

Religion on the brain: A look into the neurological impact of religion and spirituality

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Author Biography

Amelie Yan is a senior at Mclean High School with a passion for neuroscience and mathematics. At school, she is Co-President of Python Pals, a coding club, as well as Faith Revival, a Christian Club. Amelie's faith constitutes a major building block of her life. She is particularly interested in the intersectionality of faith and neuroscience. As a competitive tennis player who aspires to play at the collegiate level, sports is also a big deal for Amelie. When she's not on the court or in the classroom, Amelie enjoys reading books, listening to music, and journaling.

Abstract

Beliefs are the inherent, underlying nature of our identity, motives, and actions. One of the most significant and developed forms of belief is religion. This paper outlines the development of beliefs and provides evidence on how religion and spirituality impact the brain. Through neurotheological studies like the one done with Carmelite nuns in 2006, researchers can uncover what the brain looks like during religious/spiritual experiences. Results show that religious experiences increase activation in various regions such as the IPL, MPFC, ACC, and more. Studies have also shown that many of the results related to religion on the brain align with studies done to decipher the difference between a mentally healthy patient and a mentally unhealthy patient. One such example is that there is a similar increase in the PDR and the EEG when comparing results from a neurotheological study and brain imaging depicting positive and negative mental health. This relationship is proved through statistics revealing how religion has been known to significantly decrease the rate of depression in an individual and decrease the rate of suicide in a community. The findings suggest that integrating religious and spiritual dimensions into mental health treatment can enhance therapeutic outcomes. Ultimately, this exploration affirms beliefs' profound role in shaping our identities and promoting psychological resilience.

Keywords: Beliefs, Carmelite nuns, Depression, Mental health, Neurotheology, Neurobiology, Religion, Spirituality

Introduction

“Beliefs are convictions about what we accept as true” (Connors & Halligan, 2022). They allow us to interact with and understand the world around us. Beliefs shape our identity, and our identities influence our actions, impacting how we are perceived; essentially, we are our beliefs. However, despite the significance of belief in our lives, it has been a topic greatly neglected in scientific fields until recently. This lack of research is primarily due to the complex and nuanced nature of beliefs. Beliefs are greatly intertwined with other beliefs and often build upon one another, so it is difficult to isolate discrete beliefs to study (Connors & Halligan, 2022). However, researchers have entered into the field of neurotheology in order to dissect a specific sub-section of belief: religion. Religion is believed to be one of the most significant and developed forms of belief, so it is not as difficult to isolate circumstances to analyze brain activity caused by such religious beliefs. In this paper, I will dive into the field of neurotheology and analyze the development of beliefs to understand how exactly beliefs become an inherent part of our identities. I will also examine a study on Carmelite nuns in order to gain insight into the neurobiological mapping of the impact of religion and spirituality (R/S). Finally, I will uncover what the study results tell us about the impact of R/S on mental health. The neurological activity during an R/S experience provides strong evidence for the beneficial effects of R/S on mental health. Exploring the field of study

Religion is such an integral aspect of cultures that it raises the question of how beliefs can shape people’s identities. Identities are shaped in the brain, and it benefits us as a society to dig deeper and figure out what defines our values and how such values impact us.

Neurotheology is an emerging field of study that researches the relationship

between neurology and religion. Researchers seek to find the impact of religion on the brain. However, the field has not been deeply developed due to the nuances of religion and beliefs. Beliefs exist within broader networks of related beliefs (Quine & Ullian, 1970), so isolating beliefs in their purest forms is difficult. This leads to very little progress in the field since beliefs, as we know them, are difficult to break down into discrete elements, and so neurotheology has been hesitantly approached by researchers.

Despite these challenges, neurotheology is a field that needs to be examined, as beliefs define our choices and interactions with others. Our society, our human race, is built upon the beliefs of our ancestors, and our own beliefs are added onto those. However, despite such significance, beliefs have been largely neglected in neuroscientific studies until recently (Connors & Halligan, 2022). Neurotheology strives to understand spiritual experiences like “the perception that time, fear, or self-consciousness have dissolved; spiritual awe; oneness with the universe” (Sayadmansour, 2014).

