Is Morality Unified? Evidence that Distinct Neural Systems Underlie Moral Judgments of Harm, Dishonesty, and Disgust

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Abstract

■ Much recent research has sought to uncover the neural basis of moral judgment. However, it has remained unclear whether "moral judgments" are sufficiently homogenous to be studied scientifically as a unified category. We tested this assumption by using fMRI to examine the neural correlates of moral judgments within three moral areas: (physical) harm, dishonesty, and (sexual) disgust. We found that the judgment of moral wrongness was subserved by distinct neural systems for each of the different moral areas and that these differences were much more robust than differences in wrongness judgments within a moral area. Dishonest, disgusting, and harmful moral transgression recruited networks of brain regions associated with mentalizing, affective processing, and action understanding, respectively. Dorsal medial pFC was the only region activated by all scenarios judged to be morally wrong in comparison with neutral scenarios. However, this region was also activated by dishonest and harmful scenarios judged *not* to be morally wrong, suggestive of a domain-general role that is neither peculiar to nor predictive of moral decisions. These results suggest that moral judgment is not a wholly unified faculty in the human brain, but rather, instantiated in dissociable neural systems that are engaged differentially depending on the type of transgression being judged. ■

INTRODUCTION

Is it worse to cheat on an exam or to eat your dog? Consideration of these acts feels very different, yet we tend to classify a diverse variety of acts (e.g., theft, lying, assault, disrespect, incest) as "morally wrong." This common linguistic label does not ensure that moral judgments of such diverse acts are similar enough to be studied as a single kind of judgment. Nonetheless, research investigating moral judgments has tended to treat moral judgments pertaining to vastly different contents as comparable or even equivalent.

Many theorists suggest that there is a universal, innate human moral faculty (Hauser, 2006; Dwyer, 1999; Mikhail, Sorrentino, & Spelke, 1998; Rawls, 1971). Such theories posit that our moral judgments are fueled neither by emotion nor by conscious deliberation but by an unconscious evaluative mechanism that makes judgments based on innate, often inarticulable principles analogous to Chomsky's universal grammar. Others have emphasized the causal role of emotions in moral judgments (Wheatley & Haidt, 2005; Haidt, 2001). Still others have suggested that emotional responses and cognitive computations work in tandem to give rise to moral judgments (Dupoux & Jacob, 2007; Greene, Nystrom, Engell, Darley, & Cohen, 2004). The existence of any such shared, uniform mechanism—be it rational, affect-driven, or both—would predict shared neural responses across moral domains.

Some philosophers (Prinz, 2008), psychologists (Blair, Marsh, Finger, Blair, & Luo, 2006; Moll, Zahn, de Oliveira-Souza, Krueger, & Grafman, 2005; Haidt, 2001), and anthropologists (Shweder, Much, Mahapatra, & Park, 1997) have questioned the assumption that morality is homogenous enough to be treated as a unified faculty. Behavioral data indicates that some moral judgments are rooted in conscious reasoning whereas others are not (Cushman, Young, & Hauser, 2006) and that psychopathy scores correlate with moral judgments in some areas more than others (Glenn, Iyer, Graham, Koleva, & Haidt, 2009). These findings have underscored the need to adopt a more fine-grained approach to studying morality.

Such an approach may be especially fruitful in identifying the neural underpinnings of moral judgment. There is evidence that the neural correlates of harm judgments differ depending on whether the harms are direct or indirect (Greene et al., 2004; Greene, Sommerville, Nystrom, Darley, & Cohen, 2001), as well as whether they are intended or unintended (Young & Saxe, 2008; Borg, Hynes, Van Horn, Grafton, & Sinnott-Armstrong, 2006). There is also some evidence that different brain areas are recruited by the judgment of scenarios involving bodily harm compared with those that do not (Heekeren et al., 2005). Independent studies of dishonesty (Greene & Paxton, 2009) and disgust (Borg, Lieberman, & Kiehl, 2008; Moll, de Oliveira-Souza,

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et al., 2005) report distinct patterns of brain activations associated with judgments of moral transgressions within these broad categories, suggesting that these judgments are distinct from one another and from harm judgments. In addition, different morally relevant emotions such as guilt, anger, and embarrassment are associated with dissociable networks of brain regions (Immorino-Yang, McColl, Damasio, & Damasio, 2009; Zahn et al., 2009; Kedia, Berthoz, Wessa, Hilton, & Martinot, 2008; Moll et al., 2007; Takahashi et al., 2004; Moll, de Oliveira-Souza, & Eslinger, 2003; Berthoz, Armony, Blair, & Dolan, 2002; Dougherty et al., 1999). Across these studies, activation of the dorsal medial pFC (DMPFC), an area implicated in self-referential processing (Northoff et al., 2006) and thinking about others (Amodio & Frith, 2006), especially in ambiguous circumstances (Jenkins & Mitchell, 2010), is most widely associated with morally relevant processing (Moll, Zahn, et al., 2005). Importantly, although independent studies have been conducted within multiple moral areas (e.g., harm, disgust, and dishonesty), methodological differences between studies render direct comparisons difficult.

Another obstacle to understanding the neural basis of moral judgment is the widespread tendency to contrast moral scenarios to each other and to neutral scenarios without considering whether participants judge acts in those scenarios to be morally wrong. Notably, one study (Greene et al., 2004) found significant activation differences between those who judged the same act to be morally permissible or impermissible within the category of physical harm. It remains to be seen whether these differences extend to other moral domains. Accordingly, we sought to determine whether any neural substrate is common to judgments of moral transgressions (as compared with neutral scenarios) within or across various domains, or with judgments that an act is morally wrong (as compared with not morally wrong) within or across domains. It was predicted that judgments of different categories of moral transgressions would be related to different patterns of activity in the brain.

More specifically, it was predicted that disgusting moral transgressions would evoke activity in areas associated with affective processing, such as the amygdala, OFC, and insula (Jabbi, Bastiaansen, & Keysers, 2008; Britton et al., 2005), whereas dishonest transgressions would elicit activity in areas activated when inferring others' mental states, such as the TPJ (Saxe & Kanwisher, 2003), the posterior cingulate cortex (PCC), and the DMPFC (Rilling, Sanfey, Aronson, Nystrom, & Cohen, 2004). In line with the bulk of fMRI studies of moral reasoning that have focused on harm (e.g., Greene et al., 2001), it was predicted that the dorsolateral pFC (DLPFC), ACC, and the aforementioned mentalizing areas, as well as areas implicated in action understanding (posterior STS, inferior parietal lobule [IPL], SMA; Grafton, Arbib, Fadiga, & Rizzolatti, 1996) and, more specifically, in processing socially informative sensory information (posterior STS; Allison, Puce, & McCarthy, 2000) would show activity in response to moral transgressions involving bodily harms.

The neural correlates of "wrong" and "not wrong" judgments within and across story types were compared. As activation differences between "wrong" and "not wrong" judgments have only been found within the category of harm (Greene et al., 2004) and other studies (Borg et al., 2006) have failed to find significant differences, no specific hypotheses were made about the neural correlates of these judgments.

METHODS

Stimuli

Three rounds of pilot testing involving 75 participants at Princeton University and Dartmouth College yielded 14 acceptable scenarios in each of four categories: Disgusting, Harmful, and Dishonest moral scenarios, and Neutral (morally irrelevant) scenarios. At the start of pilot testing, participants were told that they would read multiple scenarios and make several ratings of each one. Participants were instructed to accept the details as specified in the scenario. For example, if a person is described as teasing another person, the participant should accept teasing as an accurate description of the behavior. Participants were also instructed that if they fill in details, those details should be what the participant takes to be most likely (e.g., if the story says that Jim asked Matt a question, the participant should assume that Jim was speaking loudly enough for Matt to hear him). Then, participants were given a sample scenario and the following descriptions of the ratings they were to make for each scenario:

Is the act morally wrong? This question is not about whether the act is or should be illegal. Nor is it about whether you would do the act or advise friends to do it. The question is simply about whether that particular act is morally wrong in the specified circumstances. In the above example, the question is *not* whether it is wrong in all circumstances to tell somebody to shut up but whether it is wrong in the particular scenario for Mike to tell John to shut up.

Is the act harmful? This question is not about whether harm would result if this kind of act became common or if other people found out about it. The question is only about whether this act causes any harm in the particular circumstances as specified.

Is the act dishonest? This question is about whether the act depends on intentional deception, promise breaking, cheating, theft, or something like that. It is not about whether everyone in the scenario knows exactly what is going on.

Is the act disgusting? This question is not about whether it is morally horrendous. It is, instead, about whether the act is disgusting in the way that most people find it disgusting to lick toilets or to have oral sex with their grandparents.

