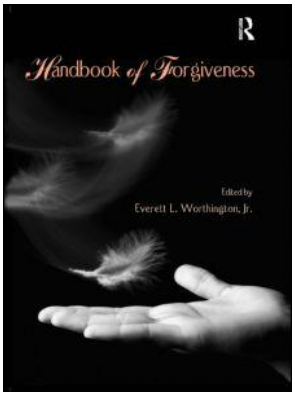

Handbook of Forgiveness

Everett L. Worthington, Jr.

Neuroimaging of Forgivability

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Chapter Sixteen

Neuroimaging of Forgivability

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Forgiveness may be defined as compassionate feelings that support a willingness to forgive or as the act of excusing a mistake or offense (WordNet, 1997). One component of forgiveness may be judging the forgivability of others' actions (possibly taking contextual information or extenuating circumstances into account).

Neuroimaging of forgivability is initially both very attractive and potentially quite disturbing. To the layperson, brain scanning equates with scientists examining which part of the brain "lights up" or activates when a particular action, emotion, or thought happens. The attractiveness of this possibility is therefore in the promise to reveal a physical basis to what is generally regarded as an ethereal and psychologically complex concept.

The disturbing aspect though, is the possibility posed by neuroimaging of exposing our innermost thoughts, moral judgments, and emotions to scrutiny and quantitative analysis. In this chapter, we will explore the ways in which neuroimaging can be used to strengthen our understanding of the physiology of forgiveness and can provide the means by which we can explore relevant brain mechanisms. For instance, we report how functional magnetic resonance imaging (fMRI) has been used to explore the brain activations associated with component processes of forgivability judgments and has allowed examination of brain regions involved in actively giving—or withholding—forgiveness.

fMRI is a noninvasive imaging technique that relies on the differing properties of oxyhemoglobin and deoxyhemoglobin (oxygenated and deoxygenated blood) in a magnetic field. This allows mapping of the distribution of oxygenated blood (and by inference, neuronal activity) in response to a particular task. fMRI scans are designed such that subjects perform contrasting tasks, the demands of which are matched as far as possible, so as to differ only by the specific cognitive process of interest. By subtracting the "baseline" task from the "active" task, many of the background and other processes unrelated to cognitive processes of interest (such as perceiving the noise of the scanner) are excluded. Brain activations to complex psychological paradigms (as opposed to, e.g., visual cortex activation to viewing a flashing checkerboard pattern) are rarely significantly strong enough for reliable and meaningful areas to be

identified in individual subjects. It is, therefore, more common for activations to be group averaged.

Such techniques also allow examination of brain changes within a group, such as those induced by psychotherapeutic or pharmacological intervention and symptom resolution. Successful imaging of complex psychological brain processes is ultimately completely reliant on the ability of the paradigm to elicit the cognitive task of interest.

PERSONAL ASSUMPTIONS ABOUT FORGIVENESS

In our early scanning studies (Farrow et al., 2001), we neither attempted to nor claim to have imaged subjects in the process of actively forgiving. To achieve such an aim would have required the application of individually tailored scenarios and would have relied on the engagement of a personally sensitive and fairly unconstrained cognitive process at the required time in an unfamiliar environment (an MRI scanner). However, more recently, this more ambitious paradigm has been attempted (Pietrini, 2003).

We were initially interested in imaging subjects making judgments about the forgivability of another's actions. To do so, we identified putative component cognitive processes according to the following rationale:

1. Forgivability judgments are likely to be dependent on our interaction with and perception of the people around us and the cultural and societal norms to which we subscribe. Hence, we sought a social cognition paradigm that probed the cognitive thoughts and processes underlying social perception and social judgments.
2. Forgivability is likely to involve moral judgments. The task therefore had to concern a moral judgment about behavior.
3. Forgivability depends on empathy. The task therefore needed to involve the person in identifying with and understanding another's situation, feelings, and motives.
4. Forgivability depends on the capacity for a theory of mind (ToM). Hence, the task would require the attribution of independent mental states to self and others in order to explain and predict others' behavior. This capacity is often described as seeing the world from someone else's point of view or perspective.