Neurotheology is a multidisciplinary study that is not strictly limited to neuroscience and theology. Some of the other fields involved include “cognitive neuroscience, neurology, neurobiology of spirituality, psychiatry and psychology, and sociology” and more (Sayadmansour, 2014). Researchers employ advanced brain scans to understand what happens in the brain when an individual experiences spiritual feelings. In the same way, theology is also a broad term that encompasses the study of religion, spirituality, beliefs, and more (Sayadmansour, 2014).

How Are Beliefs Formed?

Beliefs are an intrinsic part of our identities as human beings. At the neural level, beliefs impact the execution of lower-order processes like attention, perception,

and memory and aid in social functions like identity, relationships, and group coordination (Connors & Halligan, 2022). Psychologists Michael H. Connors and Peter W. Halligan defined the process of forming a belief with a five-stage cognitive model.

The first stage is the trigger. At this time, the brain will take note of a sensory experience. This can be a particularly significant experience or any experience that holds weight. It is also important to note that many beliefs do not need a huge event to develop and are often shaped by accepting socially agreed-upon values (Connors & Halligan, 2022). For example, you do not need an apple to fall on your head to believe that gravity exists. Impactful experiences allow us to develop our own beliefs that then allow us to build our unique identity. It is difficult to define all the many ways beliefs are developed, but an impactful experience and society's influence are two of the larger, overarching methods.

The second stage follows with the brain determining what to do with the information gathered from the trigger. This stage relies greatly upon pre-existing beliefs and the necessary context for the situation (Connors & Halligan, 2022). Therefore, the proto-beliefs that are being processed are idiosyncratic and unique to the subject's character and experiences. This stage often reinforces a pre-existing belief with new information, as humans are not wired to enjoy change. Beliefs, once developed, become an innate aspect of who we are, so proto-beliefs creating dissonance within oneself are much less likely than they are to create harmony. This is why people are so susceptible to information that aligns with their beliefs and vice-versa. This stage reveals much about the subjects' preferred heuristics for processing events, revealing much of their character and social motivations.

The third stage is where the brain finally evaluates the proto-beliefs. This is

the stage where the brain will decide if the proto-belief will be established by evaluating its consistency with pre-existing beliefs. Beliefs that do not align with inherent beliefs will be examined more intensely than aligning proto-beliefs, and many of them will not become established to avoid dissonance (Connors & Halligan, 2022).

The fourth stage is when the beliefs that pass the evaluation are accepted. The accepted belief is placed within a network of similar beliefs that are part of an interrelated network that builds up the subject's belief system. Because of this system, most beliefs will remain relatively consistent, but some beliefs will stagger in conviction and relevance over time due to circumstances and various contexts.

The fifth and final stage lies in the effects of belief. Beliefs are an inherent part of who we are; they dictate our actions and choices in our daily lives, typically without immediate questioning or reflection. They shape our understanding of the world and influence how we process information. Beliefs also affect lower-level cognitive processes, such as attention, perception, and memory, in a top-down manner. They guide how we interpret sensory data, especially when it is ambiguous, aligning our perceptions with our existing beliefs. Beliefs can also skew our cognitive processing. Our interpretation of information will usually be done through the lens of our beliefs, which can lead to bias, although the exact mechanisms of this tendency are still debated. This influence of belief on our perception is evident across various experimental studies. This processing lens then provides "further support for the belief and leads to the elaboration of related beliefs and broader world views," solidifying our belief systems and allowing new beliefs to be created through the five-stage process (Connors & Halligan, 2022).