After reading the instructions, the pilot participants made the dichotomous (yes or no) judgments listed above for each scenario. Scenarios were considered acceptable for use in the fMRI study if they adhered to the following criteria: A Neutral scenario was deemed acceptable if 80% or more of the pilot participants judged the associated act to be morally "not wrong" and no more than 20% of pilot participants deemed the act to be disgusting, harmful or dishonest. The moral scenarios (Disgusting, Harmful and Dishonest scenarios) were deemed acceptable if at least 80% of the pilot participants judged the associated act as representative of its intended moral domain (e.g., Disgusting) and no more than 20% of pilot participants deemed the act to be representative of the other two moral domains (e.g., Harmful, Dishonest). These criteria helped ensure that the transgression scenarios were representative of one and only one moral domain. In addition, the moral scenarios were acceptable only if no less than 30% and no more than 70% of pilot participants considered them to be morally "wrong." This inherent ambiguity afforded sufficient response variability to contrast "wrong" and "not wrong" responses within and across moral categories. The scenarios selected for the fMRI study did not significantly differ in length between categories (mean lengths for all four categories ranged from 44 to 46 words; $F(3, 55) = 1.95$, *ns*). For further analyses of the contents of scenarios in different categories, refer to Table A3, Table A4, and Figure A1 of the Appendix.

For the fMRI study, each scenario was converted into scrolling black text on a light blue background using LiveType software (Apple, Inc.). This ensured that participants read the same words at approximately the same time. Each scenario scrolled for 22 sec, and the full text remained on the screen for 2 sec after scrolling had ceased.

fMRI Procedure

Thirty-eight naive, right-handed adults were scanned in a 3.0-T Phillips scanner. All participants were right-handed English speakers with normal or corrected-to-normal vision. Before scanning, the experimenter obtained informed consent and explained the task to the participant. Specifically, participants were told that they would read scrolling text scenarios describing the actions of a person. After each scenario, they were prompted to press a button indicating whether they considered the main character's actions to be "wrong" or "not wrong," and then to press a second button indicating the confidence level of their judgment ("High" or "Low"). See Figure 1 for a schematic representation of a single trial.

Between reading and judging scenarios, participants viewed a fixation cross for varying amounts of time and pressed a button whenever the cross changed color. The order of the stimuli and the intervening fixation periods was optimized for hemodynamic deconvolution by the AFNI program RSFgen (Cox, 1996).

Post-imaging Procedure

After leaving the scanner, participants were provided with a written copy of all of the scenarios they had viewed while being scanned, as well as definitions of the terms "disgusting," "harmful," and "dishonest" (the same definitions used in pilot testing). After reading these definitions, participants were asked if the actions described in each scenario could be characterized as disgusting, harmful, and/or dishonest. In addition, participants rated if each

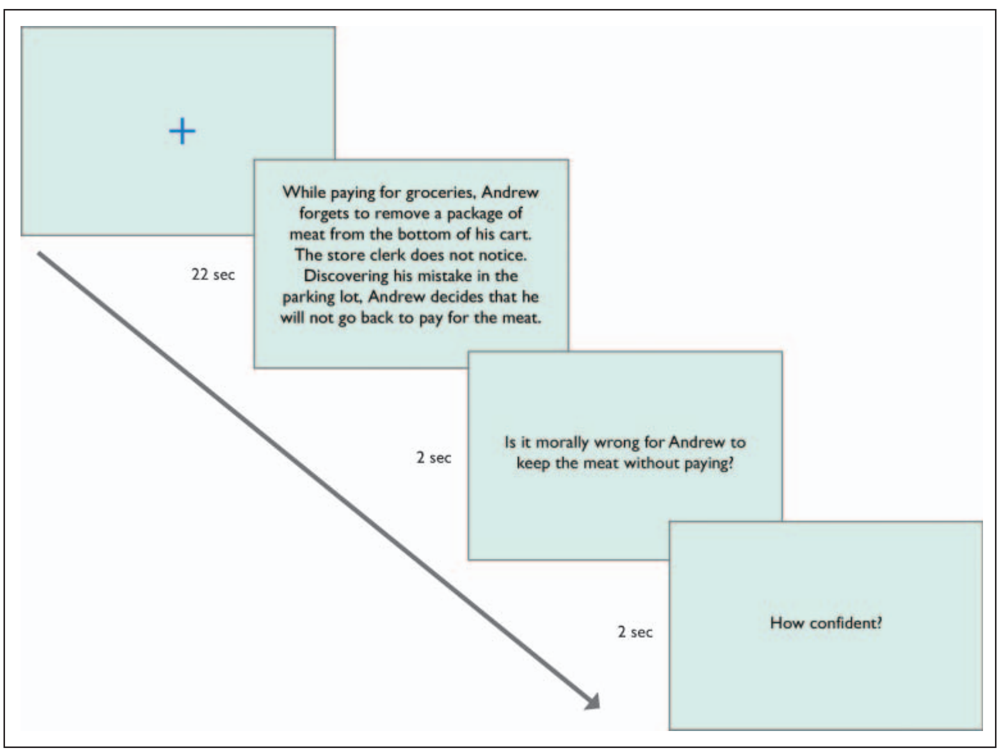


Figure 1. Schematic representation of a single trial. Participants viewed a fixation cross between trials for a varied interstimulus interval of 0–12 sec. Each trial began with a scenario, presented via text scrolling at a fixed rate for 22 sec. After the scenario had stopped scrolling, participants were asked to judge whether the act in that scenario was "wrong" or "not wrong" by pressing one of two buttons. After 2 sec, subjects were then asked to indicate whether they had made that judgment with high or low confidence using a button press.

scenario evoked emotion using a Likert scale from 1 (*not at all*) to 4 (*intensely*).

Imaging Parameters

The study was performed using a Philips Intera Achieva 3-T scanner (Philips Medical Systems, Bothell, WA) with a SENSE (SENSEitivity Encoding) head coil. All stimuli were presented to the participant via a Panasonic DT-4000U DLP projector. Anatomical images were collected using a high-resolution 3-D Magnetization-prepared rapid gradient-echo sequence (124 slices, 1.2 mm thick, FOV = 240 mm, acquisition matrix = 256 × 256). Functional images were collected in seven runs using echo-planar functional images sensitive to BOLD contrast (TR = 2000 msec, TE = 30 msec, flip angle = 90°, 3 mm in-plane resolution). During each of the seven functional runs, 180 sets of axial images (36 slices/volume, 3.5 mm slice thickness with 0.5 mm skip) were collected in an interleaved fashion across the whole brain. Axial images were not angulated. See Figures A2 and A3 in the Appendix for echo-planer magnetic resonance images of a single participant to illustrate brain coverage.

Imaging Analysis

fMRI Preprocessing

Functional and anatomical images were analyzed with AFNI (Cox, 1996). Transient spikes in the signal were suppressed with the AFNI program 3dDespike. As the slices of each volume were not acquired simultaneously, a timing correction procedure was used. All volumes were motion corrected, normalized to the standardized space of Talairach and Tournoux (1988), and smoothed with a 6-mm FWHM smoothing kernel before conversion to percent signal change from the mean.

fMRI Analysis

A regression analysis using 3dREMLfit in AFNI was conducted on each participant's preprocessed EPI volumes to estimate the individual hemodynamic response to each of the five stimulus conditions. Stick functions indicating the onset times of each stimulus were convolved with a 30-sec block function. Second-order trends and the participant's head motion were included as regressors at this stage to account for signal changes due to scanner drift and motion artifact. The convolved hemodynamic response for each condition for each participant was submitted to a series of t tests conducted with 3dMEMA (Chen, Saad, & Cox, 2010), an AFNI program that adopts a mixed-effects meta-analysis approach and takes into account both within- and between-participants variability, making it relatively robust to outliers.

Unless otherwise noted, all reported clusters survived a statistical threshold of $p < .05$, corrected for multiple comparisons as stipulated by AlphaSim within AFNI (afni.nimh.nih.gov/pub/dist/doc/manual/AlphaSim.pdf). AlphaSim carries out Monte Carlo simulations by randomly generating uncorrelated three-dimensional images using the overall dimensions and voxel geometry of a data set, followed by convolution with a Gaussian function to account for correlations between nearby voxels. Using the parameters of our data set (FWHM = 6 mm and a brain-only mask), we ran 1000 iterations over a skull-stripped whole brain mask, which indicated that a voxel-wise threshold of $p < .005$ and a cluster size threshold of 675 mm^3 (25 × 27 mm^3 voxels) would provide a family-wise false positive rate of .05.

RESULTS

Evidence for Separate Systems

Behavioral Data

Consistent with the possibility that different categories of moral judgment are subserved by different cognitive systems, postscanner questionnaire results indicated that participants classified scenarios into only the appropriate categories. Disgusting scenarios were rated as disgusting but neither dishonest nor harmful, $\chi^2(5, n = 1560) = 1113.07, p < .0001$. Dishonest scenarios were rated as dishonest but neither disgusting nor harmful, $\chi^2(5, n = 1560) = 1369.45, p < .0001$, and Harmful scenarios were rated as harmful but neither dishonest nor disgusting $\chi^2(5, n = 1560) = 1302.26, p < .0001$. Neutral scenarios were rated as neither disgusting nor harmful nor dishonest $\chi^2(5, n = 1560) = 1508.47, p < .0001$.

