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Justice for the average Joe: The role of envy and the mentalizing network in the deservingness of others' misfortunes

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The misfortunes of enviable individuals are met by observers with pleasure whereas those of "average", non-enviable individuals elicit pain. These responses are mirrored in deservingness judgments, as enviable individuals' misfortunes are perceived as deserved and those of non-enviable individuals perceived as undeserved. However, the neural underpinnings of these deservingness disparities remain unknown. To explore this phenomenon, we utilized fMRI to test the hypotheses that (A) non-enviable targets' misfortunes would be associated with activation of brain regions that mediate empathic responding (pain matrix, mentalizing network) and not for enviable targets and (B) that activation of those regions would predict decreases in deservingness judgments. Supporting our first hypothesis, the misfortunes of non-enviable targets (as opposed to good fortunes) were associated with activation of the mentalizing network: medial prefrontal cortex, posterior cingulate cortex, temporal–parietal junction, and anterior temporal lobes. Supporting our second hypothesis, dorsomedial prefrontal cortex activation from this contrast was negatively correlated with subsequent reports of how much the non-enviable target deserved his/her misfortune. These findings suggest that non-enviable individuals' misfortunes are perceived as unjust due, in part, to the recruitment of the mentalizing network.

Keywords: Envy; Deservingness; Empathy; Misfortune; Mentalizing network; fMRI.

> *Envy, among other ingredients, has a mixture of the love of justice in it.*
>
> –William Hazlitt

Envy is the aversive emotion that occurs when individuals become aware of their inferiority on an important domain (Foster, 1972; Heider, 1958; Schoeck, 1969; Smith & Kim, 2007). Envy is a commonly felt and culturally universal emotion that can take two forms: benign envy that is more akin to admiration, and malicious envy in which there is a hostile intent toward the enviable target (e.g., van de Ven, Zeelenberg, & Pieters, 2009). Misfortune that befalls the envied is associated with schadenfreude, or pleasure at the misfortune of others (Smith, Parrott, Ozer, & Moniz, 1994). Indeed, the hardships of an envied other are associated with activation in the ventral striatum, a dopamine-rich brain circuit associated with hedonic reward (Cikara, Botvinick, & Fiske, 2011; Singer et al. 2006; Takahashi et al. 2009). Conversely,

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non-enviable individuals' misfortunes are typically met with empathic concern and activation of the insula, which is associated with pain (Cikara & Fiske, 2011).

ENVY AND DESERVINGNESS

Based on self-report methods, evidence suggests that these disparate pain and pleasure responses to misfortune linked with enviability are also related to how much an individual is perceived to *deserve* his/her misfortune, though in complex ways (e.g., van de Ven et al., 2009; Smith et al., 1994). Generally, deserved misfortunes are reported as more pleasing than undeserved ones and the standards for determining deservingness seem relatively clear-cut and normative (e.g., Feather, 2006, 2008; Hafer, 2012; van Dijk, Ouwerkerk, Goslinga, & Nieweg, 2006). When envy is involved, however, perceptions of deservingness tend to be subjectively derived. People feeling malicious envy usually begrudge the envied person's success and can rationalize that any misfortune he/she experience is deserved (e.g., Rawls, 1999; Smith, 1991; Smith et al., 1994). Adding to this rationalized component may be the simple fact that many invidious advantages enjoyed by others can be perceived as arbitrary, and thus "unfairly" distributed by fate (e.g., Parrott, 1991; Smith, 1991). Moreover, evolutionary accounts of envy suggest that it is adaptive to construe another's advantage as unfair, as this provides the motivation to improve one's relative position in the social hierarchy (Hill & Buss, 2008). By contrast, there is a tendency to root for and support non-envied people and view their suffering as undeserved (e.g., Kim et al. 2008). The neural mechanisms linked to these disparate reactions, however, are less well understood. A psychological process with clear neural correlates that might mediate the effect of envy on deservingness is that of empathy.

