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The spiritual brain

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EDITORIAL

"Once the game is over, the king and the pawn return to the same box", an Italian proverb states. This is a poignant reminder of the inevitability of death, no matter who we are, who we were, or what we owned. Yet, this quote allows for a deeper question: what will the king and the pawn do while they are in the box? From a human perspective, it is more compelling to believe that both entities continue to partake in something beyond, as facing 'nothingness' would be a profound disappointment. Will it be a life in peace? Will they find peace? Will they await reincarnation? Apparently, ancient civilizations already grappled with such abstract questions by weaving spiritual beliefs into their cultures. Some of these practices still persist today, and some say that they provide solace, guidance, and meaning to countless individuals.

To establish a clear premise before delving further, we understand spirituality as the acknowledgment of something greater than oneself, "something else" than sensory experience, and the acceptance of some kind of abstract -cosmic/divine- entity of which we all are part. For many, spirituality is a personal journey, which means that it often relies on emotional interpretations, intuitive insights, and subjective experiences that resist standardization and validation through traditional scientific methodologies. In an age in which scientific inquiry and skepticism are -fortunately- central in human thought, spirituality can find itself at odds with the rigors of empirical investigation. Is spirituality merely a figment of our imagination, a psychological crutch to cope with the unknown? Or does it hold deeper truths that elude the grasp of science? Can the realms of spirituality and science coexist harmoniously, or are they fundamentally incompatible? Is it even possible to be spiritual and a scientist? We're not the first to ponder these questions, they've puzzled thinkers for ages, but that doesn't mean we shouldn't attempt to answer them.

Some may argue that spirituality, by its very nature, defies the principles of empirical verification and falsifiability upon which science is based. However, recent advances, driven by fields like neuroscience and psychology, have expanded their scope to encompass phenomena once deemed purely metaphysical, and are offering new insights into spirituality and human consciousness, behavior, and well-being. Now, permit me to use a fallacy: if spirituality has endured for so long and across such diverse cultures, it deserves at least some scrutiny—skeptical, of course, but scrutiny nonetheless. Thus, we assert that spirituality can indeed be addressed through a scientific lens. As for the remaining existential questions, we aim to provoke reflection in the following pages. Welcome!

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A Look at the *Why* in **Spirituality**

Anne Sophie Brilla Luca Wienand

Around 70-85% of the world's population is estimated to affiliate with a religion, regardless of their practice[1,2]. While religious identification can serve many purposes, the extraordinary proportions at hand indicate that spirituality and religious practices are in some way deeply bound to the human experience, raising questions about the purpose that spirituality serves. We're curious: why and how do people believe? Although spirituality and religion are not the same thing, religion can be conceptualized as a type of spirituality[3]. In this article we specifically seek out an evolutionary perspective on this overlap. We begin by examining animism as a possible evolutionary origin of spirituality, explore whether religion and spirituality are exclusive to humans, and investigate reasons that may have led to the emergence of the diverse religious cultures we see in humans today.

Although it is difficult to directly investigate the origin of ritualized spiritual practices, cross-cultural phylogenetic meta-studies indicate that animism is the earliest documented form of spirituality in human cultures[4]. Animism, in its most basic form, describes a worldview where the world is inhabited by other minds and persons, who have some level of agency and who you can interact with[5]. All animistic beliefs distinguish between important and unimportant entities, that is, agents and objects, respectively. However, who or what is regarded as an important entity can greatly differ between cultures and there is no standard version of animism[5].

The term animism was first coined by anthropologist E.B. Taylor in the 19th century, and predominantly used by European social scientists and anthropologists who regarded it as the 'primordial' source from which modern religion evolved[6]. However, early discussions around animism were heavily influenced by the contemporary ideologies of European progress and colonial superiority. Animism was considered to be exclusive to indigenous tribes, which were regarded as 'primitive' or 'savage' for misattributing agency to inanimate objects[6]. Within the colonialist framework of the time, researchers viewed the belief systems of these 'primitive' indigenous societies as an evolutionary baseline, from which European and Western societies 'evolved' to develop modern religions such as polytheism and monotheism[6].