Table A2 in the Appendix contains the number of "wrong" and "not wrong" decisions for all moral and neutral scenarios, as well as the variance of participants' responses for each scenario and for each category. A one-way ANOVA of the three moral categories (Harm, Dishonesty, Disgust) with response variance across participants for each scenario as the dependent variable was performed. As Levene's test of equality of variances indicated that the assumption of homogeneity of variance was violated ($F(2, 39) = 3.56$, $p < .05$), the Brown–Forsythe F ratio is reported. There were differences between moral categories with respect to response variability, $F(2, 31.42) = 6.84$, $p < .01$. The Games–Howell post hoc test was used to detect differences between categories because it does not assume equal variances (Games & Howell, 1976). Disgust scenarios elicited less variable responses than both Harm and Dishonesty scenarios (both p's $< .05$), whereas Dishonesty and Harm scenarios did not differ in response variability ($p = .81$).

Semantic Content of Scenarios

Whereas syntactic complexity was kept consistent across categories (see Table A4), semantic content varied by design. In the interest of ecological validity, scenarios were constructed to resemble as closely as possible how they might be described colloquially. As such, scenarios in each category differed with respect to their characteristic semantic content. In addition, Disgust scenarios were naturally more emotionally evocative than Neutral, Dishonest, or Harmful scenarios. These between-category differences and within-category similarities ensured that scenarios were classified easily into their respective moral domains and only their respective moral domains. See Figure A1 and Table A3 in the Appendix for analyses of emotional evocativeness and semantic content, respectively. Also refer to the Appendix for a full list of scenarios used in the fMRI study.

fMRI Data

To identify the neural correlates of processing different types of moral transgressions, we conducted two sets of analyses. In the first set of analyses, we compared brain activity associated with the judgment of each type of moral transgression to that of morally neutral scenarios, as well as to transgressions in the remaining two moral categories. A moral transgression was defined as an act in a moral scenario that was judged to be morally wrong. Previous behavioral results indicate that individuals differ in which acts they classify as morally wrong versus merely conventionally inappropriate (Haidt & Hersh, 2001). Further, there exist significant differences in brain activity between participants who judge the same physical harms to be either morally permissible or impermissible (Greene et al., 2004). Limiting the first set of analyses to moral scenarios deemed wrong by the participants, therefore, afforded cross-subject comparisons most relevant to participants' judgments of moral wrongness. Please refer to Table A1 for similar analyses including brain activity associated with all moral stories as compared with neutral, irrespective of the associated decision ("wrong"/"not wrong"). Importantly, because all conditions, both moral and neutral, involved moral reasoning, the contrasts outlined in Table A1 do not reveal the neural correlates of moral reasoning. Rather, these differences in the hemodynamic response reflect differences associated with the processing of moral scenarios relative to neutral scenarios, irrespective of the ensuing moral judgment. The following comparisons contrast the hemodynamic responses associated with moral transgressions compared with neutral scenarios. "Moral transgressions" entered into the analysis for each participant include only those scenarios that he or she deemed to be morally "wrong." Our primary question was whether different moral transgressions would evoke hemodynamic responses consistent with a unified or a disunified (separate systems) account of moral judgment.

Harmful transgressions. The judgment of transgressions involving physical harms compared with neutral scenarios was associated with increased activity in the left DLPFC, a region of DMPFC including the ACC, the SMA, the IPL, and the posterior STS (see Table 1). Similarly, compared with judgments of both Disgusting and Dishonest transgressions, judgment of Harmful moral transgressions was associated with increased activity in an area of the

Table 1. Talairach Coordinates for the Centers of Mass of Significant Clusters for Each Moral Transgression versus Neutral Scenario Comparison

Area	*Hemi*	*BA*	*vxls*	*x*	*y*	*z*
Harmful transgressions						
DMPFC	L	9/32	107	−4	39	28
DMPFC	R	6/9/10	71	6	41	30
SMA	L	6	139	−13	17	54
DLPFC	R	8/9	72	29	39	35
DLPFC	L	9	58	−30	32	37
STS	L	39	38	−45	−57	13
IPL	L	40	40	−55	−44	31
Cerebellum	R		28	41	−55	−35
Dishonest transgressions						
DMPFC	L	6/8/9	583	−14	32	44
DMPFC	R	6/8	185	14	22	56
DLPFC	L	8	119	−40	20	42
TPJ	L	39/40	306	−46	−56	36
TPJ	R	39/40	96	56	−56	35
PCC	L	31	53	−4	−50	30
Disgusting transgressions						
DLPFC	L	9/10	203	−21	41	35
DMPFC	L	8/9/10	226	−4	51	27
DMPFC	R	9/10	88	7	55	23
IFG	L	47	70	−23	15	−15
IFG/FO	L	46/47	222	−42	34	9
TP	R	38	125	32	16	−22
TP	L	36	129	−26	−4	−29
Fusiform gyrus	L	37	91	−42	−43	−16
Amygdala	L		259	−20	−4	−12
Amygdala	R		239	19	−2	−13
ACC	L	24/32	137	−4	31	21
PCC	L	7/31	159	−3	−44	27
Thalamus			150	−2	−16	5
Cerebellum	R		88	38	−58	−30
All transgressions						
DMPFC	R	9	28	2	50	29

$p < .05$, corrected.

IFG = inferior frontal gyrus.

Table 2. Talairach Coordinates for the Centers of Mass of Significant Clusters for Direct Comparisons Between Moral Transgression Types

Area	*Hemi*	*BA*	*vxls*	*x*	*y*	*z*
Harm						
Harmful transgressions > Dishonest transgressions						
SMA	L	6	33	−17	5	54
Midcingulate	L	31	25	−12	−24	39
IPL	L	40	94	−56	−32	31
IPL	R	40	39	60	−34	27
Precuneus	R	7	37	9	−63	43
Precuneus	L	7	27	−7	−50	55
Harmful transgressions > Disgusting transgressions						
DLPFC	R	6/8/9	270	30	24	44
IPL	R	40	36	60	−40	37
Precuneus	L	7	68	−7	−53	47
Precuneus	R	7	26	7	−52	46
Dishonesty						
Dishonest transgressions > Harmful transgressions						
VMPFC	L	10/32	113	−6	49	−6
DLPFC	L	8	33	−14	31	51
TPJ	L	39/40	213	−42	−63	38
TPJ	R	39/40	70	52	−60	35
MTG	L	21	166	−55	−10	−15
MTG	R	21	97	63	−32	−11
PCC	L	23/31	41	−4	−55	18
Dishonest transgressions > Disgusting transgressions						
DLPFC	R	8/9	155	34	23	44
DLPFC	L	8/9	43	−42	20	43
OFC	R	10/11	40	35	50	−8
SMA	L	6	25	−14	25	54
TPJ	R	39/40	212	53	−53	35
TPJ	L	39/40	155	−49	−55	30
Hippocampus	L		41	−36	−37	3
Disgust						
Disgusting transgressions > Harmful transgressions						
VMPFC	L	10/24/32	215	−4	47	0
VMPFC	R	10/24	109	7	45	−1
OFC	L	47/11	52	−25	34	−10
FO/IFG[a]	L	13/47/34/25	46	−17	7	−11
SgACC	R	34/25	38	8	6	−11
Parahippocampal gyrus[b]	L	38/28	197	−25	22	−25
Parahippocampal gyrus[b]	R	38/28	124	27	14	−23
TP	R	38	35	39	20	−25
Fusiform gyrus	R	20/37	70	60	−43	−13
Fusiform gyrus	L	37/20	111	−51	−45	−12
Lingual gyrus	R	18	42	14	−85	−14
Lingual gyrus	L	18	36	−14	−85	−13
Precuneus	L	7/19	109	−31	−63	42
PCC	L	23/30/31	227	−4	−43	25
PCC	R	23/31	81	5	−36	25
Amygdala	L		132	−22	−1	−15
Amygdala	R		96	22	−1	−15
Disgusting transgressions > Dishonest transgressions						
FO/Insula	L	13	66	−41	4	−6
FO[a]	R	13/47/34	46	17	2	−10
Parahippocampal gyrus[b]	L	28/36/38	135	−25	2	−28
Parahippocampal gyrus[b]	R	28/38	111	28	8	−26
Fusiform gyrus	L	37	85	−43	−43	−16
Lingual gyrus	L	18	155	−9	−87	−6
Lingual gyrus	R	18	46	11	−83	−5
IPL	L	40	31	−48	−27	33
Precuneus	R	7	84	11	−66	35
Amygdala	L		151	−23	−2	−14
Amygdala	R		139	22	−2	−14

$p < .05$, corrected.

[a]Activation extends to sgACC.

[b]Activation extends to TP.

VMPFC = ventromedial prefrontal cortex; MTG = middle temporal cortex.

