1.00$, $P = 0.32$]. We counterbalanced which sentences (e.g. controllable or uncontrollable) were paired with each picture across participants to ensure that certain images were not evoking unique neural responses.[1]

Since we were interested in how the controllable and uncontrollable scenarios would affect implicit evaluations of stigmatized targets, we did not collect behavioral ratings on the images from participants while they were in the scanner. We did not want to prompt affective responses such as pity or disgust for the targets, so we limited participants' responses to indicating when they had formed an impression. However, we were interested in verifying that the uncontrollable scenarios elicited more pity, greater willingness to help and less disgust as compared to the controllable scenarios in order to align our findings with previous research. We therefore had a separate group of 25 undergraduates (who were recruited in the same manner as the participants in the fMRI study) make ratings of how much pity they felt for each target person based on the scenario, how willing they would be to help that person and how much disgust they felt toward that person. These three ratings were presented in three discrete blocks in a counterbalanced order across participants.

### Data analysis

fMRI data were analyzed using the general linear model for event-related designs in SPM8 (Wellcome Department of Cognitive

[1]Although we presented 80 scenarios, only 60 of those scenarios (30 controllable, 30 uncontrollable) were paired with images. The remaining 20 scenarios (10 controllable, 10 uncontrollable) were designated as catch trials and were therefore not paired with images (e.g. Ollinger et al., 2001). The purpose of this design was to ensure that we could separate the hemodynamic responses to scenario and image components of our trials. By using this method in addition to variable ISIs between scenario and image variable ITIs (between image and the next scenario-image trial), we were able to attain sufficient estimates of the BOLD signal along the full hemodynamic response function for both trial parts.

Neurology, London, UK). Data underwent standard preprocessing to remove sources of noise and artifact. Functional data were spatially smoothed [8 mm full-width-at-half-maximum (FWHM)] using a Gaussian kernel. We used a general linear model incorporating task effects for the two different image types (image paired with uncontrollable scenario and image paired with controllable scenario), the two different scenario types (uncontrollable and controllable) and covariates of no interest (a session mean, a linear trend and six movement parameters derived from realignment corrections) to compute parameter estimates ($\beta$) and $t$-contrast images (containing weighted parameter estimates) for each comparison at each voxel and for each subject.

Since our primary focus in the present article is on how the uncontrollable and controllable scenarios affected the manner in which participants formed impressions when they saw the images, we compared neural activation for the images following controllable scenarios to the activation in response to the images following uncontrollable scenarios. This analysis approach is consistent with previous research in social neuroscience examining the neural correlates underlying impression formation (e.g. Harris and Fiske, 2007, 2010; Cloutier *et al.*, 2011a).

## RESULTS

### Behavioral results

#### *Pity, disgust, willingness to help ratings*

In order to confirm that the images paired with the controllable and uncontrollable scenarios elicited distinct affective responses, we collected ratings from a different group of undergraduates on the amount of pity, disgust and willingness to help they felt toward individuals who were paired with the controllable and uncontrollable scenarios. Participants indicated that they felt more pity for the people in the images paired with uncontrollable scenarios ($M_{pity} = 5.72$, s.d. $= 1.14$) as compared to those paired with controllable scenarios [$M_{pity} = 2.85$, s.d. $= 1.08$, $t(23) = 13.01$, $P < 0.001$]. Similarly, they were more willing to help the people in the images paired with uncontrollable scenarios ($M_{help} = 5.63$, s.d. $= 0.97$) as compared to those paired with controllable scenarios [$M_{help} = 2.96$, s.d. $= 1.3$, $t(28) = 13.76$, $P < 0.001$]. However, they reported less disgust for people in the images paired with uncontrollable scenarios ($M_{disgust} = 1.26$, s.d. $= 0.47$) as compared to those paired with controllable scenarios [$M_{disgust} = 4.53$, s.d. $= 1.26$, $t(25) = 13.76$, $P < 0.001$].