Brain Regions Known to be Related to or Responsible for Religious Faith

Understanding how beliefs are formed and how they impact different brain regions is important. To understand the concept of belief more fully, we will look mainly at the regions known to be related to religious beliefs. The main regions involved with religious beliefs are the prefrontal cortex (PFC), the temporal lobes, the parietal cortex, and the limbic system.

Many people's core values are shaped by their religion. Whether it be love for others, adherence to karmic ideals, or self-control against temptation, all of these values stem from religious precepts. This alignment between religion and beliefs allows results from studies on neurotheology to provide insight into beliefs.

In 2006, an experiment was carried out where fifteen Carmelite nuns were told to recall and relive their "most intense mystical experience" (Rim et al., 2019). The study tracked changes during a Mystical condition, a Control condition, and a Baseline condition. The Mystical condition was when the nuns recalled their intense spiritual experience. The Control condition was when the nuns recalled their intense experience with another human. The Baseline condition was their normal resting state with their eyes closed. The study utilized a blocked-design model, rotating through three different blocks: Mystical, Control, and Baseline. This model gave the nuns enough time to reach "the target states" (Beauregard & Paquette, 2006).

After the experiment, several subjects recounted feeling the presence of God during the Mystical condition—specifically, "His unconditional and infinite love, as well as plenitude and peace" (Beauregard & Paquette, 2006). Subjects also reported "that from a first-person

perspective, the experiences lived during the Mystical condition were different than those used to self-induce a mystical state" (Beauregard & Paquette, 2006). During the Mystical and Control conditions, subjects mentioned "the presence of visual and motor imagery" and a feeling of unconditional love, specifically during the Control condition (Beauregard & Paquette, 2006).

When comparing functional magnetic resonance imaging (fMRI) results between Mystical and Baseline conditions, significant loci of activation were found in the right medial orbitofrontal cortex (MOFC), right middle temporal cortex (MTC), right IPL and SPL, right caudate, left medial prefrontal cortex (MPFC), left dorsal anterior cingulate cortex (ACC), left IPL, left insula, left caudate, and left brainstem. A few loci of activation were also seen in the extra-striate visual cortex. Comparing Mystical and Control found significant loci of activation in the right MOFC, right MPFC, right dorsal ACC, right MTC, left IPL, and left SPL. Control versus Baseline found activation in the right SPL, right inferior occipital cortex (IOC), left dorsal ACC, left SPL, left caudate, and left brainstem. Finally, control versus mystical only found significant activation in the left putamen (Beauregard & Paquette, 2006).

For context, the MOFC is responsible for reward value and decision-making based on reward (Rolls et al.). The MTC is responsible for visual perception, and the IPL and SPL are involved in spatial orientation and oculomotor control. The caudate is involved in movement, learning, reward, motivation, and more functions. The MPFC is responsible for decision-making processes and judgment. The ACC integrates cognition, emotion, and behavior and involves many psychological processes. The brainstem is responsible for regulating vital functions that are inherent to humans, like breathing and heart rates. The extra-striate visual cortex processes visual information and is involved in conscious perception.

Finally, the IOC handles visual processing.

The study results provide grounds for us to believe that these various brain regions conciliate mystical experiences. These religious/spiritual experiences are multidimensional, implicating changes in perception, cognition, and emotion. Researchers found that a significant result of the study was that there was a distinction in the brain regions in play during the Mystical condition compared to the Control condition and during the Mystical versus Baseline condition. Contrastingly, when comparing the Control and Mystical conditions to the Baseline condition, the recalling of the two socioemotional memories showed activation in different regional patterns of brain activation. This distinction stood out to researchers because one could reasonably expect that the intense experience of connecting with a divine being and connecting with another human would involve most of the same neural regions. In relation to this study, many other studies also suggest a relationship between religious, spiritual, and mystical experiences (RSMs) and temporal lobe epilepsy (TLE) when the subject is awake but not aware of what is going on around them. These findings allow researchers to hypothesize that the right middle temporal activation during the Mystical condition is “related with the subjective impression of contacting a spiritual reality” (Beauregard & Paquette, 2006).

