

Science Education Collection

Using fMRI to Dissect Moral Judgment

URL: <https://www.jove.com/science-education/10306>

Overview

Source: William Brady & Jay Van Bavel—New York University

In examining the roles of reason and emotion in moral judgments, psychologists and philosophers alike point to the trolley dilemma and the footbridge dilemma. With the trolley dilemma, most people say that it is appropriate to pull a switch to stop a train from hitting five people by diverting it to kill one person. However, with the footbridge dilemma, most people say it is inappropriate to push a large man off of a bridge in order to hit a train (killing him) and stop it from running into five people. Reason would dictate that in both of the foregoing dilemmas, one life should be sacrificed to save five lives. But to many people, pushing the large man just “feels wrong” because it triggers more negative emotions than pulling a switch. In this case, emotion seems to trump reason.

In recent years, psychology and neuroscience have entered the debate over the roles of reason and emotion in moral judgment. Researchers can scan brain activity as individuals make moral judgments. Research shows that different brain areas associated are active during contemplation of the footbridge dilemma versus the trolley dilemma.

Inspired by Greene, Sommerville, Nystrom, Darley and Cohen, this video demonstrates how to design moral dilemma tasks and integrate them into experiments using functional magnetic resonance imaging (fMRI) technology.¹

Principles

To assess brain activity during task performance, an analysis of variance (ANOVA) is performed on the functional images created by the fMRI. The authors reported several functioning imaging studies linking the following brain areas with emotion: medial frontal gyrus, posterior cingulate gyrus, and angular gyrus. Conversely, the following brain areas were linked to cognitive, non-emotional processing: middle frontal gyrus and parietal lobe. Using this information, brain images derived during the experimental procedure can be analyzed to evaluate the participant's relative use of reason versus emotion in the psychological processes involved with conditions of moral judgment.

Procedure

1. Data Collection

1. Conduct a power analysis and recruit a sufficient number of participants.
2. Create 30 moral dilemmas divided equally into categories of (1) personal moral dilemmas, (2) impersonal moral dilemmas, and (3) non-moral dilemmas. See the supplementary materials from Greene *et al.* for specific examples.¹
 1. A **personal moral dilemma** involves the participant imagining to perform an action that directly harms one person in the service of some goal. Examples include the footbridge dilemma, harvesting the organs of a person to save several other people, and throwing someone off a lifeboat to save others on the boat.
 2. An **impersonal moral dilemma** involves the participant imagining to perform an action that indirectly harms one person in the service of some goal. Examples include the trolley dilemma, cheating on taxes, and stealing a boat in order to save people from a storm.
 3. A **non-moral dilemma** involves the participant imagining to perform an action that is not typically viewed in moral terms at all. Examples include deciding to buy a name-brand versus an off-brand medicine and whether to travel by plane or train given certain time constraints.
3. Present every participant with each of the 30 dilemmas while undergoing brain scanning using fMRI.
 1. Verify that stimuli (dilemmas) are shown on a visual display projected into the scanner.
 2. Present each dilemma as text through a series of three screens, the first two describing a scenario and the last posing a question about the appropriateness of an action one might perform in that scenario (e.g., turning the trolley).
 3. Give participants 46 s maximum to get through all three screens.
 4. Note that the intertrial interval (ITI) lasts for a minimum of 14 s (seven images) in each trial.
 5. Define baseline activity as the mean signal across the last four images of the ITI.
 6. Measure task-related activity using a “floating window” of eight images surrounding (four before, one during, and three after) the point of response.
 1. This window includes three post-response images in order to allow for the 4- to 6-s delay in hemodynamic response to neural activation.
 7. Acquire functional images in 22 axial slices parallel to the AC-PC line (echoplanar pulse sequence; TR, 2000 ms; TE, 25 ms; flip angle, 90°; FOV, 192 mm; 3.0-mm isotropic voxels; 1-mm interslice spacing) using a 3.0-T Siemens Allegra head-dedicated scanner.
4. Dependent measure: Measure participants' moral judgments by their rating of whether or not the action described in the dilemma was appropriate or inappropriate (binary choice).

2. Data Analysis

- Before statistical analysis, co-register images for all participants using a 12-parameter automatic algorithm and smooth with an 8-mm full width at half maximum 3D Gaussian filter.
- Analyze fMRI scans for each participant during each task.
 - For the images contained in each response window, use a voxel-wise mixed-effects ANOVA with participant as a random effect, and dilemma-type, block, and response-relative image as fixed effects.
 - Threshold statistical maps of voxel-wise F-ratios for statistical significance ($p = 0.0005$) and cluster size (8 contiguous voxels).
 - Threshold the planned comparisons for significant differences between conditions for statistical significance ($p = 0.05$ and cluster size (8 voxels).
- Measure the percentage change, relative to the baseline, in brain activity for each of the crucial brain areas at play.