We attempted, therefore, to elucidate the component processes that together are required to make a forgivability judgment. Social cognition, moral judgments, empathy, and ToM have all been examined using neuroimaging, and their study is also of relevance to many neuropsychiatric conditions. Empathy includes the interpretation and expression of emotions and contains a cognitive (understanding a conspecific's behavior and his or her intentions) and an affective (visceral emotional) component. Successful human social interaction (cohesion) requires understanding of other people's intentions, actions, and emotions. Specific to neuropsychiatry, empathic ability is often compromised in psychopathy, borderline personality disorder, and orbitofrontal and ventromedial cortex damage, whereas ToM deficits exist in autism, Asperger's syndrome, and schizophrenia. Posttraumatic stress disorder (PTSD) is known, in

contrast with the other neuropsychiatric conditions mentioned, to respond well to a course of cognitive behavioral therapy (CBT; Tarrier et al., 1999). PTSD has been characterized as an impairment of the accurate evaluation and categorization of experiences (Stein, Jang, Taylor, Vernon, & Livesley, 2002), which may lead to a reduced or conditioned "normal" emotional physiological response and subsequently affect information processing (see chapter 22 by Noll for a review). The possibility therefore exists of conducting pre- and posttherapy brain imaging in patients with PTSD, using a paradigm such as empathic or forgivability judgments.

In this chapter, we will consider studies that attempt to image forgivability, then those that have examined the four component processes previously described.

REVIEW OF THE THEORETICAL AND EMPIRICAL LITERATURE

Neuroimaging Studies of Forgivability and Forgiveness

To date, there have been four separate studies of neuroimaging of forgiveness. These involved forgivability judgments in healthy controls (Farrow et al., 2001), forgivability judgments in patients with PTSD pre- and posttherapy (Farrow et al., 2002), forgivability judgments in patients with schizophrenia (Egleston et al., 2004; Green et al., 2003), and "actively forgiving" in healthy controls (Pietrini, 2003; Ricciardi et al., 2004).

Empathic and Forgivability Judgments in Healthy Controls

In Farrow et al. (2001), 10 healthy control subjects (mean age 31 years [range 21–51 years]; 7 men and 3 women) underwent an fMRI scan while making empathic and forgivability judgments. Subjects began by reading a short scenario before making five serial forced-choice decisions from two possible answers (see Table 16.1). Each scenario (empathic or forgivability judgments) was alternated with "baseline" social reasoning judgments to allow activation-of-no-interest subtraction that focused on activations related to the effect of the cognition of interest. Data analysis and results were restricted to brain activations in response to the judgment-making process, as scenario-reading activations were excluded. It was hypothesized that frontotemporal brain regions would be differentially activated by empathic and forgivability judgment tasks.

Areas of activation are reported by two methods—neuroanatomical name (i.e., brain region) and Brodmann's area (BA; a functional and cytoarchitectonic parcellation of brain grey matter, similar but not identical to the brain's gyral folds). Empathy judgments relative to social reasoning were associated with significant activations of left anterior middle temporal (BA 21), left superior frontal (BA 9), left inferior frontal (BA 47), orbitofrontal gyri (BA 11), and precuneus (BA 7; see Figure 16.1a). Judgments of forgivability relative to social reasoning were associated with significant activations

TABLE 16.1. Examples of Presentation Paradigms

Social reasoning judgments (baseline)		
Scenario: Approaching a large traffic jam on the motorway.		
Details: It is not rush hour. There have been no road work signs.		
Decision: More likely explanation for the delay.		
A car crashed ahead	OR	A lorry crashed ahead
A local football match	OR	A local hockey match
A car burst into flames	OR	A car ran out of petrol
A slow lorry ahead	OR	A slow tractor ahead
Flooding on the road	OR	An oil spill on the road
Empathic judgments		
Scenario: Your friend's daughter is happy.		
Details: She is nine years old, in high spirits, and excited about a forthcoming event.		
Decision: More likely explanation for her emotional state.		
Her birthday the following day	OR	Her birthday the following week
Favourite football team won a match	OR	Favourite football team won the league
Going to the cinema that afternoon	OR	Going to the ice-rink that afternoon
Buying a new school uniform	OR	Buying a new party dress
Going to her grandmother's house	OR	Going to her friend's house
Forgivability judgments		
Scenario: A celebrity appearing in court.		
Details: You read in the newspaper that a well-known television presenter has appeared in court, charged with an offense.		
Decision: Which of the following crimes you would see as more forgivable?		
Income tax evasion	OR	Council tax evasion
Driving while drunk	OR	Driving while disqualified
Speeding on a motorway	OR	Speeding on a country road
Assaulting a journalist	OR	Assaulting an autograph hunter
Shoplifting from a food store	OR	Shoplifting from a clothes store