### Imaging results

The scenarios and images were divided into two categories: images of homeless individuals paired with uncontrollable scenarios and images of homeless individuals paired with controllable scenarios. Our main interest was to determine how, if at all, either controllable or uncontrollable scenarios affected the neural mechanisms underlying participants' subsequent evaluations of the homeless individuals. Specifically, we sought to identify how perceptions of controllability influence participants' evaluations of the homeless individuals. Thus, we wanted to identify the different patterns of neural activity when participants viewed an image that was associated with either a controllable or an uncontrollable origin. In order to isolate the effects of controllability on participants' evaluations of the stigmatized individuals, we conducted two sets of analyses. In the first section, we identify the neural regions that were more active in the controllable > uncontrollable condition for the images alone. In the second section, we conducted a separate analysis that explicitly excludes the neural activation resulting from the scenario to ensure that we separated any holdover effects from the scenario. The goal of this analysis was to control for the condition-specific effects of reading scenarios about homeless people and isolate the neural activity unique to evaluating the images (see Supplementary Materials for results for the scenarios alone). In this second analysis, we first created a contrast for the controllable images > controllable scenarios and a separate contrast for the uncontrollable images > uncontrollable scenarios. We then conducted a paired samples t-test between these two contrasts in order to identify the neural mechanisms that were unique to viewing the images while controlling for condition-specific effects that may have been elicited by reading the scenarios.

Below, we first report the findings for the controllable > uncontrollable contrasts. We then present the same analyses for the uncontrollable > controllable contrasts. All data below are reported at $P < 0.05$ corrected (See 'Methods' section for corrections).

#### *Controllable > uncontrollable comparisons*

*Controllable > uncontrollable images.* In order to examine the neural activity that was unique to examining images of individuals who were homeless due to controllable factors, we next compared neural activation that was greater when participants evaluated images of homeless individuals who had been paired with controllable scenarios as compared to those who had been paired with uncontrollable scenarios.

Results revealed greater activation that was primarily localized to areas in the prefrontal cortex, as well as the bilateral occipital lobes when participants evaluated individuals who were homeless due to controllable as compared to uncontrollable factors (Figure 1). Specifically, in the prefrontal cortex we observed heightened activation in this contrast in left medial frontal cortex (BA 32/10), right ventral mPFC (BA 10), bilateral orbital cortex (BA 11), left inferior frontal gyrus (BA 47), left superior frontal gyrus (BA 6) and bilateral anterior cingulate cortex (BA 32). We also observed heightened activation in the bilateral inferior occipital gyrus (BA 18; see Table 1 for complete list of coordinates).

*Controllable > uncontrollable images controlling for scenarios.* In order to control for condition-specific effects that may have been elicited by reading the scenarios, we created a contrast for the controllable images > controllable scenarios and a separate contrast for the uncontrollable images > uncontrollable scenarios. We then conducted a paired samples $t$-test between these two contrasts in order to identify the neural mechanisms that were unique to viewing the images with controllable origins while controlling for the neural mechanisms that were unique to viewing the scenarios. The results were consistent with the findings from our previous contrast, revealing activation in the same peaks of interest as reported in the direct controllable image > uncontrollable image (e.g. right ventral mPFC (BA 10), left orbital cortex (BA 11) and bilateral anterior cingulate cortex (BA 32); see Table 2 for complete list of activations). Interestingly, we also found a few additional activations that did not emerge in the controllable image > uncontrollable image contrast, notably a slight increase in neural activity in the left superior temporal gyrus (BA 22) for the controllable images as compared to the uncontrollable images.

#### *Uncontrollable > controllable*

*Uncontrollable > controllable images.* We then compared neural activation that was greater when participants evaluated images of homeless individuals who had been paired with uncontrollable scenarios compared to those who had been paired with controllable scenarios. As before, the results in this section focus on the neural activity engaged when participants viewed images of homeless individuals.

Here we found widespread activation throughout the brain (Figure 2). Specifically, in the uncontrollable > controllable contrast,