Results

The imaging data support the idea that emotion is more involved in personal moral dilemmas than impersonal dilemmas and non-moral dilemmas (**Figure 1**). Brain areas previously linked with emotion (e.g., the medial frontal gyrus) were significantly more active when participants made judgments about personal dilemmas (e.g., the footbridge dilemma) than when they made judgments about impersonal dilemmas (e.g., the trolley dilemma). For impersonal dilemmas, brain areas previously linked with reasoning were significantly more active than when making personal dilemmas. The authors concluded that moral judgments about personal dilemmas rely heavily on emotional processes, while moral judgments about impersonal dilemmas rely more heavily on reasoning processes.

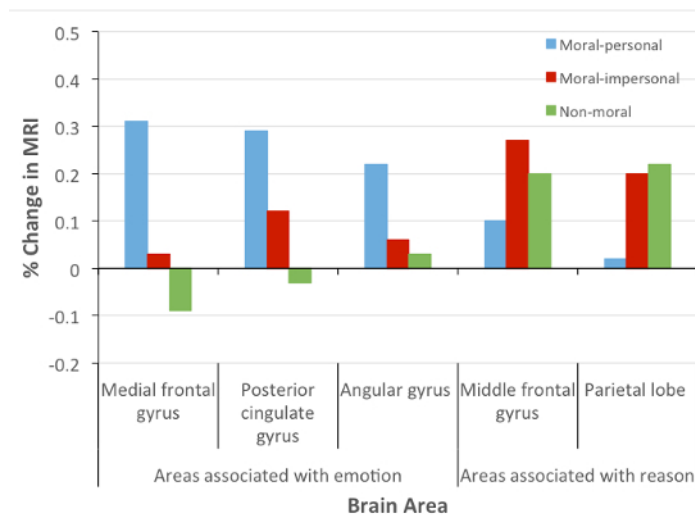


Figure 1. Differences in brain activity in response to making judgments about personal, impersonal, or non-moral dilemmas. Percentage change in MRI signal relative to baseline is plotted across brain areas associated with emotion (left) and reasoning processes (right). Personal moral dilemmas evoked significantly greater activation in emotion areas of the brain compared to the other dilemma types. Impersonal and non-moral dilemmas evoked greater activation of these reasoning areas of the brain than did personal dilemmas.

Applications and Summary

In the debate over the effects of reason versus emotion in moral judgment, this experiment provides evidence of powerful psychological processes involved: Moral judgments about personal dilemmas rely heavily on emotional processes, while moral judgments about impersonal dilemmas rely more heavily on reasoning processes. Indeed, judgments concerning impersonal dilemmas are more like judgments concerning non-moral dilemmas than personal dilemmas. Techniques involved in this experiment are basic, and the results derived should be used as a basis for more sophisticated research.

These results shed light on an ancient debate about our sense of morality. Do people rely more on emotion or reasoning? This research suggests that the answer is both: Emotion drives our moral judgments especially during personal dilemmas, whereas impersonal situations typically involve more reasoning. This finding has at least three major implications. First, given that political divides are often driven by differences in moral views (e.g., American conservatives who view same-sex marriage as wrong versus liberals who view it as permissible), this research highlights that these differences are often driven by emotions that may not be responsive to reasoned argumentation presented by the other political party.²

Second, these results provide an interesting explanation for the immoral behavior of certain abnormal populations such as psychopaths, who appear to be perfectly intelligent yet perform immoral acts such as murder. The results of this study suggests that these abnormal populations may have their reasoning intact, but may have no emotional response telling their brain that what they are doing is wrong when they are committing personal immoral actions.³ If this is true, these populations may require therapy that focuses on training them to be more in touch with their feelings or fostering specific emotions toward certain immoral actions.

References

1. Greene, J. D., Sommerville, R. B., Nystrom, L. E., Darley, J. M., & Cohen, J. D. (2001). An fMRI investigation of emotional engagement in moral judgment. *Science*, **293** (5537), 2105-2108.
2. Weston, D. (2007). *The political brain: The role of emotion in deciding the fate of nations*. Perseus Books.
3. Bartels, D. M. & Pizarro, D. A. (2011). The mismeasure of morals: Antisocial personality traits predict utilitarian responses to moral dilemmas. *Cognition*, **121**, 154-161.