DLPFC that included the SMA as well as the IPL and the anterior aspect of the precuneus (see Table 2).

Dishonest transgressions. As predicted, the judgment of Dishonest transgressions compared with neutral scenarios was correlated bilaterally with increased activity in the DMPFC, the TPJ extending superiorly into the IPL and the PCC, as well as increased activity in the left DLPFC (Table 1). Dishonest scenarios elicited increased activity in the left DLPFC and bilaterally in the TPJ compared with both Disgusting and Harmful transgressions (Table 2).

Disgusting transgressions. The Disgusting versus Neutral scenario contrast revealed increased activity bilaterally in the

DMPFC, amygdalae, ACC, and PCC, as well as the right temporal pole (TP), left DLPFC, and a region in the left inferior frontal cortex encompassing the frontal operculum (FO) and the anterior aspect of the insula (see Table 1). Compared with both Dishonest and Harm scenarios, Disgust scenarios elicited increased activity bilaterally in the amygdalae, TPs, and lingual gyri, in the left FO/anterior insula and fusiform gyri, as well as the right subgenual ACC (sgACC) and posterior portion of the precuneus (see Table 2).

System Overlap

To explore whether there was any activation common to all transgression types relative to neutral scenarios, we performed a conjunction analysis. One 28-voxel cluster in the DMPFC was independently activated in the comparison of each moral transgression type compared with neutral scenarios (surviving a threshold of $p < .05$, corrected, for all comparisons). To investigate whether this region was activated specifically by moral transgressions, this cluster was then applied as a mask to each individual's data to extract the average hemodynamic response for the "not wrong" scenarios for each category type. This secondary ROI analysis revealed that Dishonest and Harmful scenarios judged to be "not wrong" also activated this region more strongly than Neutral scenarios ($p < .005$; $p < .05$, respectively). See Figure 3.

Secondary Analyses

No significant activation differences between "wrong" and "not wrong" judgments within moral categories emerged. Also, judgment confidence (high vs. low) was not a significant predictor of brain activity within any system, with the exception of Disgust. Within the network of areas involved in the judgment of disgusting transgressions, confidence level modulated activity in the PCC. Greater judgment confidence was associated with greater activity in this area (Talairach coordinate of center of mass: −1, −48, 26; 30 voxels).

DISCUSSION

Separate Systems

Overview

The behavioral and imaging results reported here suggest that multiple distinct cognitive systems support moral judgment (see Figure 2). These systems are consistent with multiple intercategory differences in semantic content and the associated processing demands of that content. Judgments of transgressions involving physical harm activated areas commonly associated with action understanding. Judgments of dishonest transgressions evoked activity in areas associated with representing other people's beliefs. Judgments of disgusting transgressions evoked activity in areas associated with affective processing.

Harm

Transgressions involving physical harms recruited areas associated with understanding and imagining actions (Grafton et al., 1996): the IPL, the STS, and the SMA. Additionally, the DLPFC and ACC were more activated by the

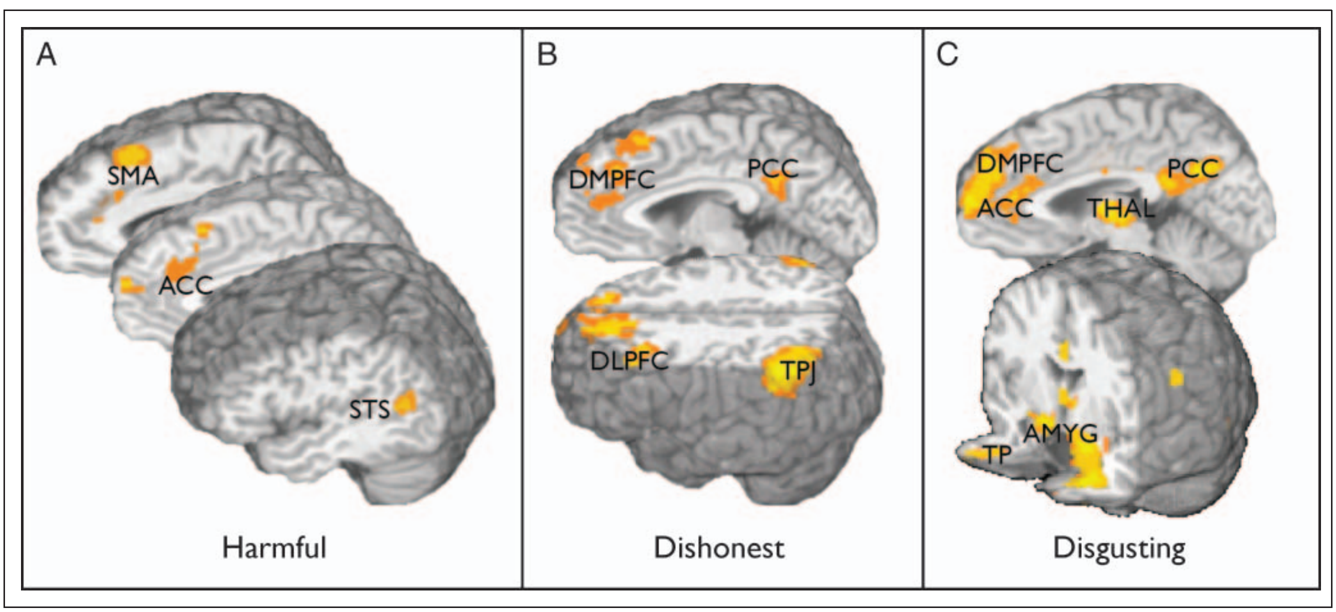


Figure 2. Separable moral systems. Brain regions showing increased activity when judging moral scenarios to be "wrong" as compared to judging neutral scenarios to be "not wrong." (A) The judgment of physically harmful scenarios was associated with increased activity in the dorsal ACC, SMA, and STS. (B) The judgment of dishonest transgressions was associated with increased activity in the DMPFC and TPJ bilaterally, as well as the left DLPFC and PCC. (C) The judgment of disgusting moral transgressions elicited increased activity in the temporal poles and amygdalae, as well as in the DMPFC, ACC, and PCC. For significant activations not pictured, refer to Table 1. For display purposes, these group data are projected onto a reference anatomical image (N27 AFNI brain).

judgment of harms than for that of neutral scenarios, consistent with previous studies implicating these areas in moral reasoning about physical harms (Greene et al., 2001). Further, compared with Dishonest and Disgusting transgressions, the judgment of transgressions involving physical harms elicited greater activity in areas associated with action understanding, such as the SMA and IPL, as well as a region of the precuneus implicated in self-centered visuospatial imagery strategies (Cavanna & Trimble, 2005). These results suggest that in comparison with other types of moral transgressions, understanding moral transgressions involving physical harms relies more on processing and imagining the physical actions described in these scenarios.

Dishonesty

The judgment of Dishonest transgressions was correlated with increased bilateral activity in a region encompassing the TPJ and IPL that is implicated in reasoning about mental (Saxe & Kanwisher, 2003; Fletcher et al., 1995) and nonmental (Apperly, Samson, Chiavarino, Bickerton, & Humphreys, 2007) representations, simultaneously holding on-line multiple possible perspectives (Decety & Jackson, 2004), and attentional reorienting more generally (Corbetta, Patel, & Shulman, 2008; Astafiev, Shulman, & Corbetta, 2006). Dishonest transgressions also preferentially activated the left PCC and DMPFC, areas robustly associated with inferring others' mental states (Rilling et al., 2004). Similarly, compared with judging other moral transgressions, judging Dishonest transgressions was associated with DLPFC and TPJ activity (Table 2). These findings suggest that understanding dishonest transgressions requires mentalizing, or, more generally, a shifting of attention between deceitful actors' conflicting words and actions. Interestingly, however, Dishonest and Harmful scenarios did not significantly differ from each other in the frequency of belief or communication verbs (see Table A3 in the Appendix). This suggests that the increased bilateral activity in the TPJ for Dishonest, as compared with Harmful, transgressions (see Table 2) does not reflect the processing of mental state words per se but how the words, in combination, evoke different cognitive operations such as mentalizing. Alternatively, the bilateral activation of TPJ for Dishonest scenarios may reflect other cognitive operations associated with this region such as the discrimination of self and other (Cheng, Chen, Lin, Chou, & Decety, 2010; Decety & Sommerville, 2003). For example, the Dishonest scenarios (e.g., academic dishonesty) may have hit particularly "close to home" with our college-aged participants, thereby evoking a need to distance oneself from the protagonist.

The PCC is also associated with social–emotional processing (Britton et al., 2005) and the evaluation of emotionally evocative stimuli (Maddock, 1999). Therefore, its activation in the Dishonest versus Neutral contrast could also reflect the greater emotional arousal and evaluative processing elicited by Dishonest transgressions relative to Neutral scenarios. The activations observed in this contrast could reflect a greater need for deliberation when judging Dishonest, as compared with Neutral, scenarios.