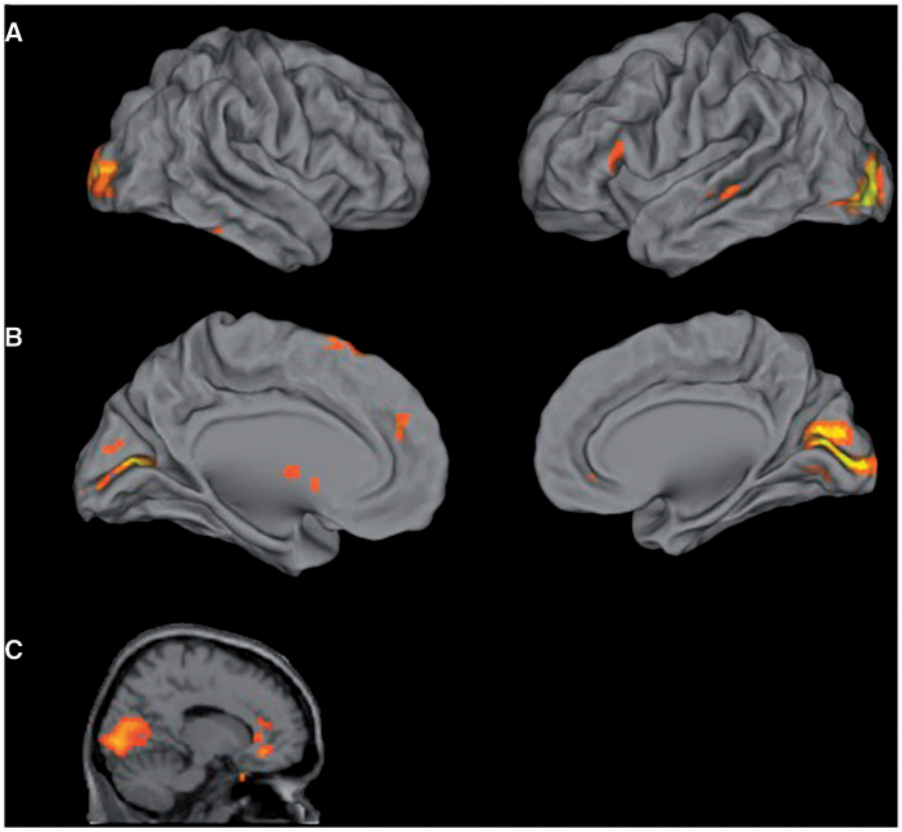


**Fig. 1** Neural activation when perceivers were evaluating images of homeless individuals in the controllable > uncontrollable condition showing (**A**) a left and right, respectively, medial view on a inflated cortical rendering of the brain, (**B**) the left and right, respectively, lateral view and (**C**) a mid-sagittal brain slice denoting activations in the mPFC and ACC. Contrasts are thresholded at $P < 0.05$, corrected.

**Table 1** Controllable image > Uncontrollable image ($P < 0.05$ corrected), all coordinates MNI

| Brain Region | *x* | *y* | *z* | Kextent | *t*-score |
|---|---|---|---|---|---|
| Left inferior occipital lobe (BA 18) | −33 | −87 | −6 | 1363 | 10.36 |
| Right ventral medial frontal gyrus (BA 10) | 15 | 36 | −9 | 19 | 5.22 |
| Left inferior frontal gyrus (BA 47) | −54 | 33 | −18 | 114 | 4.60 |
| Right orbital gyrus (BA 11) | 15 | 18 | −30 | 28 | 4.56 |
| Left medial frontal gyrus (BA 32/10) | −18 | 45 | 9 | 100 | 4.51 |
| Right cingulate gyrus (BA 32) | 18 | 36 | 15 | 44 | 4.24 |
| Left dorsal medial frontal gyrus (BA 6/8) | −6 | 33 | 60 | 73 | 4.12 |
| Left caudate nucleus | −3 | 9 | −3 | 40 | 3.98 |

**Table 2** (Controllable image > Controllable scenario) > (Uncontrollable image > Uncontrollable scenario) ($P < 0.05$ corrected), all coordinates MNI. We also report sub-clusters (denoted with an '*' for activation within the mPFC)

| Brain Region | *x* | *y* | *z* | Kextent | *t*-score |
|---|---|---|---|---|---|
| Left inferior occipital lobe (BA 18) | −24 | −87 | −6 | 1379 | 9.49 |
| Left superior temporal gyrus (BA 22) | −48 | −27 | −3 | 205 | 3.64 |
| Left cingulate gyrus (BA 32) | −18 | 45 | 9 | 166 | 5.24 |
| Right cingulate gyrus (BA 32) | 18 | 33 | 15 | 132 | 5.18 |
| Right ventral mPFC (BA 10) | 15 | 36 | −9 | * | * |
| Left superior frontal gyrus (BA 6/8) | −6 | 36 | 60 | 56 | 4.62 |
| Left caudate nucleus | −3 | 9 | −3 | 91 | 4.60 |
| Right claustrum | 27 | −21 | 21 | 44 | 4.56 |
| Left inferior frontal gyrus (BA 45/46) | −57 | 33 | 15 | 117 | 4.09 |
| Left superior temporal gyrus (BA 22) | −63 | −54 | 15 | 49 | 3.81 |
| Left precentral gyrus (BA 4/6) | −54 | −6 | 45 | 23 | 3.58 |
| Left orbital gyrus (BA 11) | −12 | 39 | −12 | 56 | 3.53 |