Note: Examples of paradigms used in scanner. Each functional scan lasting 306 s incorporated six 51-s epochs in a boxcar design of paradigm presentation (3 "active" empathic or forgivability judgments alternated with 3 "baseline" social reasoning judgments). Each 51-s condition consisted of a 16-s visually presented scenario followed by five serially presented pairs of possible answers. Each pair of possible answers was displayed for 7 s, thereby creating a 35-s epoch during which subjects made serial forced-choice judgments about the same index scenario.

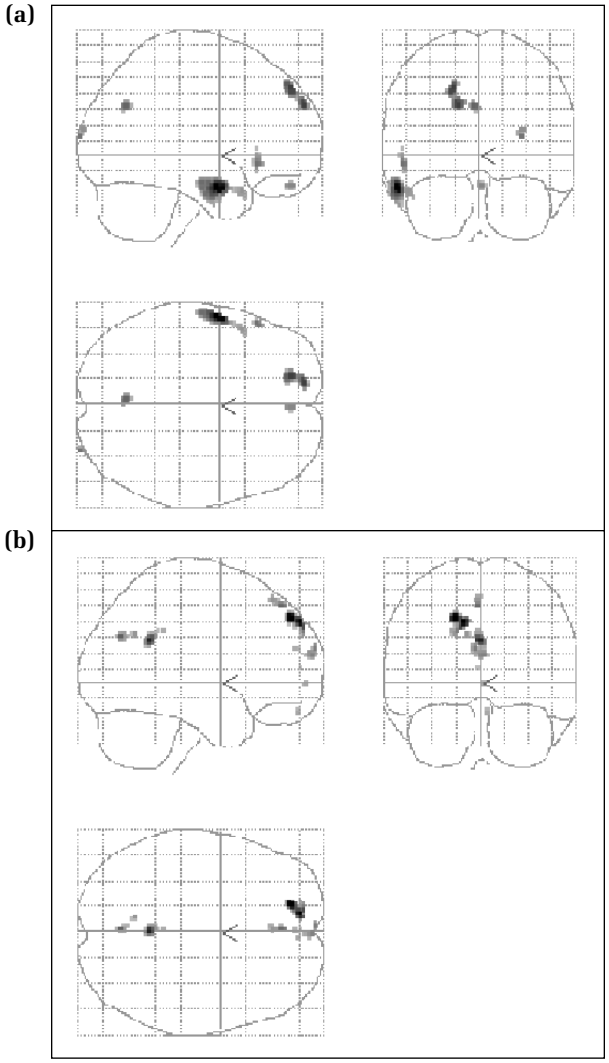

FIGURE 16.1. **(a)** Empathic vs. social reasoning judgments. **(b)** Forgivability vs. social reasoning judgments. SPM activation maps depict "averaged" regional brain activations from 10 subjects performing empathic judgments (Figure 16.1a) and forgivability judgments (Figure 16.1b) relative to social reasoning judgments. Extent of activation is shown in grey voxel clusters ($p < 0.05$, corrected for multiple comparisons) within 3 "transparent" brain projections viewed from the right aspect (sagittal projection; top left of figure), the posterior aspect (coronal projection; top right of figure), and from the superior aspect (axial projection; bottom left of figure). Reproduced with permission of Lippincott, Williams, & Wilkins Publishers. From Farrow, T. F. D., Zheng, Y., Wilkinson, I. D., Spence, S. A., Deakin, J. F. W., Tarrier, N., Griffiths, P. D., & Woodruff, P. W. R. (2001). Investigating the functional anatomy of empathy and forgiveness. *NeuroReport, 12*, 2433–2438.

of [left] superior frontal (BA 8/9/10) and posterior cingulate gyri (BA 31; see Figure 16.1b). Both empathic and forgivability judgments were associated with significant activations of left superior frontal (BA 9); orbitofrontal gyri (BA 11); and precuneus (BA 7). The activation areas common to empathic and forgivability judgments are distinct from the activations seen for each judgment paradigm individually.