While the original definition of animism has been largely deemed outdated and obsolete due to this colonialist context[5,6], contemporary philosophers and theologists have tried to rehabilitate the concept as a way to explain the human origins of religion. For instance, the ethnologist and religious studies researcher Graham Harvey[5] distinguishes between two definitions of animism: "new animism" and "old animism." While Harvey acknowledges that "old animism" would often be connected to the outdated belief that animistic societies generally have a skewed understanding of who and what is alive, he argues that the "new" definition of animism might be more useful. This definition describes animism as a broad belief that "the world is full of persons, only some of whom are

human, and that life is always lived in relationship with others." In other words, it describes a form of religious culture that is mainly concerned with finding respectful ways to interact with other agents in the world. Harvey further defines that, under this concept of animism, the distinction between agents and objects is mostly based on the question of whether you can, more or less reciprocally, interact with them in any form.

Stewart Guthrie, a professor of anthropology at Fordham University, further argues that the inherent ambiguity of our environment necessitates a constant vigilance for hidden agents—in this case, an agent is any entity which can reach decisions and act[7]. For instance, a wild area might contain a bear or contain no bear: regardless of whether said bear-agent is unseen or truly absent, behavior is likely to change in the face of uncertainty about which agents surround us. Complex and ambiguous environments lead to the potential for false negatives, where humans perceive agents that do not actually exist. Consequently, Guthrie argues that the origin of spirituality is rooted in this perceptual and cognitive strategy, thereby laying out the foundation for the emergence of later religions[7].

These and other researchers therefore consider these cognitive mechanisms to constitute a biological basis for religion and spirituality in humans. Based on this acknowledgement, Peoples et al. argue that the universal and innate animistic tendency is only distinguished, and oftentimes reduced, later in life by the culture into which a person is born, determining which entities are considered a "real" person possessing agency and a mind, and which are not[4].

The fact that the animistic tendency of the human mind can be shaped by cultures and societal norms refocuses the question behind the evolutionary origin of religion to a more specific inquiry into what aspects of animism might have been useful and contributed to a selection advantage during the evolution of human societies. The most basic and universal form of animism can be defined as the capacity to take the perspective of another individual and imagine oneself in their perspective, which can also be regarded as empathy[8].

Considering hunter-gatherers, it quickly becomes apparent how a general capacity for empathetic perspective-taking as a facet of animism could have provided significant evolutionary advantages. Social groups where individuals have a natural aptitude for considering the feelings and subjective viewpoints of other group members likely show better cooperation and harmonious social dynamics, which would have made these groups more efficient in achieving cooperative goals[8]. Indeed, some authors have argued that organized religion functions primarily as a norm-enforcing structure that serves to enhance social cohesion and cooperation among humans, for example through the construction of a shared moral code[9,10]. A similar view posits that participation in spiritual activities can act as a social signal that functions to form and sustain the trust of others[11]. A common thread between such accounts is the assumption that spirituality is beneficial, and that this beneficial nature has influenced human evolution in some form. This improved cooperation would therefore have led to a group-based selective pressure for empathetic and thereby animistic capacities.

While empathy is mostly discussed in an intraspecies context, animistic tendencies can consequently be thought of as the capacity for empathetic perspective-taking whenever agents extend their own species' boundaries—whether it be to a bear or an all-knowing

creator. Researchers argue that animism lies deep within the natural, innate workings of the human cognition. The psychologist Paul Bloom, for example, argues that as the result of an "evolutionary accident," the human mind is innately dualist, instinctively separating concepts of mind and body[12]. This is nicely illustrated by the widely recognized animistic tendencies young children show when they attribute minds to a variety of inanimate and animate entities, for example their toys, animals, or robots[4,13,14]. The cognitive ability to separate mind and body consequently allows humans to imagine minds, souls or spirits without physical representations, thereby facilitating religious beliefs such as an afterlife[15]. But why did humans develop this spiritual capability in the first place?

The answer might not be so simple—and not lie with humans at all, but rather deep within our evolutionary history. Ritualistic behavior in chimpanzees, such as directed drumming and rain dancing[15,16], suggests the presence of cognitive capacities which parallel aspects of human spirituality. This also indicates that early hominins likely demonstrated similar ritualistic behaviors, although archaeological evidence is challenging to gather[17,18]. Furthermore, the basic animistic capacity for empathetic perspective-taking is hypothesized to be present at least in any animal that lives in a complex social group, as finding common values and beliefs is crucial to fostering cohesion and cooperation[8,19,20]. And not only are social animals assumed to have spiritual capacities, but the basic possibility to identify agents and even to imagine agents where there are none is probably bound to be widespread across the animal kingdom, as most animals have the need to constantly interpret and scan their environment for potential agents that could harm (or benefit) them[7]. While this offers insight into the evolutionary reasons for spirituality, it begs the question of how we arrived at the myriad forms of organized religion we see in recent human societies.