heightened activations in the prefrontal cortex were found in the bilateral middle frontal gyrus (BA 9) and right inferior frontal gyrus (BA 44). Outside of the prefrontal cortex, we found heightened activation in the left insula (BA 13), bilateral fusiform (BA 37), right middle temporal gyrus (BA 37 and BA 39), left precuneus (BA 7) and bilateral parietal cortex (BA 40; for complete list of activations as well as MNI coordinates, see Table 3).

*Uncontrollable > controllable images controlling for scenarios.* In order to control for condition-specific effects that may have been elicited by reading the scenarios, we created a contrast for the uncontrollable images > uncontrollable scenarios and a separate contrast for the controllable images > controllable scenarios. We then conducted a paired samples *t*-test between these two contrasts in order to identify the neural mechanisms that were unique to viewing the images with the uncontrollable origins while controlling for the neural mechanisms that were unique to viewing the scenarios. Results validated our previous contrast, revealing activation in the same peaks of interest as reported in the direct uncontrollable image > controllable image (e.g. bilateral middle frontal gyrus (BA 9) and right inferior frontal gyrus (BA 44). Outside of the prefrontal cortex, we found heightened activation in the left insula (BA 13), bilateral fusiform (BA 37), right middle temporal gyrus (BA 37 and BA 39), left precuneus (BA 7) and bilateral parietal cortex (BA 40); see Table 4 for complete list of activations).

### Understanding the effect of perceived controllability on activity in the mPFC

To examine the effects of perceived controllability on mPFC activity in an unbiased manner, a region of interest (ROI) was defined based on