Farrow et al. (2001) investigated the functional anatomy of forgiveness by examining one of many (postulated) cognitive components of forgiving—the neural correlates of making empathic and forgivability judgments. In keeping with previous studies of social cognition (as we will see later), making empathic and forgivability judgments clearly implicates frontotemporal brain regions. In particular, there was a discrete activation of left middle temporal gyrus while making empathic judgments, which was not seen during judgments of forgivability. These preliminary results suggest that attempting to understand others (i.e., empathizing) is physiologically distinct from determining the forgivability of their actions. The middle temporal gyrus has been described as "a common neural system of stored knowledge of personal identity" (Gorno-Tempini et al., 1998, p. 2103). The lack of middle temporal gyrus activation in response to the forgivability judgments may have been due to the forgivability scenarios being based on unknown individuals, whereas the empathic scenarios were based on personal acquaintances. The empathic judgments in our study required the imagining of a known person's responses, whereas the forgivability judgments centered on unknown people. This possible confound could have been addressed by adapting the empathy protocol so that it referred to persons unknown to the experimental subjects. However, it could be argued that by nature, empathy is likely to be applied most accurately with reference to another person known to the individual. Left frontal cortex was activated by both empathic and forgivability judgments, a finding that is congruent with reports of impaired empathy following left frontal cortical lesions (Grattan & Eslinger, 1992). In particular, left medial prefrontal cortex exhibits highly circumscribed activation common to both conditions, suggesting that they share a common neurocognitive substrate.

Lack of empathy is of central importance to many psychiatric conditions (e.g., schizophrenia, narcissistic personality disorder, antisocial personality disorder). Our results give a strong indication that activations of very high-level cognitive processes are recordable and that abnormal mental states could be reasonably predicted to show differing patterns of activation. There is an emerging literature on the beneficial effects of forgiveness as a psychotherapeutic intervention for many conditions (e.g., PTSD, postabortion grief, and incest; Coyle & Enright, [1997], Freedman & Enright, [1996]). "Abnormal" brain activations may therefore be amenable to "normalization" through cognitive intervention, possibly containing a forgiveness component.

Empathic and Forgivability Judgments in Posttraumatic Stress Disorder

Farrow et al. (2002) reported preliminary findings from an ongoing study using 13 patients with PTSD (following a road traffic accident or assault). We wished to explore

the way in which PTSD symptoms would impact on emotional and social cognition processing (i.e., patients' ability to make empathic and forgivability judgments). We hypothesized that the psychological impact of PTSD would be reflected in attenuation of brain activation in regions previously shown to subserve social cognition (Farrow et al., 2001) and that CBT tailored to include a forgiveness component, would result in "normalization" of brain activation on tasks that probe empathy and forgivability.

Subjects were scanned while making the empathic and forgivability judgments described in Farrow et al. (2001) both before and after CBT that specifically addressed issues of forgiveness of the perpetrator. The CBT comprised up to 10 weekly 1-hour sessions of fixed content, together with intersessional tasks (e.g., writing a trauma impact statement to be regularly read and rewritten during the therapeutic course). The concepts of empathy and forgiveness were discussed in the context of the expression of anger, frustration, and the need for revenge. In subsequent sessions, empathy with the perpetrator was discussed as a positive emotional state competing with potential negative emotional states. Topics included types of empathy, expression of empathy, and techniques for promoting empathy and making statements to the offender promoting empathy. Patients' intersessional tasks at this stage included writing a letter to themselves from the offender's perspective.

Patients then spent three sessions specifically investigating forgiveness in relation to their index incident. The first of these specific sessions, "forgiveness as a meaningful skill," included exposure to hurt, identifying events to focus forgiveness on, identifying personal ways of forgiving, and forgiveness role-play. The intersessional tasks included writing a letter from the offender's perspective and rehearsal of forgiving.