Additionally, in various brain imaging studies, the caudate nucleus is activated and seems to be associated with positive emotions like happiness, romantic love, and other forms of love. The caudate activation recorded during the Mystical condition was related to the reported feelings of joy and unconditional love.

Regarding the brainstem, it is believed that certain brainstem nuclei “map the organism’s internal state during emotion” (Beauregard & Paquette, 2006). This means

that the activation of the left brainstem during the Mystical versus Baseline and the Control versus Baseline conditions connects to the somatovisceral changes that occur during feelings associated with activation of the caudate nucleus—joy and love.

The insula is greatly involved in autonomic regulation. It presents a depiction of sensory inputs and integrates the representations of these external sensory inputs with our internal somatic state. The insula helps bridge the connection between our physical sensations and our emotional experiences, making us aware of how our body responds to different feelings. The left insular activation during the Mystical on Baseline experiment allows us to infer that it relates to the representation of the body responding to somatovisceral reactions associated with the, once again, reported feelings of joy and love (Beauregard & Paquette, 2006).

Additionally, the left MPFC is involved in the personal awareness of one’s emotional state. The left dorsal ACC’s activation reflects the emotional awareness involved with emotional signal detection during the Mystical condition. Finally, the MOFC is believed to be activated for subjective pleasantness. It is usually activated according to the pleasantness of the sensory features of stimuli. Knowing this, the right MOFC activation recorded during the Mystical versus Control experiment was most likely due to the fact that the mystical experiences relived during this state were relatively pleasant (Beauregard & Paquette, 2006).

During the Mystical condition, the right SPL was activated, which could mean changes in body schema. This change is most likely due to the context of the Mystical condition, a time when the body felt as if it was a part of something greater than self. Participants also reported experiencing visual imagery during the Mystical condition, which can be explained by the involvement

of the extra-striate visual cortex, which includes the MOC and LG areas, which are responsible for visualization (Beauregard & Paquette, 2006).

We must also acknowledge that this study was limited since the Carmelite nuns merely recalled an R/S experience—data was not recorded while they were actually actively achieving such an experience. This type of experience is difficult to manufacture authentically, so recalling a past experience was the next best option for the study. However, data is still significant because the results demonstrate that subjects experienced genuine mystical experiences during the Mystical condition. Researchers also report that these “mystical experiences felt subjectively different than those used to self-induce a mystical state” (Beauregard & Paquette, 2006).

Religion and Spirituality's Impact on Mental Health

The brain not only explains the impact of beliefs but is also impacted by those beliefs. Religious beliefs have been known to aid in coping with stress, death anxiety, and more (Rim et al., 2019). Attending religious services is associated with lower rates of suicide (VanderWeele et al., 2016), and being engaged in religion is correlated with a lower risk of mental illness in children (Chen and VanderWeele, 2018). Religious people also have greater life satisfaction and a lower percentage of depression and anxiety (Rim et al., 2019). This percentage is so significant that research has backed employing R/S in mental health treatments (Baetz & Toews, 2019).

However, it is also important to acknowledge the clash between religion and mental health in society. While increased studies have linked religion to psychological wellness, there is still a strong bias against R/S in psychological fields (Pargament &

Lomax, 2013). The main sources of the conflict between religion and psychiatry include the clashing beliefs in science and faith; most psychiatrists being irreligious, therefore not accounting for the significance of religion to some patients; and a lack of common knowledge on the impact of religion on the psyche (Pargament & Lomax, 2013).

There are a few cases where patients will attribute feelings of anger, guilt, suffering, and despair to their faith (Pargament & Lomax, 2013). There are two types of religious struggle that lead to resentment: religious struggles that are the result of psychological struggles and religious struggles that lead to psychological struggles. Other cases can also be caused by traumatic events. Some people may begin to blame their faith when struggling psychologically—wondering why their deity or higher power has allowed them to suffer. Others may begin to distance themselves from their faith for some reason and suffer psychologically due to the significance of religion on fundamental values (Pargament & Lomax, 2013). Religion is a way of life that usually dictates a person's core values, and stepping away from such a lifestyle can lead to severe mental repercussions. Some studies have connected religious struggles to “declines in mental health, physical health, and even greater risk of dying” (Exline et al., 2013).