Early hunter-gatherer societies were likely more directly dependent on and interconnected with the ecosystem around them, which is why understanding the agency—or lack of it—of other entities might have provided them with an evolutionary advantage, for example when predicting movements of prey or predatory animals, or to understand seasonal growth or dispersal patterns of useful plants.5 The advantage of religious and ritualistic practices to increase group cohesion and cooperation might therefore have been centered around these "natural" agents in early humans. This would also fit the religious structures observed in the many belief systems of modern and ancient hunter-gatherer communities, who show a deep understanding of the ecosystem, incorporated into animistic considerations about the local plants and animals[21].

As human societies advanced through technological and agricultural progress, the potential for large-scale communication emerged[4]. While attributing agency to inanimate or physically absent entities may have initially served to cultivate cooperation and shared values within small social groups, religious practices and ideologies now were able to spread rapidly and extensively. This helped cultures to ensure cooperation in large-scale societies by condensing power into a single or few shamanic entities, even if they were beyond the possibility of interaction for the majority of the population[22]. Most people will never see the pope, God, or Edward Scissorhands, but many people still cooperate based on their presumed agency. As a result of this development, many different forms of belief systems emerged, eventually culminating in religions such as Islam, Christianity, or Hinduism, with billions of followers across the world.

While humans appear to have taken spirituality to a level exclusive to them, and human religions may have exceeded the purposes that led to their selection in the first place, one thing is clear: the origins of religion lie deep in our evolutionary history. As the fields of cognitive science and neurotheology continue to expand, new insights will help to further improve our perspectives on spirituality and its connection to religious culture in animals—human and non-human alike.

THE SPIRITUAL BRAIN

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Public playlist

A gentle blend of tunes to set the mood...

...turning neuroscience into a dreamy melody.

#	Title	Album
1	Utopia ODIE	N.F.A. DEMOS
2	Andromeda Weyes Blood	Titanic Rising
3	Static Still Corners	The Last Exit
4	The Race Archer Prewitt	Three
5	Humans Night Tapes	Humans
6	You Already Know Evita	You Already Know
7	Nomad Stella, Redinho	Up and Away
8	Liberta Omeria	Liberta
9	Melody Noir Patrick Watson	Wave
10	Predicament Kllo	Backwater
11	Yes I'm Changing E Tame Impala	Currents

Sacred Sanity:

The Intersection between **Psychopathology** and **Religion**

Jorge Ratia

The Crusades, The Salem witch trials, Al-Qaeda, Boko Haram... Perhaps too frequent instances of extreme behaviors in the name of God contribute to the perception of a connection between religion and "psychopathology", understood as abnormal mental states that impair individuals' lives or the lives of others. However, pathological religiosity does not necessarily imply explicit violence. There are more subtle and observable behaviors in daily life that can still impact individuals and communities, and they often manifest in ways that can be emotionally, psychologically, or socially harmful. For instance, in some religious communities, there may be an expectation for strict conformity to a particular set of dress codes or social norms, and a culture of guilt and shame is fostered. Other religious beliefs may contribute to the discrimination against individuals with diverse sexual orientations or gender identities. Noteworthy, these examples of extreme behaviors exist on a spectrum, and they represent a minority of cases within religious communities. Most individuals find fulfillment and purpose in their religious beliefs -regardless of their logical validity- without experiencing pathological consequences[1].

Yet, some critics argue that the rejection of scientific rationalism in favor of religious doctrines may reflect cognitive biases or maladaptive intellectual processing[2]. Also, unconventional religious practices and misunderstood religious experiences, such as claims of divine bidirectional communication, can contribute to the perception of pathology within religious contexts[3]. Moreover, conflicts between religiosity and secular values, particularly regarding medical treatments or social issues, can lead to the view that certain expressions of religiosity could be harmful[4].

If these circumstances are indeed prevalent to any extent, why is religion rarely brought under the spotlight as a potential cause or consequence of psychological abnormality? Perhaps it is because religion represents one of the most ingrained social agreements within society, and historically, it has been viewed as a normal aspect of human existence rather than a potential old-fashioned human bias. However, as the understanding of mental health continues to evolve, it becomes imperative to examine the intersection of religion and mental well-being.