NEURAL NETWORKS OF EMPATHY

Empathy refers to a shared emotional state between an observer and a target. Research on this phenomenon has demonstrated that others' misfortunes are represented mentally and neurally as if they happened to ourselves (Preston & de Waal, 2002). Such empathic responding is mediated by two neural networks: the pain matrix and the mentalizing network.

The pain matrix

The pain matrix includes an affective group (anterior insula, ACC) and sensory group (posterior insula, secondary and primary somatosensory cortex; Davis, 2000; Peyron, Laurent, & García-Larrea, 2000). The affective group, but not the sensory group, has been robustly associated with seeing others endure both abstractly and physically painful misfortunes (Bruneau, Pluta, & Saxe, 2012; Jackson, Meltzoff, & Decety, 2005, Jackson, Brunet, Meltzoff, & Decety, 2006; Singer et al. 2004). This resonance of pain allows us to feel empathy for those who experience misfortune, though it is not the only psychological process that facilitates empathy.

The mentalizing network

Simulating the mental states of others, known as *mentalizing*, is a necessary precondition for empathic responding to the misfortunes of others (Frith & Frith, 2003; Preston & de Waal, 2002). A network of neural regions is reliably associated with mentalizing and includes the dorsal medial prefrontal cortex (dMPFC), posterior cingulate cortex (PCC), temporal–parietal junction (TPJ), and the anterior temporal lobes (ATLs; Frith & Frith, 2006). Each region within the mentalizing network serves an individual yet complimentary function that, on the whole, yields the human ability to mentalize about others. Taken together, this network allows individuals to perspective-take with others, predict their thoughts and behavior, know when such cognitions and behavior are relevant to ourselves and our past, and to integrate this information with other cognitive processes to produce the coherent experience of mentalizing others' psychological states. However, the activity of both the mentalizing network and pain matrix is modulated by characteristics of the target.

ENVY CONSTRAINS EMPATHY

A growing body of evidence suggests that enviable individuals' misfortunes are met with diminished empathy, which may constrain the brain's empathic response. Members of enviable outgroups have their misfortunes met with less aversion than pitiable individuals, as evidenced by activation of the anterior insula, a neural region associated with interoception and the affective component of pain (Cikara & Fiske, 2011). Further, misfortune that befalls the envied is associated with activation in the ventral striatum, a dopamine-rich brain circuit associated with hedonic reward (Cikara et al., 2011; Singer et al. 2006; Takahashi et al. 2009). These findings suggest that the misfortunes of the enviable are not met with the brain's prototypical empathic response.

CURRENT RESEARCH

One goal of the current research was to replicate the reward-related activation associated with the misfortunes of the enviable using a novel procedure in which participants responded to ostensibly real, target individuals, who were either enviable or not, and, who either experienced a misfortune or a good fortune. Afterwards, participants rated how much each individual deserved the outcome he/she received. To replicate previous research, we hypothesized that the misfortunes of enviable targets (as compared to non-enviable targets) would be associated with increased activation of reward- and pleasure-related brain areas. Additionally, we expected that these reactions would be associated with greater perceptions of deservingness. We also hypothesized that the misfortunes of enviable targets would be associated with lesser activation of both the pain matrix and mentalizing network than non-enviable targets—and that activation of these regions would be associated with lower perceptions of deservingness.

METHOD

Participants

Twenty-six participants were recruited in compliance with the human subjects regulations of the University of Kentucky and were compensated with course credit for their participation. All participants were fluent English-speakers and were screened for visual acuity and right-hand dominance, as well as medications, psychological, and/or neurological conditions that might influence the blood oxygenation level-dependent (BOLD) response. Data from three participants were excluded from analyses because of missing fMRI data. Analyses were performed on 23 remaining participants (12 females; Age: $M = 18.78$, $SD = 0.80$).