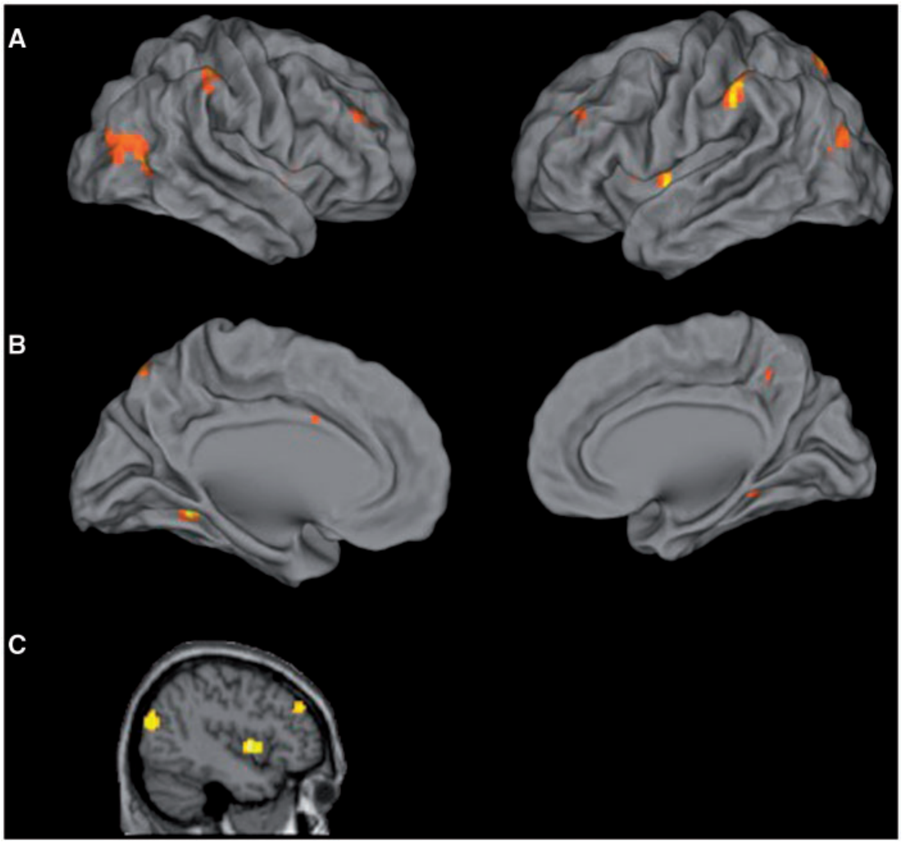


**Fig. 2** Neural activation when perceivers were evaluating images of homeless individuals in the uncontrollable > controllable condition showing (**A**) a left and right, respectively, medial view on a inflated cortical rendering of the brain, (**B**) the left and right, respectively, lateral view and (**C**) a mid-sagittal brain slice denoting activations in the left insula. Contrasts are thresholded at $P < 0.05$, corrected.

**Table 3** Uncontrollable image > Controllable image ($P < 0.05$ corrected), all coordinates MNI

| Brain Region | x | y | z | Kextent | t-score |
|---|---|---|---|---|---|
| Right middle frontal gyrus (BA 9) | 33 | 42 | 24 | 76 | 5.51 |
| Left fusiform gyrus (BA 37) | −30 | −48 | −9 | 55 | 5.50 |
| Right middle temporal gyrus (BA 37/39) | 54 | −66 | 6 | 200 | 5.01 |
| Left precuneus (BA 7) | −12 | −69 | 57 | 75 | 4.65 |
| Left insula (BA 13) | −42 | 0 | 0 | 56 | 4.60 |
| Left inferior parietal gyrus (BA 40) | −60 | −30 | 39 | 85 | 4.59 |
| Left middle frontal gyrus (BA 9) | −36 | 36 | 30 | 54 | 4.53 |
| Right inferior parietal gyrus (BA 40) | 57 | −30 | 51 | 83 | 4.49 |
| Left middle occipital gyrus (BA 19) | −48 | −78 | 15 | 119 | 4.35 |

**Table 4** (Uncontrollable image > Uncontrollable scenario) > (Controllable image > Controllable scenario) ($P < 0.05$ corrected), all coordinates MNI

| Brain region | x | y | z | Kextent | t-score |
|---|---|---|---|---|---|
| Left precuneus (BA 7) | −12 | −69 | 57 | 105 | 5.36 |
| Left fusiform gyrus (BA 37) | −30 | −48 | −9 | 58 | 5.30 |
| Left middle frontal gyrus (BA 9) | −36 | 36 | 27 | 103 | 5.21 |
| Left inferior parietal gyrus (BA 40) | −57 | −30 | 42 | 100 | 5.07 |
| Left insula (BA 13) | −42 | 0 | 0 | 78 | 5.04 |
| Right inferior parietal gyrus (BA 40) | 57 | −30 | 51 | 77 | 4.75 |
| Right middle temporal gyrus (BA 37/39) | 54 | −66 | 3 | 202 | 4.74 |
| Right fusiform gyrus (BA 37) | 30 | −42 | −9 | 27 | 4.24 |
| Right middle frontal gyrus (BA 9) | 33 | 42 | 21 | 60 | 4.23 |
| Left middle occipital gyrus (BA 19) | −42 | −81 | 21 | 98 | 4.16 |
| Right inferior frontal gyrus (BA 44) | 57 | 15 | 0 | 35 | 4.13 |
| Right middle frontal gyrus (BA 9) | 42 | 42 | 39 | 24 | 4.07 |
| Right superior parietal gyrus (BA 7) | 15 | −72 | 51 | 52 | 3.86 |

the peak activation in the mPFC from studies by Harris and Fiske (2007). Average parameter estimates were extracted from these peak activations by using the contrast from each condition relative to baseline fixation (e.g. controllable image *vs* baseline and uncontrollable image *vs* baseline). ROIs were extracted using the functional ROI tool in SPM8 (marsbar; Brett *et al.*, 2002). A spherical ROI (8 mm) was generated based on the peak activation in the left dorsal mPFC (−6, 51, 25). Signal intensity values for each trial type of interest were then extracted from each ROI and the parameter estimates were used for subsequent *t*-tests comparing activation during evaluations of the images in the controllable and uncontrollable conditions.