Author note:

Many of the studies referenced in this article focus on religious behaviors within Western cultures. These studies provide valuable insights into the relationship between religiosity and psychological well-being, but there are some limitations to applying these findings universally across all cultural contexts.

RELIGIOSITY AND OBSESSIVE-COMPULSIVE DISORDER

"I started praying about twice an hour. Then, when I was about 11, I read some scripture about forgiving people 70 times, and that number stuck with me. Somehow my mind decided I needed to pray 70 times a day, and if I didn't reach that number, I could kiss any hope of going to heaven goodbye. I only felt relief when I hit 70."

This is the story of Grace, as shared by Medical News Today[5]. "I'm also from a religion that believes sins must be confessed. My version of this was to apologize constantly. There was a period of time where every hour on the hour I would rattle off quick apologies for anything I might have done wrong. Some people's recovery will take them away from religion, and that's OK. But for me, my religion is a strength, and the cause of my pain was not religion, just OCD."

Religion has long been a source of comfort, guidance, and community for countless individuals around the world. However, the intense scrutiny of religious norms and moral codes within religious communities can sometimes intersect with mental psychological disorders[6], such as scrupulosity, one of the main subtypes of Obsessive-Compulsive Disorder, which is recognized by excessive concerns about moral or religious purity. Individuals who exhibit high levels of religiosity may, in some cases, experience a heightened vulnerability to scrupulosity due to the intense scrutiny of their adherence to religious norms and moral codes[7]. Scrupulosity is often accompanied by compulsive obsessions, which are excessive concerns about, typically, fear of committing blasphemy, angering God, fear of having committed a sin, behaving overly morally, excessively striving for purity, fear of going to hell or being punished by God, and many others[8].

In addition to experiencing heightened concern regarding religious and moral matters, individuals with scrupulosity tend to participate in mental and/or behavioral compulsions, while also avoiding situations that may act as triggers[9]. Some of these compulsions are repeatedly seeking reassurance from religious leaders and loved ones, acts of self-sacrifice, excessive prayer, or mental efforts to neutralize "bad" thoughts. Compulsions or scrupulosity are not inherently tied to religion, but scoring very high in religiosity may be associated with more exacerbated symptoms for some individuals[10]. Cultural factors play a significant role in the prevalence of scrupulosity as well, with studies indicating higher rates of religious symptoms among individuals in certain religious environments[11]. In Western, secular countries, up to a third of individuals with OCD may exhibit scrupulous symptoms, with approximately 5% experiencing primary scrupulosity[12]. According to the International OCD Foundation, in some religious cultures and subcultures, religious

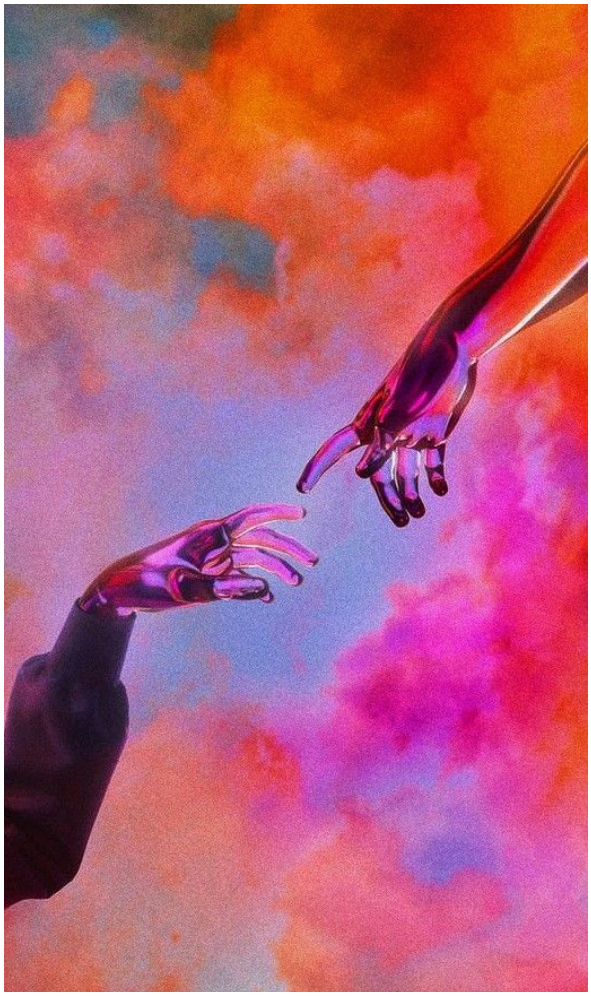
symptoms are present for the majority of people with OCD. Additionally, a recent study suggested that religiosity and guilt may have a significant effect on the symptomatology and outcome of OCD[15].