Procedure

Pre-scan interview summaries

Participants began the experiment outside the MRI scanner by reading summaries of interviews ostensibly acquired from 24 same-sex students at their university who were applying to work in a prestigious Student Ambassador Program. Participants were told that the purpose of the study was to assess how well people remember information about new acquaintances. The applicants to the ambassador program were described as fellow undergraduates because previous research has shown that envy most often occurs in comparisons to similar others (e.g., Parrott, 1991; Schaubroeck & Lam, 2004; van Dijk et al., 2006) and when the domain of social comparison (e.g., attractiveness, GPA, owning a car) is relevant to the self (e.g., Salovey & Rodin, 1991; Tesser, 1991).

Each interview summary contained the applicant's first name, academic year, grade percent average, hobbies, career plans, whether he/she lived on- or off-campus, whether he/she possessed a vehicle, and finally, a picture of his/her face. After reading all 24 interview summaries, participants were asked to respond to several questions about each applicant without looking back at the summary, to ensure that they had truly read and remembered each one. In addition to these recall items, participants indicated how much they felt toward each applicant that measured malicious envy: "envious of" "jealous of" "resentful of" "inferior to", and "hostile towards." Participants responded to each item along an 11-point Likert scale with higher values indicating greater perceptions of malicious envy. We measured the malicious form of envy to the exclusion of its benign form because malicious envy is most associated with the perception that the good fortunes of others are undeserved and the misfortunes of others are deserved (Smith & Kim, 2007).

The content of the interview summaries was manipulated so that half of the applicants were highly enviable in that they were attractive, had high grade point averages, ambitious career plans and hobbies, lived off-campus, and possessed a vehicle (High Envy condition). The other half of the interview summaries described applicants who were not enviable, in that they had average-attractiveness faces, average grade point averages, unambitious career plans and hobbies, lived in on-campus dormitories, and did not possess a vehicle (Low Envy condition). Participants then completed a brief survey to assess their initial feelings of envy toward the people featured in the interview. All interview summaries were pretested to ensure that the face pictures were perceived as attractive in the High Envy condition and of average attractiveness in the Low Envy condition.

Scanner task

While in the scanner, participants were presented with each of the 24 profile images for 5 s, with a one-sentence description of an activity reminding participants of information in the interviews displayed below his/her picture. This familiarized participants with the procedure and reinforced key aspects of each interview. Then, for the study proper, participants were presented with an event-related design of the 24 profile images. Each profile was similar to the practice trials, except that there was an additional sentence describing whether they had been accepted or rejected by the Student Ambassador Program. Six of the twelve enviable individuals were accepted into the program (High Envy–Good Fortune condition), whereas the other six enviable individuals were rejected from the program (High Envy–Misfortune condition). Likewise, six of the twelve non-enviable individuals were accepted into the program (Low Envy–Good Fortune condition), whereas the other six non-enviable individuals were rejected from the program (Low Envy–Misfortune condition).

To ensure that participants successfully encoded each individual's outcome, they were instructed to press "1" on a keypad if individuals had been accepted and "2" if they had been rejected. Each profile was presented for 5 s. After each profile, a screen depicting a fixation point appeared for 2.5 s, indicating that participants should clear their minds. These post-profile fixation trials served to account for any residual brain activation from viewing the profiles.[1] Interspersed among the profiles were 12 baseline trials that depicted a fixation point for 7.5 s, indicating that participants should clear their minds. The order of profile and baseline trials were randomized but held constant across participants. Participants viewed all of the stimuli described above over the course of a single run (duration: 4 min, 30 s), repeatedly for a series of four runs. Each of the four consecutive runs had a different, randomized order of profile and baseline trials.

Post-scan questionnaires

After being removed from the scanner, participants reviewed each profile that they saw in the pre-scan portion of the experiment and responded to a set of items, two of which were designed to measure how much participants believed each applicant deserved the outcome he/she received: "they deserve what has happened to them" and "they are to blame for what has happened to them." Participants responded to each item along an 11-point Likert scale with higher values indicating greater perceptions of deservingness. One participant did not complete the post-scan questionnaires. Finally, participants completed an open-ended, funneling questionnaire which measured suspicion (none were judged suspicious), and were debriefed.