Results from this analysis revealed heightened activation in the dorsal mPFC when individuals evaluated images of homeless individuals who were described as having controllable as compared to uncontrollable origins to their stigmatized condition [$t(15) = 3.11$, $P < 0.01$]. This pattern of activation was consistent with the pattern we identified independently for the dorsal mPFC in the results from the current study.

## DISCUSSION

Perceiving a stigmatized condition to have a controllable or uncontrollable origin elicits disparate affective and neural responses. Specifically, participants expressed more pity and greater willingness to help homeless individuals whose stigmatized condition was perceived as originating in uncontrollable factors, whereas they expressed more disgust for homeless individuals whose situation was seen as originating in controllable factors. At the neural level, when a separate group of participants evaluated individuals with controllable origins to their stigmatized condition as compared to those with uncontrollable origins, we found heightened activation in the dorsal and slightly more ventral mPFC, the anterior cingulate cortex and the orbitofrontal cortex. Conversely, when participants evaluated individuals with uncontrollable origins to their condition, they had greater activation across more widespread areas of the brain, including the left insula and the bilateral parietal cortex. These activations were independent of the neural activation that occurred in response to reading the controllable and uncontrollable scenarios. Thus, these activations occurred while forming an impression about the homeless individual, not simply while reading a sentence describing how that individual became homeless.

The findings from the current study extend previous research on the neural correlates engaged during passive evaluations of stigmatized individuals by demonstrating that contextual information about the origin of the stigmatized condition can alter the behavioral and neural response to these individuals. Before delving into the interpretations for these findings, an important caveat to consider is that this study was designed to identify the neural correlates underlying the evaluation of stigmatized individuals (people who are homeless) when perceptions of the controllability of their condition are altered. Since this question has not been explored previously, the current study was therefore exploratory by nature. Thus, the range and scope of the interpretation is inherently limited. Although our behavioral data and ROI mask bolster our understanding of the patterns of neural activity observed in this study, future research may provide further insight and understanding into the pattern of activity observed in this study.

Our results suggest that evaluating images of homeless individuals with controllable origins to their conditions elicits heightened activation throughout the prefrontal cortex, notably the mPFC. There are several possible explanations for this finding. First, extensive research has implicated the ventral mPFC in reward processing and positive effect, particularly when it is activated in conjunction with the orbitofrontal cortex (OFC; e.g. O'Doherty *et al.*, 2003). However, our behavioral findings demonstrate that evaluating homeless individuals with controllable origins to their condition elicited less positive affect than evaluating the same individuals with uncontrollable origins. Thus, it is unlikely that the activation in the mPFC reflects positive affect in this study.

Instead, a more plausible explanation for the mPFC activation we observed is that it reflects perceivers' increased attempts to mentalize about the homeless individuals in the controllable condition. Previous research has demonstrated that the mPFC plays a central role in impression formation (Mitchell *et al.*, 2002, 2005, 2006; Mason *et al.*, 2004), including inferring intentionality for both ingroup and outgroup members (e.g. Gallagher and Frith, 2003; Harris and Fiske, 2007; Mitchell *et al.*, 2005). For instance, Harris and Fiske (2007) found that when extreme outgroup members were individuated, they elicited heightened activation in the dorsal mPFC, whereas, this was not the case when extreme outgroups members were passively evaluated (Harris and Fiske, 2006). In order to determine the role of the mPFC in evaluating homeless individuals with controllable origins to their condition, we conducted an ROI analysis using the same peak of dorsal mPFC identified by Harris and Fiske (2007). The results from this analysis demonstrated that this region was more active in the controllable as compared to uncontrollable condition. This finding suggests that the mPFC was likely engaged because perceivers were trying to infer the intentionality of stigmatized individuals with controllable origins. Indeed, the controllable origins to homelessness, by design, contained a clear component of intentionality (e.g. because the homeless individual ostensibly intentionally followed a path that led to becoming homeless), whereas uncontrollable origins to homelessness might not implicate intentionality to the same extent.