RELIGIOSITY AND COGNITIVE BIASES

First things go first: Cognitive biases are types of reasoning that often deviate from the principles of logic, probability reasoning, and plausibility, rooted in the human brain.

While the study of religious belief has traditionally been the domain of sociology and anthropology, recent advancements in cognitive psychology have provided new insights into the role of cognitive biases in shaping religious beliefs, suggesting that they may influence how individuals perceive and interpret religious phenomena.

One of the main cognitive tendencies thought to be implicated in religious beliefs is mentalizing, which involves understanding the mental states of others[14]. In religious contexts, believers often attribute human-like traits to supernatural beings, such as gods or spirits, as they seek to understand and connect with these entities on a personal level[15]. This anthropomorphism fosters the perception of agency in abstract concepts, contributing to the formation of religious beliefs[16]. Similarly, mind-body dualism, the idea that the mind is separate from the body, underpins many religious traditions' notions of souls and spirits[17]. This dualistic view of the self and the world around us shapes religious worldviews and informs beliefs about the afterlife and the nature of existence beyond the physical realm. Teleological thinking, which is the inclination to perceive purpose or design in events, also plays a significant role in religious belief formation[18]. Believers often attribute intentionality to natural phenomena, seeing them as evidence of divine creation or providence. This teleological perspective fosters a sense of meaning and purpose in the universe, reinforcing religious beliefs and practices[19].



Several studies pointed out that not only do cognitive biases exert a significant influence on the formation of religious beliefs, but cultural learning also plays a crucial role in reinforcing these beliefs. Growing up within a religious community heightens the probability of adopting specific religious beliefs and molds the particular religious practices individuals adhere to[20]. Nonetheless, scholars in the field of cognitive science of religion contend that cognitive biases serve as primary drivers of religious beliefs, relegating the influence of culture to a secondary position[21]. With that being said, the presence of cognitive biases does not necessarily invalidate religious beliefs or experiences[22]. Instead, it highlights the complex interplay between cognition and culture in shaping our understanding of the divine.

Although these theories are plausible and influential, there has been a scarcity of empirical research directly examining the correlation between specific cognitive biases and diverse religious beliefs. Additionally, there has been a lack of formal modeling of cognitive theories within a unified conceptual framework that evaluates how various cognitive biases, when considered collectively and in relation to each other, contribute to religious belief.

An essential -final- aspect to consider in this regard may be the potential for reverse causation within the dynamic between religious engagement and cognitive

tendencies[23]: Religious engagement might actually amplify cognitive tendencies, rather than the other way around. Thus, it would be interesting to change the focus in future research, and although some studies point out some directionality, it is advised to be extremely cautious when attempting to draw causal relationships.

THE RELIGIOUS BRAIN

The intersection of religion and neuroscience has emerged as a fascinating area of inquiry, shedding light on the neural correlates of religious experiences and the cognitive processes underlying religious beliefs.

Functional magnetic resonance imaging (fMRI) studies have shown patterns of brain activity associated with religious practices[24]. Regions of the brain typically involved in the Theory of Mind, emotional processing, and reward systems are consistently activated during religious experiences, suggesting a neurobiological basis for religious cognition[25]. Furthermore, studies exploring the effects of religious beliefs on brain structure and function have highlighted the dynamic interplay between cognition and neural plasticity. Long-term religious practices, such as meditation and prayer, have been associated with structural changes in brain regions involved in attention, emotion regulation, and self-awareness[26]. These findings suggest that long-term religious activities may shape the architecture of the brain, influencing cognitive processes and subjective experiences. For instance, a study from Duke University Medical Center showed significantly greater hippocampal atrophy among participants reporting a life-changing religious experience than the other groups[27]. Significantly greater hippocampal atrophy was also observed from baseline to final assessment among born-again (i.e. people who had a conversion experience) Protestants, Catholics, and those with no religious affiliation, compared with Protestants not identifying as born-again.