[1] These inter-stimulus intervals may have been too short in duration, leading to the presence of residual signal from one trial to the next. However, this would have been an issue for only half of the trials as they were followed by a longer baseline fixation. Further, this issue would only serve to dampen the differences we observed between experimental conditions, though it may have contributed to our failures to replicate several findings relevant to schadenfreude and empathic pain.

fMRI data acquisition

All images were collected on a 3T Siemens Magnetom Trio scanner (Siemens Medical Solutions USA, Inc., Malvern, PA, USA). Functional images were acquired with a T2*-weighted gradient echo sequence with the following parameters: 2.5 s repetition time, 30 ms echo time, 64 × 64 matrix, 224 × 224 mm field of view, 38 3.5 mm axial slices acquired in an interleaved order. A 3D shim was applied before functional data acquisition. These parameters allowed for whole brain coverage with 3.5 mm cubic voxels. A high-resolution, T1-weighted image was also acquired from each subject so that functional data could be registered to native space and then normalized to the Montreal Neurological Institute (MNI) atlas space.

fMRI data analysis

All preprocessing and statistical analysis was conducted using the FSL software toolbox (MRIB Analysis Group, Oxford, UK) (Oxford Center for Functional Magnetic Resonance Imaging (FMRIB); Smith et al., 2004; Woolrich et al. 2009). Functional volumes were reconstructed from k-space using a linear time interpolation algorithm to double the effective sampling rate, the first three volumes were removed to allow for signal equilibration. The remaining functional volumes were corrected for head movement to the median volume using FMRIB's Linear Image Registration Tool for Motion Correction (MCFLIRT) (Jenkinson, Bannister, Brady, & Smith, 2002), corrected for slice-timing skew using temporal sinc interpolation, pre-whitened using FMRIB's Improved Linear Model (FILM) (Woolrich, Ripley, Brady, & Smith, 2001), and smoothed with a 5 mm full width at half maximum (FWHM) Gaussian kernel. To remove drifts within sessions, a high-pass filter with a cut-off period of 100 s was applied. Non-brain structures were stripped from functional and anatomical volumes using the Brain Extraction Tool (BET; Smith, 2002).

FMRI analysis was performed using FSL's FMRI Expert Analysis Tool (FEAT version 5.98). A fixed-effects analysis modeled event-related responses for each run of each participant. Each event consisted of two consecutive volumes. High Envy–Good Fortune profiles, High Envy–Misfortune profiles, Low Envy–Good Fortune profiles, and Low Envy–Misfortune profiles and were modeled as events using a canonical double-gamma hemodynamic response function with a temporal derivative. Post-profile fixation trials were modeled as a nuisance regressor whereas baseline fixation trials were left unmodeled. To assess misfortune-specific activation in both the High Envy and Low Envy conditions, the contrasts of interest were Low Envy–Misfortune>Low Envy–Good Fortune and High Envy–Misfortune>High Envy–Good Fortune. Functional volumes and first-level contrast images from this analysis were first registered to corresponding structural volumes using 7 degrees of freedom, and then spatially normalized to a stereotaxic space template image (MNI) using 12 degrees of freedom with FMRIB's Linear Image Registration Tool (FLIRT; Jenkinson & Smith, 2001; Jenkinson et al., 2002). A second-level analysis created contrast estimates for each participant by collapsing across runs, treating runs as a fixed effect. FEAT's FMRIB's Local Analysis of Mixed Effects (FLAME) 1 module (Beckmann, Jenkinson, & Smith, 2003; Woolrich, 2008; Woolrich, Behrens, Beckmann, Jenkinson, & Smith, 2004) was used to perform top-level, mixed-effects analysis which created group average maps for contrasts of interest. Z (Gaussianized T/F) statistic images were thresholded using clusters determined by $Z > 2.3$ and *a* (corrected) cluster significance threshold of $p < .05$ (Worsley, 2001).