Disgust

Disgusting transgressions were associated with increased bilateral activity in the amygdalae, DMPFC, and PCC, areas implicated in social–emotional processing (Britton et al., 2005) as well as in the right TP, implicated in binding visceral affective responses to complex stimuli (Olson, Plotzker, & Ezzyat, 2007), in understanding social norm violations (Mendez, Anderson, & Shapira, 2005), and in social conceptual understanding more generally (Zahn et al., 2006). This comparison also revealed increased activity in the anterior portion of the left insula extending into the FO, a region associated with the experience of disgust as well as disgusting mental imagery (Jabbi et al., 2008). Results of this contrast suggest that the judgment of disgusting moral transgressions relative to neutral scenarios involves affective processing as well as social evaluation. This result is consistent with the higher number of emotion words contained in Disgust scenarios (see Table A3), as well as the higher ratings of elicited emotion for these scenarios (see Figure A1).

Compared with Dishonest and Harmful moral transgressions, judgments of Disgusting moral transgressions were correlated with bilateral activity in areas also identified in the Disgust versus Neutral contrast that are involved in general emotional processing (amygdalae, TP), as well as emotional processing specific to disgust (left FO/insula). These contrasts also revealed activity in the sgACC, an area implicated in emotional arousal and interoception (Critchley, 2004). Both contrasts also revealed increased activity in a region of the precuneus that has been implicated in the attribution of emotions to the self and others (Ochsner et al., 2004), possibly indicating that emotional empathy was preferentially engaged by scenarios involving sexual disgust. The bilateral lingual and parahippocampal gyri activations observed in both of these contrasts have previously been associated with processing erotic stimuli (Hu et al., 2008). Finally, the activation of the fusiform gyrus by Disgust scenarios could reflect increased imageability for disgusting transgressions relative to other transgression types, as activity in the fusiform gyrus has been consistently associated with mental imagery (e.g., Ishai, Ungerleider, & Haxby, 2000). Together, these activation differences highlight the many inherent characteristics of content and processing demands that differentiate moral transgressions that involve sexual disgust from other types of moral transgressions.

The differences in semantic content between moral categories almost certainly yielded concomitant differences in cognitive operations engaged by those contents. Such semantic and processing differences are expected in scenarios designed to be as natural and emblematic of their respective categories as possible. Indeed, the moral categories used here most likely differ in a number of ways left unspecified (e.g., imageability). These many differences underline the fact that moral transgressions are intrinsically diverse and differ systematically for several reasons, only some of which can be quantified by analyses of scenario contents, behavioral ratings by participants, and associated neural activity. Taken together, the diversity of content and concomitant cognitive and emotional processes coupled with the differences in brain activity between categories of moral transgressions further illustrate that "moral" judgment is best investigated as a superordinate category of judgments that share "family resemblances" (Rosch & Mervis, 1975) rather than any defining feature or set of features.

In addition to differences between scenarios that were consistent across participants, in at least some cases, the cognitive processes elicited by the same moral scenarios likely differed somewhat between participants. For instance, interesting work by Kedia et al. (2008) and Moll et al. (2007) indicates that agency perspective affects the neural correlates of moral processing. Although all scenarios were written in the third person, it cannot be ascertained whether individual participants took the perspective of the victim or transgressor while reading. Similarly, although many studies (Immorino-Yang et al., 2009; Zahn et al., 2009; Kedia et al., 2008; Moll et al., 2003, 2007; Takahashi et al., 2004; Berthoz et al., 2002; Dougherty et al., 1999) indicate that experiencing different moral emotions is associated with neural activation differences, we cannot ascertain what specific emotion(s) participants were experiencing while reading each scenario, which likely differed between participants for many reasons, including the agency perspective that participants took while reading a scenario. For instance in Dishonesty scenarios, different participants could have experienced indignation or guilt, depending on the agency perspective they assumed while reading. Similarly, for Harm scenarios, different participants could have differentially experienced compassion for the victim and/or contempt for the aggressor to varying degrees. For these reasons, characterizing the moral emotions evoked by different transgression types is beyond the scope of the present study. This endeavor and, more generally, the detailed characterization of the many differences that exist between categories of moral transgressions remains an important direction for future research.

System Overlap

A region in the DMPFC was independently activated by the contrast of each moral transgression type compared with Neutral scenarios. This region was also activated by Dishonest and Harmful scenarios judged to be "not wrong" relative to Neutral scenarios. Together, these findings suggest that the activity observed in this region reflects evaluative processes engaged by the moral scenarios that are not peculiar to a particular moral decision ("wrong" or "not wrong"). This interpretation is consistent with at least two lines of research investigating the characteristics of this region.

First, activity in this region is known to be modulated by ambiguity both in social (Jenkins & Mitchell, 2010) and nonsocial (Volz, Schubotz, & von Cramon, 2003) contexts. Our moral scenarios were ambiguous by design to allow for comparisons of "wrong" and "not wrong" judgments of the same scenarios. This ambiguity was not present in the neutral scenarios and is reflected in the high variability of responses to moral scenarios as compared with neutral scenarios (see Table A2 in the Appendix). Thus, the processing of ambiguous information represents one explanation for the shared DMPFC activation observed in the moral versus neutral comparisons.

Second, this area is consistently activated when thinking about other people (Van Overwalle, 2009; Amodio & Frith, 2006; Gallagher & Frith, 2003; Goel, Grafman, Sadato, & Hallett, 1995) and in self-referential processing (Northoff et al., 2006). It is likely that the evaluation of moral transgressions, as compared with Neutral scenarios, involves a deeper evaluation of individuals' motives and actions and how they relate to one's own values. Of particular relevance to the current study, a recent meta-analysis found this region to be involved not only in moral judgment tasks, but also in mentalizing and in understanding goal-directed actions (Van Overwalle & Baetens, 2009). This explanation is not mutually exclusive with that of ambiguity resolution. Indeed, the observed activity in this region is consistent with its known role in evaluating other people in ambiguous situations (Jenkins & Mitchell, 2010).

Because participants were asked to employ moral reasoning (i.e., to answer the question, "Was it morally wrong?") on all trials, both moral and neutral, characterizing the neural underpinnings of moral reasoning, as compared with other types of reasoning, is beyond the scope of the current study. Rather, this study was primarily concerned with characterizing the processing of what participants deemed to be moral transgressions. Nevertheless, because moral reasoning was common to moral and neutral trials, the finding that the DMPFC was activated by the conjunction of all moral transgression types relative to neutral scenarios (see Figure 3) and by the conjunction of all moral story types relative to neutral stories (see Table A1 in the Appendix) suggests that some property of the moral scenarios relative to the neutral scenarios was driving this activation—possibly their inherent ambiguity.

Regardless of the exact mechanisms involved, the present results suggest that the overlapping activation in DMPFC reflects aspects of processing moral transgressions that are not peculiar to the decision of moral wrongness. This suggests that this region is not the seat of a unified moral faculty in the strongest sense—that is, a faculty that is dedicated to judgments of moral transgressions in particular. The present results are consistent with a more general role of this region in the evaluation of human behavior, of which moral action is a subcategory. Thus, lesions or disruptions to this region would likely result in deficits or differences in making moral judgments due to the disruption

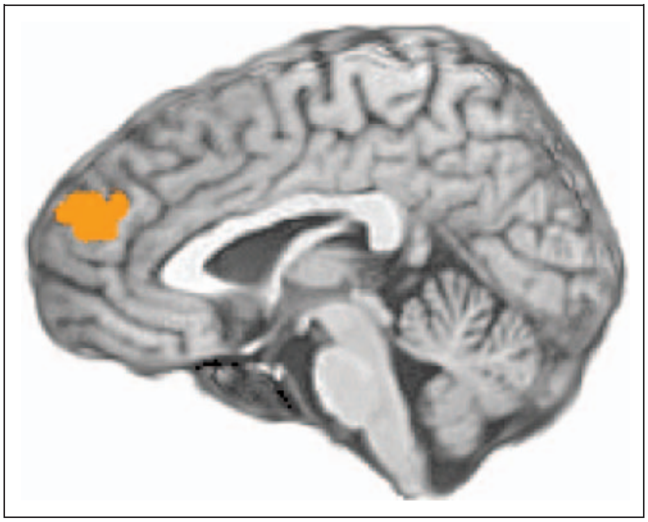


Figure 3. System overlap. One 28-voxel cluster in the DMPFC was independently activated by the judgment of each moral transgression type (Harmful, Disgusting, Dishonest) relative to the judgment of neutral scenarios.

of evaluative processes (e.g., ambiguity resolution, mentalizing) that are not specific to the domain of morality.

Wrong versus Not Wrong Judgments

Although we had hoped to compare "wrong" and "not wrong" judgments within categories, we lacked sufficient power to do so. Although our sample was relatively large ($n = 38$), subtle activation differences between "wrong" and "not wrong" judgments may have been diluted by the length of the written scenarios used, which limited the number of exemplars per condition and precluded isolating the specific time at which an individual reached a moral judgment for each scenario. Future studies employing designs with greater temporal constraints may find more significant differences between "wrong" and "not wrong" moral judgments. However, these differences appear to be subtle in comparison with differences between moral transgression types.

