The Neural Substrates of Moral, Religious, and Paranormal Beliefs

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orality, religion, and superstition are three important phenomena in life that overlap to some degree. They all involve strong beliefs and emotions, and play important roles in guiding behavior. They involve a complex interaction between cognition and emotion that can lead to adaptive or maladaptive actions. While they are strongly influenced by culture, not all individuals in a given culture subscribe to the same beliefs. Examining these phenomena from a biopsychosocial model—looking at their biological, psychological, and social/cultural bases—may help us to better understand them. While the psychological and social underpinnings of these phenomena have been researched for decades, their biological components have only recently started to be seriously examined.

Religion involves a variety of beliefs and behaviors including cosmology, morality, and those regarding practices and observances. Religious beliefs and practices are also typically associated with deep emotions such as fear, comfort, guilt, joy, and awe. While religious beliefs and practices are widespread throughout human history, their neurobiological basis is only beginning to be understood. Advances in neuroscience in the past few decades allow us, for the first time in human history, to examine what occurs in the human brain during complex mental phenomena, including those involved in religion.

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Saver and Rabin (1997) have extensively reviewed how neurological and psychiatric conditions affect religious experience. Epilepsy is a condition of repeated seizures occurring in the brain, producing excessive and chaotic discharges of electrical activity. In some individuals, seizures can evoke intense religious experiences, such as the feeling of a presence of a deity, a dreamlike state, or out-of-body experiences. Individuals with temporal lobe seizures can manifest increased interest in religion and philosophical concerns. Indeed, many historical religious figures described seizure-like symptoms. For example, St. Paul saw sudden bright lights, fell to ground, and heard voices. Religion-related phenomena in epilepsy may relate to activation and sensitization of sensory-limbic circuits in the brain. The limbic system represents emotion in the brain, so excessive activity would cause ordinary experiences to take on a deeper, more intensified meaning. As William James (1902) noted in The Varieties of Religious Experience, there is no special sense for religion, but rather it involves heightened significance of regular sensory perceptions.

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Others have cited neurological phenomena as a basis for religious experiences, including near-death experiences, hallucinogenic drugs, and delusional disorders such as schizophrenia, mania, and psychotic depression (Beyerstein 1988, Blackmore 1991). Pentecostal church followers who speak in tongues have shown excessive spiking activity in the temporal lobes of the brain, part of the limbic system. Most of the neurological phenomena associated with religious experience involve some form of over-activation of the limbic system, and correspondingly intensified experiences. Conversely, Alzheimer's disease is associated with a deterioration of the limbic system and those afflicted tend to lose interest in religion, even those who have exhibited a lifelong interest. Thus, Saver and Rabin concluded in their Limbic Marker Hypothesis that the emotional component of religion is represented in the limbic system of the brain, since excess activity increases religious interest while lack of activity decreases religious interest.

Religiosity

Heightened religiosity has also been noted in individuals with obsessive-compulsive disorder (OCD) (Tek and Ulug 2001). OCD is known to involve dysfunction of prefrontal systems in the brain (Whiteside, Port, and Abramowitz 2004). Nervous system function relates to religious phenomena not only in people with neuropsychiatric illnesses, but also in healthy individuals as well. For example, healthy religious individuals were asked to read religious writings (the Bible or Qu'ran) and showed activation of the prefrontal cortex and parietal cortex of the brain (Azari et al. 2001). Highly religious Protestants show greater levels of obsessive-compulsive symptoms compared to atheists and agnostics (Abramowitz et al. 2004). From these beginnings, cognitive neuroscientists are beginning to model how diverse systems in the brain contribute to producing the variety of religious phenomena (Boyer 2003).