Parameter estimates from activated clusters from contrasts of interest were converted to units of percent signal change, extracted, and averaged across each subject (as outlined by Mumford, J. http://mumford.bol.ucla.edu/perchange_guide.pdf). The resulting percent signal change values represent the degree to which the BOLD signal changed from baseline fixation trials to its levels during a given condition *minus* the BOLD change from the reference condition. These values were computed across all trials of each condition for a single voxel and then averaged across all voxels within the functional region-of-interest (ROI). Correlations between these percent signal change values and self-reported deservingness represent the association between the condition-specific BOLD signal of a given ROI and subsequent deservingness judgments.

RESULTS

Self-report results

Sufficient reliability was established for the five-item measure of malicious envy (Cronbach $\alpha = .95$) and the two-item measure of deservingness-of-outcome (Cronbach $\alpha = .70$). Confirming our envy manipulation, High Envy profiles were rated higher (M = 1.69, SD = 1.41) on malicious envy than Low Envy profiles (M = .65, SD = 1.10), $t(21) = 7.43$, $p < .001$. Deservingness-of-outcome ratings were characterized by a main effect of Envy, $F(1, 21) = 9.93$, $p = .005$, such that ratings were higher for High Envy profiles as compared to Low Envy profiles (Figure 1). Additionally, we observed a main effect of Outcome for deservingness ratings, $F(1, 21) = 20.20$, $p < .001$, such that ratings were higher for profiles in the Good Fortune condition than the Misfortune condition. Replicating previous work and validating the predicted uniqueness of the Low Envy–Misfortune condition, deservingness ratings were lower for this condition than for all three other conditions, $F(1, 20) = 10.21$, $p = .004$, and most importantly, lower than the High Envy–Misfortune condition, $t(21) = 2.20$, $p = .039$.

Imaging results

Misfortunes, as compared to Good Fortunes, of Low Envy targets were associated with activation of the mentalizing network, namely the dorsal MPFC (dMPFC), PCC, left TPJ, and bilateral ATL (Table 1; Figure 2A–C). Activation of these regions was not observed for the equivalent contrast for High Envy targets. Failing to replicate previous research, the Misfortunes > Good Fortunes contrast for High Envy targets was not associated with activation of the ventral striatum. Misfortunes, as compared to Good Fortunes, of both High and Low Envy targets were not associated with activation of the pain matrix. Comparing Low Envy targets to High Envy targets on Misfortune trials (i.e., Low Envy–Misfortune > High

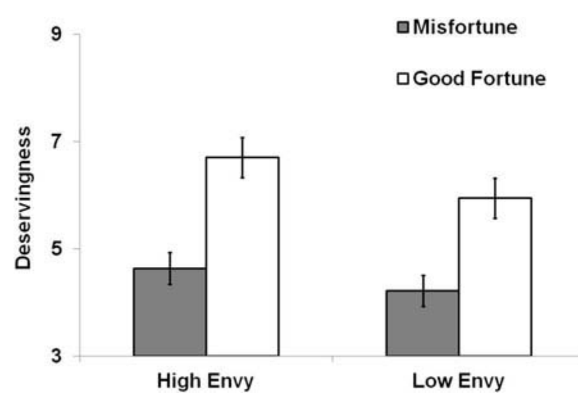

Figure 1. Means and standard errors of deservingness-of-outcome judgments by profile condition.