Differences between aspects of the content of the scenarios (such as whether they depict physical violence, deceit, or sexual acts that elicit disgust) were much more robust. This suggests that previously observed patterns of activity that characterize moral judgment may reflect, at least in part, processing of characteristics of these scenarios independent of whether acts are judged morally wrong.

Conclusion

These results provide empirical support for philosophical arguments against the existence of a functional or anatomical module common and peculiar to all moral judgments (Prinz, 2008; Sinott-Armstrong, 2008). Although consistent networks of brain regions have been reliably implicated in some dimensions of cognition using diverse methods (e.g., theory of mind; Saxe, 2009), no network seems to be common to the judgment of a diverse variety of moral transgressions. Separate systems were found to characterize different kinds of moral judgment. The only region of anatomical overlap between these systems (DMPFC) is robustly associated more generally with self-referential processing, thinking about other people and processing ambiguous information.

It is likely that moral judgment is even more multidimensional than what is suggested here, given that there remain other domains of morality that were not examined in the current study (e.g., disrespect, betrayal of an in-group, fairness). These results suggest that, just as disparate systems are now understood to subserve aspects of cognitive faculties once thought to be monolithic (e.g., memory, attention), distinct systems subserve different types of moral judgment. Future research may benefit from working toward a taxonomy of these systems as Haidt and Graham (2007) have suggested. Such a taxonomic approach should help reduce the risks of false negatives and overgeneralization. The risk of false negatives is present whenever diverse stimuli are combined within a single experimental condition. Lumping together diverse moral transgressions risks failing to detect the component processes activated by one type of transgression that are not also activated by other types of transgressions. Similarly, caution should be taken in generalizing neural and cognitive processes across moral domains. Conflation of different types of moral judgment for analysis likely contributes to inconsistency in the current literature regarding, for instance, whether emotion causes (Haidt, 2001) or emerges as a mere consequence of (Huebner, Dwyer, & Hauser, 2009) moral judgment and whether the principles that guide moral judgments are consistent across demographic groups (Hauser, Cushman, Young, Jin, & Mikhail, 2007) or vary as a function of socioeconomic status and political affiliation (Haidt & Graham, 2007).

The current results are consistent with the hypothesis that morality is not a natural kind in the mind but, rather, is comprised of multiple dissociable mental processes. That said, there could exist a cognitive process common and peculiar to moral judgments that is not detectable using the current methods. The hemodynamic differences observed here appear to be modulated primarily by differences in the semantic content of moral scenarios, and the general cognitive processes they engage, rather than their perceived moral wrongness. Irrespective of whether subsequent studies find evidence for a unified moral faculty, future research using fMRI and standard paradigms will likely benefit from taking an increasingly fine-grained approach—from isolating distinct categories of moral behavior for study, and from investigating the specific component processes that contribute to different types of moral judgments. In so doing, we will be most likely to generate consistent and precise findings across studies, and to gain a more accurate and thorough understanding of the manifold judgments, we term "moral."

APPENDIX 1: SCENARIOS BY CATEGORY

Harmful Scenarios

1. Francis is writing a very important paper that is due tomorrow. Alex talks to him repeatedly and plays music loudly to distract Francis, even after Francis asks him to leave the room. Finally, in frustration, Francis punches Alex hard enough to bruise him badly.
2. Peter sees a car coming straight at him. He knows the driver is trying to kill him. His only escape is to run behind a crowd, so the car will hit them instead of him. He runs behind the crowd, and the car hits three people before it stops.
3. Beth has two young sons who often play very rudely, cursing at each other. After more than 3 hr of trying to control them, Beth finally hits them on their hands with a wooden ruler hard enough to make their hands bruise.
4. Elaine and five other passengers are up in a hot air balloon with a big hole, so it is falling rapidly. The only way to prevent a life-threatening crash is to throw a passenger overboard. Elaine pushes out the heaviest passenger, who hits the ground hard and breaks his legs.
5. Susan owns a small camera store and lives in an apartment above it. One evening she hears something in the store. When she goes downstairs, she sees someone stealing her cameras. She pulls her gun and shoots the thief in the back before he can leave.
6. After their ship sinks, Elmer and 12 other passengers are in an overcrowded lifeboat that is about to sink. The only way to keep it afloat is to force two passengers overboard. After drawing lots Elmer pushes out two passengers, who soon drown.
7. Jen is walking upstairs to class with her friend Tom who is teasing her relentlessly. Jen asks Tom to stop, but he keeps teasing her and playfully pushes her. Jen pushes him back hard, which knocks him down the stairs. Tom breaks his arm in the fall.
8. Ferdinand lives alone in the country. Late one night, he hears some noises in his living room. He runs downstairs with his gun and sees an intruder wearing a ski mask across the room. Without warning, he shoots and kills the intruder.
9. Allen sees an assassin in a crowd of people aiming at him. To protect himself, he shoots at the assassin with both barrels of a double barreled shotgun that he just brought back from a hunting trip. He hits the assassin and a bystander in the crowd.
10. Laura is in a library with her young daughter, Mandy, who is being disruptive. Laura tries to reason with Mandy and warns her several times, but Mandy keeps making noise. When a librarian tells them to leave, Laura forcefully drags Mandy out by the arm, hurting her.
11. Mike has a few beers at a party. His friend, Alice, tells him that he's too drunk to drive. Mike still insists on driving home, so Alice hits him to make him drop his car keys. Mike falls and bangs his head, causing a concussion.
12. Matthew and Nick get into a heated argument. Nick suggests they settle it by a fistfight. Matthew is reluctant, but Nick insists, so Matthew finally agrees. Matthew is much bigger and stronger, so he quickly wins by punching Nick in the side, breaking two ribs.
13. Kim and Olivia have an argument. Olivia suggests that they resolve their dispute by wrestling, although she knows Kim is on a wrestling team. Kim agrees and quickly wins with a special move she learned from her wrestling coach. In the process, she badly dislocates Olivia's shoulder.
14. Greg is driving when he sees another car out of control heading directly toward an unsuspecting pedestrian. The pedestrian can't get out of the way, so Greg slams his car into the other car, saving the pedestrian, but paralyzing the driver of the other car.

Dishonest Scenarios

1. While paying for groceries, Andrew forgets to remove an expensive package of meat from the bottom of his cart. The store clerk does not notice. Discovering his mistake in the parking lot, Andrew decides that he will not go back to pay for the meat.
2. Helen borrows her boyfriend's car to go shopping. She accidentally bumps into a pole and scrapes the side of the car. She knows her boyfriend will be furious if he finds out, so she tells him that she found it that way when she came out of the store.
3. Jeff is watching his favorite TV show. His friend calls him from the airport, which is 45 min away, and asks for a ride. Jeff doesn't want to miss his show, so he tells his friend that he let someone borrow his car for the night.
4. Belinda borrows her friend Samantha's jacket and accidentally leaves $40 in the pocket and a stain on the sleeve. Samantha finds the money when she takes the coat to get cleaned. Belinda hasn't mentioned the money and Samantha is broke, so she decides to keep the $40.
5. When his grades come, Ed sees the recorded grade in math is A. He later bumps into his math teacher, who tells him that he was sorry to have to give Ed an A—because he was just below the cut off. Ed says nothing.
6. Claire can't afford the ink cartridges that her kids need to print their school assignments. The office where Claire works has plenty of ink cartridges and often discards extras when new printers arrive. When nobody is looking, Claire takes an ink cartridge without asking.

Dishonest Scenarios (*continued*)

7. Ellen's daughter needs medicine to relieve her chronic pain, which is available only at CVS (a pharmacy). CVS buys the medicine cheaply in large quantities and never sells out. They charge much more than Ellen can afford. The manager at CVS refuses to help, so Ellen steals some medicine.
8. In the morning Taryn promised her mother that she would come over for dinner. She doesn't feel like leaving her apartment, however, so she calls her mother and tells her that she isn't feeling well. Her mother, although disappointed, tells her she that she should stay home.
9. Alison deposits a check for $156 in her bank. When her monthly statement arrives, it lists a deposit of $165 instead of $156. Alison knows that this is a mistake, but she decides not to tell anyone at the bank about this error.
10. Every month Alvin has his paychecks deposited automatically into his bank account. When his monthly statement arrives, it lists a deposit of $3530 instead of $3503. Alvin knows that this is an error, but he does not mention the mistake to his employer.
11. Suzy takes Joe to an expensive restaurant that she can barely afford. When the bill comes, she notices that the charges do not include the bottle of wine they drank. She leaves a good tip but does not correct the mistake on the bill.
12. Priscilla's house contains a room that she uses mainly for guests and occasionally as an office. For tax purposes, she claims the room is an office, counts it as a business expense, and takes a deduction. She knows that she will never be caught.
13. During a closed-book take-home French exam, Sammy catches a glimpse of an answer on a conjugation table on his wall, which he forgot to take down. His grade won't affect other students' grades, so he decides not tell the teacher that he looked at the table.
14. Esther asks to borrow Debbie's car to go dancing when Esther really needs to study for an important test. Debbie worries about Esther failing, but she does not want to argue or anger Esther, so she tells Esther that her car is broken, although it isn't.