While religions involve moral codes, morality is a separate concept involving systems of ideas about right and wrong conduct. Moral behavior and reasoning have also been shown to have neurobiological correlates. For example, individuals engaging in moral reasoning tasks show activation of prefrontal systems of the brain (Greene et al. 2004). Activation of these regions suggests that reasoning through a moral dilemma has both emotional and cognitive components (e.g., whether or not to sacrifice one life in order to save others). Other studies have similarly found that moral reasoning depends on the function of the human prefrontal cortex (Moll et al. 2003). Further evidence for prefrontal systems in moral behavior comes from individuals with dysfunction in these regions. Various brain imaging and neuropsychological studies suggest that individuals lacking in morality, such as those with antisocial personality disorder and psychopathic characteristics, have prefrontal dysfunction (e.g., Vollm et al. 2004, Dolan and Park, 2002). Indeed, damage to prefrontal systems can cause psychopathic-like personality changes in a formerly healthy person, a condition called acquired sociopathy (Anderson et al. 1999).

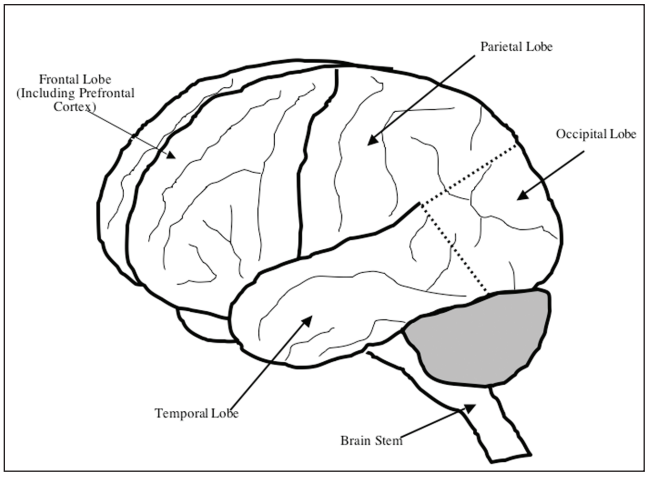

Figure 1: Side view of the human brain

Superstition

Superstitious beliefs are commonly held ideas about paranormal or anomalous phenomena that are incompatible with scientific explanation. The neurobiological basis of paranormal beliefs has not yet been thoroughly investigated. Individual paranormal experiences may be dissociative in nature, and many cases are associated with abuse or other forms of childhood traumatic experiences (Irwin 1994, Ross and Joshi 1992). Superstitious beliefs are often irrational in nature and are contradictory to logical understandings of causality (e.g., black cats cause bad luck). In fact, such beliefs persist despite evidence to the contrary (Zebb and Moore 2003). Superstitious beliefs likely persist because of their emotional appeal, representing attempts to re-conceptualize distressing circumstances that are beyond an individual's control (Jahoda 1969).

Superstitious thinking is associated with disorders of cognition such as obsessive-compulsive disorder (Einstein and Menzies 2004a). However, this association is not limited to individuals with the disorder but exists to varying degrees in the general population (Einstein and Menzies 2004b). The neurobiology of OCD again suggests the possibility of prefrontal system dysfunction in superstitious thinking. Numerous brain imaging studies have shown that logical reasoning depends on prefrontal systems of the brain. Verbal analogy reasoning is known to activate prefrontal systems (Luo et al. 2003). Different regions of prefrontal cortex are involved in emotionally neutral reasoning compared to emotionally laden reasoning (Goel and Dolan 2003).

Thus, the prefrontal cortex appears to be critical to morality, religion, and superstitious thinking (figure 1). There are logical reasons why this structure plays such an important role in these and other activities. The prefrontal cortex is the frontmost region of the brain, located behind the forehead and above the eyes. It is proportionately larger in humans than any other animal and is essential for higher forms of thinking and reasoning. The area and associated deeper structures in the brain (such as the basal ganglia and thalamus) mediate what are collectively referred to as executive functions. These include mental abilities that are essential for autonomy and pursuing long-term goals. They include planning, organizing, impulse control, self-motivation, abstract reasoning, and mental flexibility (Tekin and Cummings 2002).