TABLE 1
Activated clusters of Misfortune > Good Fortune contrasts, by Envy condition

	Contiguous voxels	*Peak MNI coordinates (x,y,z)*	*Peak Z-value*	*Brodmann's area(s)*
Low Envy–Misfortune > Low Envy–Good Fortune				
ATL	844	60,2,−22	4.12	21,38
ATL/LOFC	4,475	−52,26,−4	5.06	21,38/45,47
dMPFC	1,576	−8,52,38	4.60	9,10
MOFC	860	−2,46,−22	5.06	11
PCC	1,048	0,–50,38	4.17	23
TPJ	494	−52,–62,26	3.65	22,39
High Envy–Misfortune > High Envy–Good Fortune				
LOFC	1,355	−56,26,2	4.26	45,47

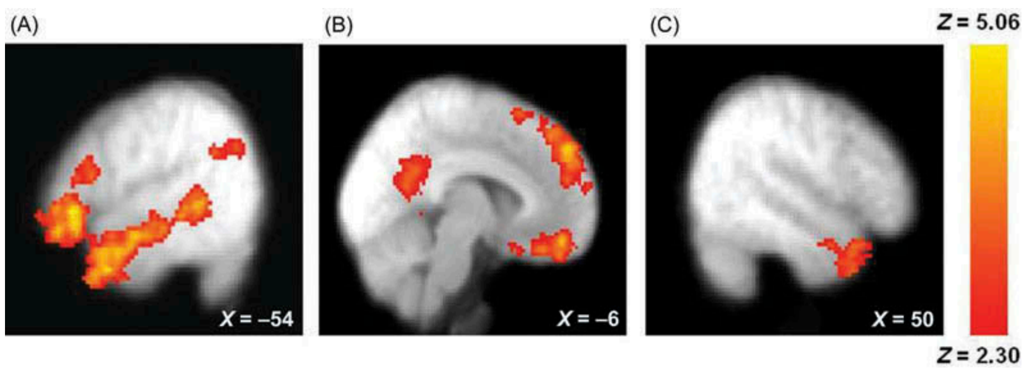

Figure 2. Activated clusters from the Low Envy–Misfortune > Low Envy–Good Fortune contrast. Clusters are overlaid atop participants' aggregated structural volumes and include: (A) left ATL, LOFC, IFG, and TPJ; (B) dMPFC, PCC, MOFC; and (C) right ATL. Coordinates are in MNI space.

Envy–Misfortune) did not yield any voxels of activation above threshold.

Misfortunes, as compared to Good Fortunes, of Low Envy targets were also associated with two unexpected clusters of activation in the orbitofrontal cortex (Table 1). Specifically, we observed activation in left lateral orbitofrontal cortex (LOFC) and the medial orbitofrontal cortex (MOFC). This LOFC cluster was connected with the left ATL cluster and extended slightly into the left inferior frontal gyrus (IFG). Activation of the left LOFC and IFG was also witnessed for the same contrast of High Envy targets (Table 1). As such, it is unlikely that the function of the LOFC and IFG is specific to non-enviable individuals and subsequently, not of interest for this study. The MOFC cluster was extremely ventral where an accurate BOLD signal is difficult to obtain due to the magnetic interference of the underlying sinus cavity. Because we did not utilize data acquisition techniques to minimize this interference (e.g., orienting slices along the commissure line), we refrain from interpreting the activation discovered in the MOFC.

To assess if the recruitment of mentalizing regions in response to Misfortune was associated with reduced enviability of the target, percent signal change units were extracted from the activated clusters in the mentalizing network: dMPFC, PCC, TPJ, left and right ATL. Because the left ATL and the left LOFC were originally part of the same activated cluster, we used spatial coordinates from Automated Anatomical Labeling (AAL) masks (Tzourio-Mazoyer et al., 2002) to extract percent signal change units specific to the left ATL. Further emphasizing that mentalizing network activations were greater for non-enviable individuals, activation in these areas negatively correlated with how much malicious envy individuals reported toward each profile in the Low Envy–Misfortune condition; dMPFC: $r(22) = -.45$, $p = .034$; left ATL: $r(22) = -.60$, $p = .003$; right ATL: $r(22) = -.42$, $p = .047$. TPJ activation was marginally associated with malicious envy reports of profiles in the Low Envy–Misfortune condition, $r(22) = -.35$, $p = .098$, whereas PCC activation was not significantly correlated, $r(22) = -.30$, $p = .158$.