Disgusting Scenarios

1. Jack's aunt is dying of cancer at home. She asks Jack to have sex with her after she dies as a sign of his love. Jack says he will think about it. After she dies, Jack copulates with his aunt's dead body. There are no ill effects.
2. Phil is visiting his 67-year-old grandmother. As she is baking, he comes up behind her and kisses her passionately. They are both aroused and start to rub up against each other until they climax. This encounter never creates problems for either of them.
3. Tim is hiking one afternoon when he discovers a freshly dead male coyote. He has not seen anyone on the trail all day, so he has anal intercourse with the coyote body, using a condom. Afterwards, he continues his hike and never suffers any ill effects.
4. While taking a walk, Miles finds a recently deceased female deer in his backyard. He gets a condom and has sexual intercourse with the still warm doe carcass. Afterwards, he buries the deer and cleans off. He never suffers any ill effects.
5. James and Holly are brother and sister. After they both graduate from college, they share an apartment in a large building. When nobody else is around, they sometimes touch each others' genitals passionately. This activity never creates any problem for either of them.
6. After college, Leah moved in to live with her grandfather, who is 70 and healthy. One evening Leah and her grandfather fondle each other sexually. They both feel closer afterward but never do it again. Neither suffers any ill effects.
7. Jane's father asks her to stimulate his penis right after he dies to see whether he gets an erection. She never promises, but after he dies Jane stimulates his penis for several minutes with her hand. Jane suffers no ill effects, and she feels sexually aroused.
8. Larry and Max are brothers who enjoy boating together. One night, when they are alone on their boat, they have anal intercourse with each other. Both of them enjoy it, and the memory of that experience makes them feel closer. Neither of them ever suffers any ill effects.
9. Katie and David are adult siblings camping in the woods one evening. For fun, they have sexual intercourse. They use multiple forms of birth control and never do it again. Afterwards, they feel a stronger connection, and neither of them ever suffers any ill effects at all.
10. Fred goes to a large chain supermarket once a week and buys a fresh whole chicken. At home, he thoroughly cleans the chicken and rubs butter all over it. Then he has sexual intercourse with it, using a condom. He does this only once.
11. Ann and Bob are adult siblings. When they are alone, they like to kiss each other on the mouth passionately, using their tongues. They do this only a few times, and neither of them ever suffers any ill effects from doing it.
12. While preparing a tenderloin roast for his dinner, Frank cuts a hole into the roast and has sexual intercourse with it, using a condom. Afterwards, he cleans and eats the roast. He does it again a few times but never suffers any ill effects.
13. Once in a while, when he is going to eat at home alone, William obtains sheep penises from an oriental meat market. He makes sure that they are still fresh. Then he cooks the sheep penises thoroughly and simulates oral sex with them while he eats them.
14. Ursula occasionally buys leftover pig sex organs at a butcher shop in a large grocery store. After she takes them home, she plays with these sex organs by inserting the male organs repeatedly into the female organs, slowly at first and then faster to simulate sexual intercourse.

Neutral Scenarios

1. Amy buys a lemon-lime soda at a convenience store for $1.21 after tax. She notices a bowl marked "For our customers: take a penny, leave a penny" next to the register. She takes a penny so that she can pay the exact amount.
2. Patrick is a lawyer who usually eats dinner with his friends on Mondays. One Monday, he needs to stay late in his office to prepare for an important hearing the next morning. He apologizes to his friends in advance and meets them again the next week.
3. Paul's father was in an automobile accident in which he suffered compound fractures in both legs. His recovery period coincides with Paul's summer holidays. Paul was planning to stay home and take it easy anyway, so he is happy to help his dad recover at home.
4. Melissa is driving to work. The traffic in her lane is moving very slowly, and the cars in the lane next to her are moving faster. She is late to work, so after looking in her mirror and signaling properly she changes into the faster lane.
5. After lunch, Angela's bill is only for $12, but all she has is a $20 bill. Angela needs to get back to work, so she does not have time to wait for her change. She puts the $20 bill on the table and leaves.
6. Alexis goes to a fancy French restaurant for the first time in her life. She sees vichyssoise (cold potato soup) on the menu. Not knowing what it is, she orders vichyssoise and eats it. She does not like it very much, but she is glad she tried it.
7. Lindsay and Barry are friends who agree to have lunch on Wednesday at noon. On Wednesday morning, Lindsay feels ill. The only appointment that is available with her doctor is at noon. Lindsay calls Barry, who says that it is fine to have lunch on Thursday instead.
8. Lucia is waiting to check out in a long line at a supermarket. She is late for a meeting, so when she notices that there is a shorter line at another register, she leaves her line and gets in the shorter one.
9. Oscar likes to work out by lifting weights. He believes that Gatorade contains essential vitamins and minerals that will make his workouts more effective, so he drinks Gatorade before and after working out every day. Otherwise, his diet is completely normal.
10. Julie lives next to a church that is open all night for prayers. Her grandmother is very sick, so Julie goes into the church well after midnight when nobody else is there and prays for her grandmother until the sun comes up.
11. Rochelle and Bill have been married happily for several years, and they love each other very much. Now they are ready to have children of their own, so they have sexual intercourse several times at night without using any kind of contraception at all.
12. Martha's next-door neighbors tell Martha that she may come and use their outdoor hot tub whenever she wants without asking them for permission. One day, Martha visits her neighbors and asks anyway whether she may use their outdoor hot tub.
13. Pennie and Lydia enjoy going for walks in the park together on Sundays. One Sunday, Lydia is away on vacation in Europe. Pennie decides to go for a walk in the park anyway, without Lydia. She has a lot of fun, although she misses Lydia.
14. Jake asks Antonio whether he may borrow Antonio's van to pick up a heavy box from a hardware store. Antonio consents, so Jake uses the van and then returns it to Antonio with a full tank of gas and no damage to the vehicle.

Table A1. Talairach Coordinates for the Centers of Mass of Significant Clusters for Each Story Type versus Neutral Comparison

Area	*Hemi*	*BA*	*vxls*	*x*	*y*	*z*
Harmful Stories						
SMA	L	6	119	−14	17	55
DMPFC	L	8/32	55	−4	32	31
DMPFC	R	9/10	38	5	52	25
DLPFC	L	8	44	−29	32	38
DLPFC	R	9	24	23	50	31
STS	L	39	44	−44	−56	16
Dishonest Stories						
DMPFC	L	6/8/9/10/32	1069	−14	33	40
DMPFC	R	6/8/9	411	12	39	41
TPJ	L	39/40	298	−46	−58	34
TPJ	R	40	61	55	−53	35

Table A1. (*continued*)

Area	*Hemi*	*BA*	*vxls*	*x*	*y*	*z*
ITS	L	21	58	−52	−4	−22
Precuneus	L	31	48	−5	−50	31
Cerebellum	R		39	43	−58	−37
Disgust Stories						
DMPFC	L	8/9/10/32	721	−9	41	30
DMPFC	R	9/10	94	7	55	22
DLPFC[a]	L	10/13/44/46/47	313	−43	31	7
IFG	L	34/47	277	−13	−3	−3
SMA	R	6	24	7	15	56
MFG	L	9	27	−42	13	26
ACC	R	24	26	5	31	15
sgACC	R	25/34	161	10	−7	−6
TP	R	38	54	29	10	−24
TP	R	38	31	39	20	−22
TP	L	28/38	185	−26	5	−25
IPL	L	7/40	28	−35	−59	42
Fusiform gyrus	L	20/37	118	−43	−43	−16
PCC	L	23/31	166	−3	−43	26
Amygdala	L		165	−22	−3	−14
Amygdala	R		112	21	−2	−13
Cerebellum	R		154	−6	−59	−31
All Moral Stories						
DMPFC	L	9/32	44	−4	33	30
DMPFC	R	9/10	28	6	53	24

$p < .001$, corrected.

[a]Cluster includes FO and anterior insula.