Researching Executive Functions

Since the prefrontal cortex is involved in religious, moral, and superstitious thinking, my laboratory conducted research to determine whether executive functions relate to these phenomena (Wain and Spinella 2005). We decided to examine these relationships in a community sample, since clinical studies are illustrative but raise questions about applicability to the general population. While functional brain imaging studies provide vivid images of brain activity to relate to psychological phenomena, generalizing their results to the general public is hindered by the fact that they employ small numbers of research subjects and involve behavior outside of naturalistic settings (i.e., those done while sitting inside a brain imaging machine). To complement these types of studies, reliable and valid psychological measures can be used to see whether they produce results that accord with the above methods. An advantage of psychological tests is that they can efficiently be given to large community samples, filling in a gap left by clinical and brain imaging studies.

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In a sample of individuals from the college campus and local community, we measured executive functions (using the Executive Function Index), paranormal beliefs (Paranormal Beliefs Scale), religious beliefs (Traditional Religious Beliefs Scale, Belief in Divine Intervention Scale), and moral attitudes (Sociomoral Reflection Measure). Consistent with prior research, we found that people with greater religious beliefs reported greater paranormal beliefs and moral attitudes. However, a person's moral attitudes bore no relationship whatsoever to paranormal beliefs. Thus, moral attitudes and

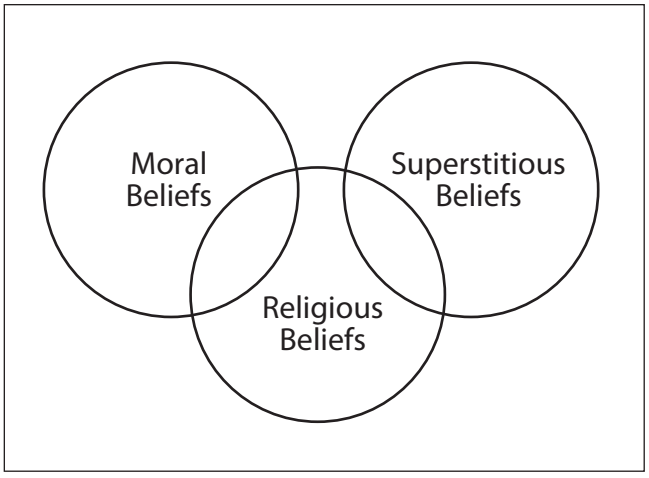

Figure 2: Overlap of religious, moral, and superstitious beliefs

People with religious beliefs reported greater paranormal beliefs and moral attitudes. However, a person's moral attitudes bore no relationship whatsoever to

superstitious beliefs appear to be two entirely separate entities, while religious beliefs partially overlap with both (figure 2). As anticipated, people with greater paranormal beliefs showed lower levels of executive function. Particularly, they had less impulse control and greater disorganization, independent of age, sex, or level of education. In contrast, people with greater moral attitudes showed greater executive functioning in all areas measured (motivation, impulse control, empathy, planning, and organization). These findings support studies suggesting that superstitious thinking involves some degree of dysfunction in the prefrontal cortex, even in the general population, while moral attitudes involve better prefrontal functioning. Traditional religious beliefs overall had little relationship to executive functioning. People with religious beliefs showed a minute increase in both empathy and impulse control, characteristics encouraged by most orthodox religions.

These findings have implications not only for the treatment of individuals with neurological and psychiatric illness but more importantly for the vast majority of healthy individuals. Despite their irrationality, superstitious and paranormal beliefs are remarkably persistent. Lapses in moral reasoning and behavior lead to greater social dysfunction, both on individual and societal levels. While religion may positively influence certain individuals, it is also evoked by others to commit harmful and antisocial acts such as racism, discrimination, terrorism, and murder. While philosophical and ethical discourse is essential to disentangle the related concepts of morality, religion, and superstition, it is instructive to understand it on a biological level as well. With a more complete picture of these phenomena on multiple levels, it may ultimately be possible to improve rationality and social cohesion through public health and education efforts.

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