Correlations with deservingness judgments

To assess whether activation in the mentalizing network was related to subsequent deservingness-of-misfortune judgments, we separately correlated percent signal change values (from the Low Envy–Misfortune > Low Envy–Good Fortune contrast) from all five activated clusters in mentalizing regions with deservingness-of-outcome judgments for the Low Envy–Misfortune condition. Correlations between these regions' percent signal change values and deservingness judgments for targets from the other three conditions were not performed as the mentalizing network activation was specific to targets from the Low Envy–Misfortune condition. Only dMPFC activation was negatively correlated with deservingness judgments, $r(22) = -.49$, $p = .021$ (Figure 3). Deservingness judgments did not significantly correlate with percent signal change units from left ATL, $r(22) = -.30$, $p = .181$, right ATL, $r(22) = -.33$, $p = .139$, TPJ, $r(22) = -.29$, $p = .188$, or PCC, $r(22) = -.27$, $p = .231$. Thus, the greater the dMPFC activation that participants experienced, the less they judged that the non-enviable person deserved getting rejected from the prestigious program.

DISCUSSION

In the current study, participants viewed the misfortunes and good fortunes of non-enviable and enviable individuals while undergoing fMRI. Participants then rated how much each individual deserved his/her outcome.

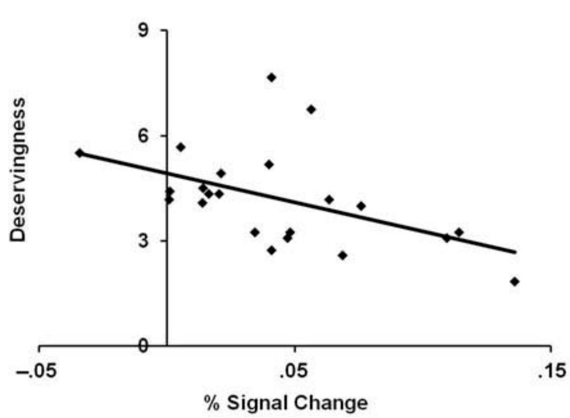

Figure 3. Correlation between dMPFC percent signal change units (from the Low Envy–Misfortune > Low Envy–Good Fortune contrast) and deservingness-of-outcome judgments for profiles in the Low Envy–Misfortune condition.

As a novel contribution, our results identify potential neural correlates of non-enviable individuals' misfortunes, and suggest the neural processes that underpin the tendency to view their misfortunes as less deserved. Activation of the mentalizing network (though not the pain matrix) was associated with the misfortunes of non-enviable individuals and not their enviable counterparts. Crucially, we found that activation of these neural regions predicted decreases in participants' perceptions of the degree to which non-enviable individuals deserved their misfortune, a proxy for their perceptions of justice. Unexpectedly, we did not replicate prior findings linking the misfortunes of enviable targets (as compared to non-enviable targets) with increased activation of reward- and pleasure-related brain areas.

Our results are in accordance with previous work demonstrating that deservingness-of-outcome judgments were lowest for non-enviable individuals who had experienced a misfortune compared to all other conditions. Extending this work and supporting our hypotheses, whole-brain fMRI analyses revealed activation of the mentalizing network, which included dMPFC, PCC, left TPJ, and bilateral ATL, when participants observed that non-enviable individuals experience misfortunes, as compared to good fortunes. We observed no such activation of this network for enviable targets' misfortunes, as opposed to good fortunes.

Because of the nature of our design, it is difficult to know if the differences we observed between our High and Low Envy targets were due to greater mentalizing for Low Envy targets, lesser mentalizing for High Envy targets, or a combination of both. Given the wealth of previous research showing that the default response to others' misfortunes involves empathy (Preston & de Waal, 2002), we assert that the difference we observed was due to reduced mentalizing among the High Envy targets. Yet, our data do not conclusively support this notion.