The second of three specific sessions focused on the "promoting of a commitment to forgive" by investigating techniques and personal ways of exploring commitment to forgive, reading the letter written from the offender's perspective, and role playing of empathic understanding. For their intersessional task, patients wrote a "letter of forgiveness."

The final session focused specifically on the ideas of forgiveness and "holding on to forgiveness," together with techniques for holding on to forgiveness—reading their forgiveness letter, discussing attribution errors, and role-playing exercises involving forgiveness.

All patients fulfilled DSM-IV (American Psychological Association [APA], 1994) criteria for PTSD pretherapy but, with significant symptom resolution, did not fulfill them posttherapy. Preliminary results suggested that pretherapy, PTSD patients' empathic and forgivability judgments relative to social reasoning were associated with significantly less activation in relevant areas, as identified from healthy controls (Farrow et al., 2001). For the same patients posttherapy, empathic and forgivability judgments produced activations similar to those seen in healthy control subjects.

The main finding from this study was therefore that patients with PTSD showed enhanced brain activation following symptom resolution in brain areas that were previously shown to be involved in social cognition (Farrow et al., 2001). Symptom

resolution was facilitated by therapeutic input that involved a central, structured forgiveness component.

Patients with PTSD were often dealing in therapy with issues of forgiveness (toward someone that they saw as to blame for their incident) and reported reduced empathy (numbing of affect toward family, friends, and colleagues). However, the scanning tasks engaged processes linked with social cognition judgments rather than directly invoking inherent emotions. It is therefore difficult at this stage to state categorically how specific the effect is to forgiveness, as opposed to other, higher order information-processing abnormalities observed in PTSD (Blomhoff, Reinvang, & Malt, 1998; McFarlane, Weber, & Clark , 1993).

This fMRI study in PTSD (Farrow et al., 2002), however, does provide convincing evidence that a psychotherapeutic intervention might lead to changes in brain activity. The issue of forgiveness is pertinent to many cases of PTSD, and this is clearly an area that would benefit from further investigation. These results are encouraging in general for similar neuroimaging studies of psychotherapeutic intervention in serious mental disorders that concern difficulties in social interaction.

Empathic and Forgivability Judgments in Schizophrenia

Difficulty with social interactions is a key clinical feature of schizophrenia, which has been characterized as "a disorder of the representation of [others'] mental states" (Frith, 1992, p. 107). These deficits may impact patients' ability to make judgments about, for example, empathic and forgivability scenarios. A better understanding of the neural basis of social cognition might ultimately help to explain brain mechanisms underlying some of the deficits in social functioning in people with schizophrenia.

One ongoing study (Egleston et al., 2004; Green et al., 2003) has been concerned with repeating the empathic and forgivability judgment paradigms (Farrow et al., 2001) in patients with schizophrenia. Data were also collected from a new set of healthy controls to confirm the reproducibility of "normal" activations. In both the healthy controls and patients with schizophrenia, scanning was conducted twice (approximately 2.5 months apart) to provide a pre- and posttreatment comparison for the patients with schizophrenia and a measure of the reproducibility of activations in healthy controls over time.

Fourteen patients with schizophrenia and fourteen age-, sex-, and IQ-matched healthy controls were scanned on two occasions. At initial scan, healthy controls showed very similar activations to those previously reported. Those data supported the reproducibility of the paradigm. At second scan, healthy control subjects showed reduced activation to both empathic and forgivability judgments, thereby giving a more valid comparator for patients' second scans. Preliminary results suggest an increased activation in schizophrenia patients following treatment, compared with controls (i.e., schizophrenia [Time 2 – Time 1] minus control [Time 2 – Time 1]) in task-relevant regions (Egleston et al., 2004; Green et al., 2003).

These findings support other neuroimaging studies implicating frontotemporal underactivation in patients with schizophrenia during social cognition tasks (e.g., Russell et al., 2000). The findings suggest that treatment-induced increases in brain activation occur in areas implicated in empathic and forgivability judgments.