Table A2. Frequency and Variance of "Wrong" and "Not Wrong" Judgments Decisions by Scenario, Sorted in Decreasing Order of Frequency of Wrongness Judgments

Category	*Scenario*	*Number of "Wrong" Judgments*	*Number of "Not Wrong" Judgments*	*Missed Trials*	*Variance*
Disgust	1	31	6	1	0.14
Disgust	2	31	7	0	0.15
Disgust	3	31	6	1	0.14
Disgust	4	30	8	0	0.17
Disgust	5	30	8	0	0.17
Disgust	6	29	8	1	0.17
Disgust	7	29	8	1	0.17
Disgust	8	29	9	0	0.18

Table A2. (*continued*)

Category	*Scenario*	*Number of "Wrong" Judgments*	*Number of "Not Wrong" Judgments*	*Missed Trials*	*Variance*
Disgust	9	27	9	2	0.19
Disgust	10	26	12	0	0.22
Disgust	11	26	12	0	0.22
Disgust	12	22	16	0	0.24
Disgust	13	21	17	0	0.25
Disgust	14	20	18	0	0.25
Disgust total		382	144	6	0.20
Dishonesty	1	29	9	0	0.18
Dishonesty	2	28	9	1	0.18
Dishonesty	3	28	10	0	0.19
Dishonesty	4	27	10	1	0.20
Dishonesty	5	24	13	1	0.23
Dishonesty	6	23	14	1	0.24
Dishonesty	7	23	14	1	0.24
Dishonesty	8	22	16	0	0.24
Dishonesty	9	22	15	1	0.24
Dishonesty	10	22	14	2	0.24
Dishonesty	11	20	16	2	0.25
Dishonesty	12	15	23	0	0.24
Dishonesty	13	13	24	1	0.23
Dishonesty	14	10	24	4	0.21
Dishonesty total		306	211	15	0.24
Harm	1	28	9	1	0.18
Harm	2	27	11	0	0.21
Harm	3	25	13	0	0.23
Harm	4	25	11	2	0.21
Harm	5	23	15	0	0.24
Harm	6	23	15	0	0.24
Harm	7	22	15	1	0.24
Harm	8	21	15	2	0.24
Harm	9	20	16	2	0.25
Harm	10	17	19	2	0.25
Harm	11	16	22	0	0.24
Harm	12	14	23	1	0.24
Harm	13	14	23	1	0.24
Harm	14	9	28	1	0.18
Harm total		284	235	13	0.30

Table A2. (*continued*)

Category	*Scenario*	*Number of "Wrong" Judgments*	*Number of "Not Wrong" Judgments*	*Missed Trials*	*Variance*
Neutral	1	3	35	0	0.07
Neutral	2	1	37	0	0.03
Neutral	3	1	37	0	0.03
Neutral	4	1	37	0	0.03
Neutral	5	1	37	0	0.03
Neutral	6	1	37	0	0.03
Neutral	7	0	38	0	0.00
Neutral	8	0	37	1	0.00
Neutral	9	0	38	0	0.00
Neutral	10	0	38	0	0.00
Neutral	11	0	38	0	0.00
Neutral	12	0	36	2	0.00
Neutral	13	0	38	0	0.00
Neutral	14	0	37	1	0.00
Neutral total		8	520	4	0.01

Table A3. Verb Frequency by Scenario Category

Scenario Category	*Action*	*Belief*	*Perception*	*Desire*	*Emotion*	*Communication*
Neutral	61	2	4	3	9	7
Harm	71	2	7	3	4	14
Dishonest	72	4	4	5	5	15
Disgust	70	0	2	0	15	3

Each scenario was parsed into the five verb categories described by Bartsch and Wellman (1989). These categories included action (e.g., eats, makes), belief (e.g., thinks, knows), desire (e.g., wants, tries), emotion (e.g., suffers, feels), and communication (e.g., asks, tells). Action verbs were more frequently represented than any other category. Chi square analyses revealed that the frequency of action, belief, and desire verbs did not differ significantly across categories ($\chi^2 < 4.64$; all *p*s > .20). The frequency of emotion and communication verbs did differ by scenario category ($\chi^2(3) = 9.06$, $p = .028$ and $\chi^2(3) = 10.13$, $p = .017$, respectively).

Table A4. Reading Ease and Grade Level by Scenario Category

Scenario Category	*Flesch Reading Ease*	*Flesch–Kincaid Grade*
Neutral	68.77 (9.82)	7.69 (1.92)
Harm	72.62 (14.48)	6.63 (2.63)
Dishonest	70.94 (12.77)	7.26 (2.03)
Disgust	70.02 (12.79)	6.66 (2.26)

Both measures (Kincaid, Fishburne, Rogers, & Chissom, 1975; Flesch, 1948) calculate textual difficulty with formulas that use sentence length and number of syllables per word. These measures are highly correlated in an inverse direction: The higher the reading ease, the lower is the grade level required to understand the text. Each cell lists the mean with standard deviations in parentheses. There were no significant differences between scenario categories for reading ease ($F(3, 52) = .23$, $p = .87$) or grade level ($F(3, 52) = .74$, $p = .53$).

Figure A1. Emotion ratings by scenario category. After the scanning session, participants indicated if each scenario evoked emotion using a scale ranging from 1 (*not at all*) to 4 (*intensely*). Error bars indicate standard error.

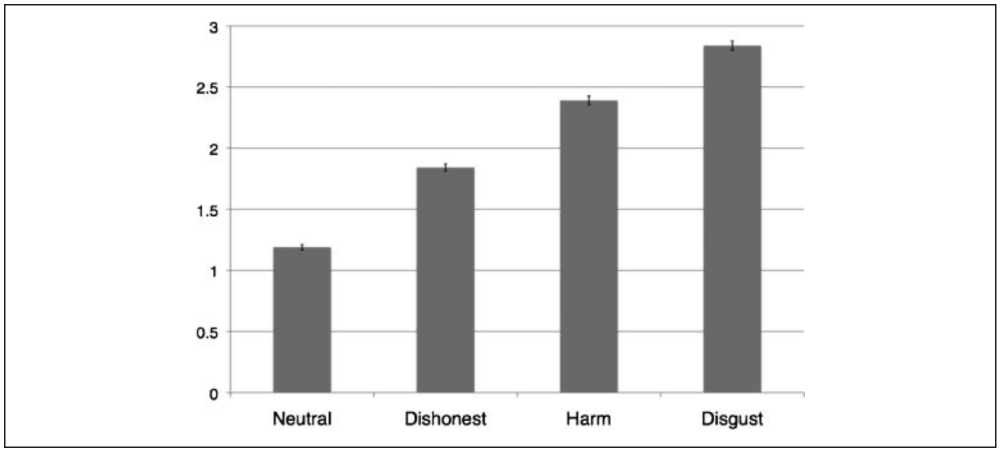


Figure A2. Ventral frontal coverage of sample subject. Slices depict three planes of the same Talairach coordinate: (A) $y = 47$, (B) $x = 1$, (C) $z = 0$.

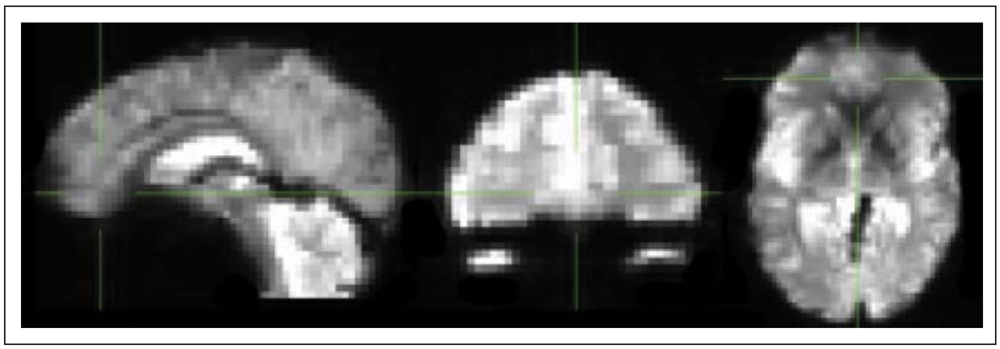
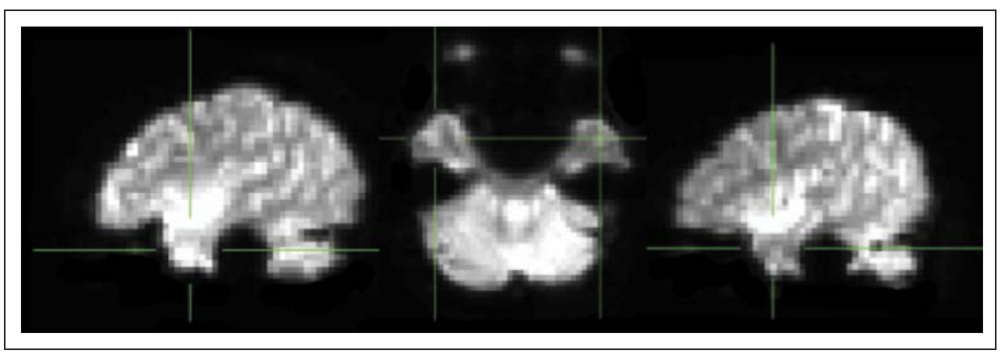


Figure A3. Temporal pole coverage of sample subject. Slices are from Talairach coordinates: (A) $x = -44$, (B) $z = -22$, (C) $x = 46$.



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