It is intriguing to note that the behavioral results suggested that although the homeless individuals with uncontrollable origins elicited more empathy than homeless individuals with controllable onsets, the imaging results demonstrated that they elicited less inferences of intentionality. An important caveat to our interpretation of the mPFC finding is that we did not find increased activation in other regions in the controllable > uncontrollable condition that have been implicated in inferring mental states [e.g. the temporo-parietal junction, precuneus, posterior cingulate; see van Overwalle (2009) for review]. Thus, in order to better conclude that the mPFC was engaged in inferring intentionality in the controllable > uncontrollable condition, future research should directly measure this possibility. One important question those arose in the current study and should be addressed in future work is whether empathy and mental state inferences are dissociable processes.

In the uncontrollable condition, we observed greater activation across more widespread areas of the brain, including the left insula. There are several possible explanations for this finding. For instance, evaluating homeless individuals with uncontrollable origins to their condition may have elicited more disgust as compared to evaluating homeless individuals with controllable origins (Harris and Fiske, 2006). However, our behavioral results are inconsistent with this interpretation. Indeed, we found that perceivers expressed less disgust toward the homeless individuals in the uncontrollable as compared to controllable condition. Furthermore, it is important to note that the Harris and Fiske study (2006) did not provide contextual cues during the evaluations (as we did in the current study). Thus, the overlapping activation in the left anterior insula may reflect distinct neural processes.

In a recent meta-analysis by Yarkoni and colleagues (2011), the authors found that activation in the insula is reported in nearly one-third of all neuroimaging studies. This finding suggests that the insula has multi-faceted functionality. For instance, in the current study, perceivers may have had an aversive response to the fact that individuals became homeless due to a situation that was ostensibly out of their control. An alternate explanation for the increased insula activity in the uncontrollable condition is that it may reflect increased prosocial feelings toward homeless individuals, such as empathy and positive reappraisal (Singer *et al.*, 2004, 2009; Jabbi *et al.*, 2007; Saarela *et al.*, 2007; Ochsner *et al.*, 2008). Such an interpretation would be consistent with the behavioral finding that homelessness that resulted from uncontrollable origins was associated with increased feelings of pity and helping, and reduced feelings of disgust. Future research should more closely examine the role of the insula in evaluating stigmatized individuals with uncontrollable origins to their conditions to better understand these differences.

Given that this study was primarily interested in activations in a few select neural regions, interpretations about the neural activations that occurred outside of these regions are speculative. For instance, with the respect to the heightened activation in the orbtiofrontal cortex and anterior cingulate gyrus that emerged in the controllable > uncontrollable contrast, one possibility is that the controllable origins may have elicited negative moral emotions. Indeed, emerging research on moral emotions has implicated the orbitofrontal cortex and the anterior cingulate gyrus in feelings of disgust and indignation (Moll *et al.*, 2004). In our behavioral data, participants expressed more disgust toward targets with controllable as compared to the uncontrollable origins to their stigmatized condition, which may also explain the pattern of neural activation we observed in the controllable condition. Of course, these regions have also been consistently implicated in evaluating cognitive and affective conflicts (Bush *et al.*, 2000; Botvinick *et al.*, 2004; Kerns *et al.*, 2004) and monitoring emotional and behavioral responses (Damasio, 1994; Stone *et al.*, 1998; Stuss and Alexander, 2000). Since we did not have *a priori* hypotheses about these regions, our interpretation remains speculative until further data are collected that specifically examine this question.

The results of this study extend previous research on the neural correlates engaged when evaluating stigmatized group members by demonstrating that these mechanisms are malleable. One strength of this study is that it extends previous work on the neural correlates engaged during passive evaluations of homelessness that have been well-characterized across numerous studies in social neuroscience (Harris and Fiske, 2006, 2007; Krendl *et al.*, 2009). We extend these finding by demonstrating that when the origin of a stigmatized condition is perceived as controllable, there is more activation in neural regions repeatedly implicated in impression formation and inferring intentionality. However, when the origin of a stigmatized condition is perceived as uncontrollable, there is greater activation in affective neural networks, thereby shedding light on the mechanisms that may underlie perceivers' strong affective response to uncontrollable homelessness. Thus, the results of this study suggest that distinct neural mechanisms underlie the evaluations of stigmatized individuals when contextual cues about the origins of their condition are manipulated.

## SUPPLEMENTARY DATA

Supplementary data are available at *SCAN* Online.

### Conflict of Interest

None declared.

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