Active Imaginal Forgiving in Healthy Control Subjects

Pietrini, Ricciardi, and their colleagues at the University of Pisa, Italy (Pietrini, 2003, Ricciardi et al., 2004) state in their abstract that, "While designating regions involved in evaluating forgivability and ethical judgments, these results [Farrow et al., 2001] do not provide any insight about neural responses associated with the process of giving or withholding forgiving" (Ricciardi et al., 2004, p. 1). Having previously successfully used fMRI combined with visual imagery strategies to explore the neural correlates of aggressive behavior (Pietrini, Guazzelli, Basso, Jaffe, & Grafman, 2000), they sought to determine the brain correlates associated with the imaginal evocation of giving or withholding forgiveness. In the fMRI scanner, six healthy volunteers (four female; mean age 26 years) evoked individually specific scenarios that comprised a hurtful event. They were then randomly instructed to imagine giving or withholding forgiveness. Activations to evocation of the hurtful event and engaging in forgiving or unforgiving behavior were all examined. Preliminary results from the evocation of the hurtful condition showed increases in anterior middle frontal and ventral temporal cortices associated with activity reductions in visual, motor, and subcortical regions, compared with the baseline control condition. The enactment of forgiving versus unforgiving behavior was associated with differences in neural activity in the right medial, middle and superior frontal cortices, right amygdala, bilateral striatum, left anterior cingulate, bilateral posterior parietal cortices, and cerebellum. These anterior areas, such as frontal cortex, amygdala, anterior cingulate and striatum; are involved with the regulation of emotional responses, moral judgments (Greene & Haidt, 2002), perception of physical and moral pain, and decision-making processes (Vogt, Finch, & Olson, 1992). Hence, there may be a convergence in our understanding of psychological component processes to forgiving and their neural correlates. Pietrini and colleagues' results are novel in that they may tap the affective (i.e., bodily, autonomic) component of *actively* forgiving and *feeling* emotional experiences (albeit from recalled memories). This may explain why their results contain areas of activation common to previous studies (Egleston et al., 2004; Farrow et al., 2001, 2002; Green et al., 2003) as well as additional regions.

RELEVANT PREVIOUS RESEARCH

Previously reported research on fMRI of empathic and forgivability judgments and giving and withholding forgiving supports the existence of components of such high-level

cognitions. These components have been elucidated by neuroimaging in healthy volunteers regarding theory of mind (ToM; Fletcher et al., 1995; Gallagher et al., 2000; Goel, Grafman, Sadato, & Hallett, 1995), moral judgments (Greene, Sommerville, Nystrom, Darley, & Cohen, 2001; Greene & Haidt, 2002; Moll, Eslinger, & de Oliveira-Souza, 2001), moral sensitivity (Moll et al., 2002), general emotional activation (Phan, Wager, Taylor, & Liberzon, 2002), and sympathy (Decety & Chaminade, 2003). ToM paradigms have also been extensively conducted in patients with autism and Asperger's syndrome (e.g., Happé et al., 1997), and patients with schizophrenia (e.g., Mazza, De Risio, Surian, Roncone, & Casacchia, 2001; Russell et al., 2000). Both of these patient groups are considered to have specific ToM deficits.

ToM tasks involve left medial prefrontal cortex, left ventrolateral prefrontal cortex, orbitofrontal cortex, and posterior cingulate gyrus in healthy control subjects. Medial prefrontal cortical (and to a lesser extent, posterior cingulate gyrus) activation during ToM tasks is not observed in patients with Asperger's syndrome. In patients with schizophrenia, ToM tasks fail to activate the ventrolateral prefrontal cortex (and to a lesser extent, medial prefrontal cortex).

Sympathy has been defined as "the affinity, association, or relationship between persons wherein whatever affects one similarly affects the other" (*Merriam-Webster Medical Dictionary*, 2002). A positron emission tomography (PET) neuroimaging study of sympathy (Decety & Chaminade, 2003) used videos of sad and emotionally neutral stories to elicit brain activations. Decety and Chaminade (2003) found that emotional expression of any kind in the videos was associated with activation of left inferior frontal gyrus. Medial prefrontal gyrus activation was associated with incongruity between an actor's emotional expression and the narrative content of a story. The authors proposed that the medial prefrontal gyrus is involved in evaluating social conflict. However, they also noted that the inferior frontal and medial prefrontal activations were modulated by subjects' assessment of the likeability of the story actors. The interaction between objective emotional interpretation and subjective judgment of a person's "likeability" may have relevance for further neuroimaging studies of forgiveness. For instance, one interpretation of this finding may be that we more easily forgive people we like.