While in some cases, religion can negatively impact a patient, empirical studies prove that religion is a main resource of reassurance for people when faced with issues like serious illness. In fact, in a study on people with mental illness in Los Angeles, “more than 80% reported that they used religion to cope with their illness and 65% indicated that religion helped reduce the severity of their symptoms” (Tepper et al., 2001). Additionally, another study showed that higher levels of religiousness were more so related to reports of lower levels of pain rather than

the presence of pain, implying that religion is “involved in the reinterpretation rather than denial of pain” (Pargament & Lomax, 2013). This study reaffirms the validity of religion as a source of comfort, as many believe R/S people are deluded and are simply ignoring pain. The strongest bias against religion in mental health situations is the generalized view of religion as a source of denial. Once again, due to the lack of religiosity among psychiatric professionals, religion is quickly dismissed when, many times, it can be a patient’s greatest source of solace.

Studies over the years have shown that the risk of depression in an individual can decrease by up to 80% compared to individuals who are not religious or spiritual (the controls) (Miller et al., 2019). A structural neuroimaging study by James I. Rim and colleagues revealed high R/S importance associated with increased cortical thickness in the parietal and occipital regions of the prefrontal cortex. The researchers believe this thickness is what allows for greater toughness against depression (Rim et al., 2019). Additionally, a study shows that a high value of R/S importance is also related to decreased default mode network (DMN) connectivity. DMN connectivity is a collection of brain regions that are active when a person is not engaging with external stimuli but is rather focused on internal processes. Finally, electroencephalography (EEG) studies have revealed a relationship between R/S value and greater posterior alpha during rest. Posterior dominant alpha rhythm (PDR) refers to the brain activity that occurs when an individual is at rest with their eyes closed. A more prominent PDR is usually associated with relaxation, and the PDR increases in amplitude when a person becomes more mentally aware of themselves and their surroundings. A greater PDR during rest is also associated with greater receptiveness to pharmacological treatment for depression (Tenke et al., 2013). It is also important to note that I found the IPL’s purpose inconclusive. Conflicting studies exist on whether reduced or

increased activation in the IPL is associated with intense R/S (Beauregard & Paquette, 2006; Miller et al., 2019). The Carmelite study performed by Beauregard and Paquette in 2006 described increased activation in the IPL during the Mystical condition compared to the Baseline condition. However, in a study by Lisa Miller and colleagues in 2019, a decreased activation in the IPL occurred when comparing the Spiritual condition to the neutral-relaxing condition (Miller et al., 2019). This inconsistency is significant since the status of IPL activation can be used to explain the impact of R/S on the risk of depression in an individual.

Overall, regions activated during R/S experiences significantly align with the regions associated with positive mental health. This leads to the conclusion that involvement in R/S can aid mental health and explains why R/S has been proven to be helpful in mental health treatments.

Conclusion

Neurotheology has yet to be fully explored but should be further researched. Beliefs shape our identities and subsequently affect how we interact with the world around us, deeply influencing our cognitive processes and emotional well-being. Religion and neuroscience are seemingly separate concepts but are, in fact, greatly entwined. R/S is often experienced internally, and external expression merely reflects inner posture. Studies like the Carmelite nun study give us insight into what the brain looks like when impacted by R/S and highlight how R/S can foster positive feelings that improve our mental health, proven by lower rates of anxiety and depression. These benefits further underline the importance of understanding and integrating R/S into mental health treatment. As the field of neurotheology continues to evolve, new insight into the correlation between R/S and our brains will surface, and such information will allow us to further understand the beliefs and values that define our identities and interactions.

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