DMPFC activation specific to non-enviable targets' misfortunes was negatively correlated with deservingness judgments in that condition, suggesting a unique role for this region in envy-based shifts in deservingness judgments of misfortunes. This unique function of the dMPFC meshes well with previous research on this neural region. The MPFC can be broadly summarized as an integrative center for social cognitive processes and it plays a powerful role in differentiating and overlapping the self with others (Amodio & Frith, 2006). Within the context of mentalizing, the dMPFC is selectively recruited for the process of perspective-taking (D'Argembeau et al. 2007) and resonating with the emotional, as opposed to physical, pain of others (Bruneau et al., 2012). As such, our findings imply that affective perspective-taking is the driving mechanism through which participants judge the misfortunes of non-enviable individuals as not deserved and unjust.

The presence of LOFC activation during both non-enviable and enviable targets' misfortunes was unexpected. However, this finding can be made sense of within the framework of the LOFC as a region that responds preferentially to punishing outcomes (O'Doherty, Kringelbach, Rolls, Hornak, & Andrews, 2001). As such, it may be that participants were potentially encoding misfortune as a punishment of the target, regardless of enviability.

Taken together, our findings indicate that the misfortunes of non-enviable individuals are unique in that they are associated with mentalizing that may sometimes be reduced for the tribulations of enviable individuals. Activation of the mentalizing network in conjunction with the absence of pain matrix activation indicates that participants were putting themselves in the shoes of the non-enviable, but not necessarily feeling their pain. Finally, the dMPFC's unique association with reduced deservingness judgments suggests that the perspective-taking component of mentalizing plays a crucial role in the determination of whether a given individual deserved his/her outcome, and whether it was just. These findings are the first to suggest the neural underpinnings of the process through which non-enviable individuals' misfortunes are perceived as less deserved. Because people often tend to believe in a "just world", decreased deservingness judgments tend to foster altruistic helping (Kim et al., 2008; Lerner & Miller, 1978); our findings have implications for increasing prosocial behavior toward the misfortunate. If the mentalizing network is attenuated by the misfortunate target's enviability, casting the misfortunate in a non-enviable light (e.g., downplay his/her wealth, play up his/her "everyday" foibles) may reduce perceptions that his/her misfortunes are deserved and subsequently foster helping behavior.

Despite these contributions, our study was limited in several dimensions. We did not observe pain matrix activation to the misfortunes of either enviable or non-enviable targets, when a wealth of empathy research would suggest that we should have. Further, we failed to replicate the finding that enviable individuals' misfortunes, as compared to their good fortunes, are associated with reward as evidenced by activation of the ventral striatum (Cikara & Fiske, 2011; Takahashi et al. 2009). This lack of reward activation may have occurred due to differences between our experimental task and that of previous neuroimaging research on this topic. Both Takahashi and colleagues (2009) and Cikara and Fiske (2011) utilized hypothetical misfortunes, whereas the misfortunes of our targets were taken as real. The realness of our targets' misfortunes may have suppressed the pleasure of watching the envious fall. Another aspect of the task that may have influenced our results was that participants were given a reason as to why a target individual was rejected from the program, but were not given a reason for his/her acceptance. This entails that our Misfortune and Good Fortune conditions were confounded with whether the outcome was explained or not. This was done to increase the believability and realism of the task as applicants are usually accepted into careers or schools based on multiple criteria and can be rejected for failing on just one. Future research might utilize tasks that do not confound these elements.

Although we successfully created malicious envy, the absolute level of the envy was low; it may be that envy would need to be much more intense for the reward system activation found in prior studies to be replicated. Future research may assess whether the differential patterns of mentalizing network activation are associated with changes in behavioral outcomes such as altruistic helping and aggression. Additionally, future research should see if the recruitment of mentalizing extends to pitiable individuals' misfortunes in comparison to those of their "average" and enviable counterparts. Notwithstanding these limitations, our findings corroborate decades of research and provide novel insight into the neural and psychological processes associated with envy, misfortune, and deservingness.

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