A further area of research relevant to forgiveness is neuroimaging moral judgments. Greene et al. (2001) presented subjects with stories about which they made moral judgments. An example of such a story was one in which a runaway train was heading toward a number of people down one fork of the track. By switching the points on the track, it would be possible to divert the train down another railway track, resulting in only one person dying. Subjects were asked to decide whether they would switch the points. This was contrasted with a (ostensibly similar) judgment of whether it would be morally correct to push a stranger in front of a train to save the lives of many people. This study reported that moral personal judgments were associated (in contrast with moral impersonal judgments) with activations including left medial prefrontal cortex and posterior cingulate gyrus. This specifically relates to

forgiveness research because moral judgments about others' actions are invariably a factor in whether those actions are forgivable.

NEW RESEARCH DIRECTIONS

An important research direction is likely to be the application of current knowledge of the neuroscience of emotional processing to our understanding of forgiveness. For instance, the functional neuroanatomy of such emotions (Phan et al., 2002) as fear, happiness, sadness, and disgust tells us about how the brain responds to distinct emotions. At some level, these emotions presumably influence our ability to forgive or make forgivability judgments. How they do so could aid our insight into the processes that lead to forgiveness. For instance, emotions are important to forgiveness because a person's decision whether to forgive may be modulated by the giver's emotional evaluation of the subject of their forgiveness. Phan and colleagues concluded that, as a generalization, the medial prefrontal cortex was specifically involved in emotional processing, whereas emotional recall, imagery, and emotional tasks that demanded a heavy cognitive load recruited both the anterior cingulate and the insula. These brain regions form candidate areas identified as significant in the generation of forgiveness. Future studies may enable us to be more specific about brain areas responsible for emotional and other psychological processes that may influence an individual's ability to forgive.

RELEVANCE FOR CLINICAL AND APPLIED INTERVENTIONS

Neuroimaging of forgiveness and forgivability have to date been used only in research settings. There are developmental and psychiatric disorders associated with deficits of ToM (autism) and empathy (psychopathy). Furthermore, adherence to social conventions may in health depend on ventrolateral prefrontal cortex function. Because all these brain regions comprise the substrate for putative component processes that lead to forgiveness, it would be tempting to speculate that lesions in these regions would lead to "deficits" in the ability to forgive. However, there are no medical disorders characterized by an inability to forgive or make forgivability judgments. On the other hand, some evidence does support the idea that the ability to forgive does confer a prognostic advantage on patients who are victims of assault (DiBlasio & Proctor, 1993). If established, it may be that neuroimaging techniques could be used to monitor an individual's psychological response to therapy or even help make predictions of their likely response to treatment. However, though the possibility of utilizing a forgivability neuroimaging paradigm in pre- and postintervention (therapeutic) clinical application is feasible, the power to detect individual changes of potential clinical utility is probably some way off.

PERSONAL THEORETICAL PERSPECTIVES ON THE FIELD

In common with many complex cognitions, forgiveness can be considered as comprising component cognitive processes, which ultimately have a representation in the brain. Rather than being reductionist, this notion merely demonstrates that many of the underlying processes can be elucidated and disentangled from one another. Choosing whether to forgive someone may still be conceptualized as a psychological process beyond the sum of these (postulated) component parts. However, by examining such parts in healthy controls and patients with known social cognition, empathy, and theory of mind deficits, our understanding of forgiveness may be further illuminated.

CONCLUSIONS

This chapter reviewed the attractive and potentially disturbing connotations of imaging forgiveness and forgivability. The early results in neuroimaging of forgiveness would suggest that further research in the area may help determine how the brain enables complex psychological processes to interact and modulate one another that may lead to variation in the capacity to forgive and determine the impact of this variation on psychological "health."

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