Another intriguing finding in this field is the differential activation of brain regions associated with religious belief compared to non-religious belief. Belief, whether religious or non-religious, is associated with increased activity in the ventromedial prefrontal cortex (vMPFC), a brain region implicated in self-representation, emotional associations, reward processing, and goal-driven behavior[28]. However, religious belief may elicit greater activity in several brain regions, including the precuneus, anterior insula, ventral striatum, anterior cingulate cortex (ACC), and posterior medial cortex[29]. These areas are involved in the regulation of emotion, self-representation, and cognitive conflict resolution.

Importantly, for now, there is no singular "God's spot" in the brain, highlighting the distributed nature of religious processing. In contrast, non-religious belief is associated with increased activity in left hemisphere memory networks[30], suggesting differential neural substrates for religious and non-religious cognitive processes. Now, it is imperative to reiterate that neural processes underlying religious belief and non-belief are poorly understood. Consequently, none of the current findings should be wielded to draw definitive conclusions or formulate categorical political decisions regarding these matters.

Cultural studies, on the other hand, have provided further insights into how religious beliefs modulate neural processing. For example, one study showed that self-referential processing induced increased activity in the ventral medial prefrontal cortex (vMPFC) for non-religious participants but in the dorsal MPFC for Christian participants[31]. In addition, the dorsal MPFC activity was positively correlated with the rating scores of the importance of Jesus' judgment in the subjective evaluation of a person's personality. This suggests that Christian beliefs, such as "surrendering to Christ", may alter the neural coding of self-referential stimuli, leading to a transformation of the autobiographical self into Christ's conceptual self[28].

Research on religion and its relationship with the brain, often referred to as neurotheology or neurospirituality, remains relatively limited[32]. What is more, this field faces challenges in obtaining funding and publication in prestigious journals due to perceptions of legitimacy. I speculate that there is a prevailing misconception that scientists in this field aim to disprove religious beliefs, which is not the case. Rather, the objective of these studies is to deepen our understanding of how religion and spirituality interface with brain systems. They do not seek to confirm or refute the validity of specific religious beliefs but rather shed light on the neurological mechanisms underlying religious experiences and behaviors.

INCONSISTENCIES AND CONCLUSIONS

Historically, research on the intersection between

religiosity and psychopathology has yielded inconsistent findings, with studies reporting positive, negative, or null associations[33]. These discrepancies can be attributed to factors such as the diverse aspects of religion and the various forms of psychopathology under investigation.

In clinical practice, the differentiation between "normal" religious beliefs and "pathological" religious delusions remains a challenge, with historical and contemporary perspectives offering contrasting viewpoints[34]. While figures like Freud regarded all religious beliefs as delusional, the DSM-IV distinguishes religious doctrine from pathology entirely. The lack of clear guidelines underscores the complexity of this issue, which may stem from the multifaceted nature of religion and the diverse manifestations of psychopathology. Nonetheless, psychological and neurocognitive findings from the last decades suggest that there may be some unexplored links between religious belief and pathological reasoning that deserve public attention (and funding) to better understand our society.

As claimed by David Cycleback[35], who is the director of the Center for Artifact Studies and a member of the British Royal Institute of Philosophy, "how religions are pathologized is based on how common they are, how they fit in with prevailing beliefs, how they relate to the person functioning and fitting with society, and even prevailing sentiments about them, and how the individual feels about them. If a religious vision fits in with normal societal views and culture and perception of reality (say a vision of Jesus in a Christian country), allows the person to fit in or work fine in society, and the person doesn't find them bad, then it is not pathologized. In fact, religious trances and spiritual visions are promoted by many cultures, even today. Pathology is subjective, relative, and cultural, and there are no objective answers to many of these questions."


Beneath the guise of faith, a shadow creeps.
Whispered voices echo in my mind.
They claim to guide, but sow a fear that seeps,
And in their grip, my soul they seek to bind.
The voices call,call, and call, relentless in their plea,
With every breath, they steal my sanity.
What once was solace, now a cruel decree,
As spirituality becomes my worst enemy.
Illustration: ULALALAU
Text: Jorge Ratia
ULALALAU.IA

DR. DAVID H. ROSMARIN:

"The number of Google searches for God skyrocketed during the Covid pandemic"

Jorge Ratia

Dr. David H. Rosmarin is a man of faith, rooted in the Orthodox Jewish tradition. This is a part of his identity, he explains, but not sufficient to understand his relevance in the research field. He is a professor at Harvard Medical School, the director of the Spirituality and Mental Health Program at McLean Hospital, and founder of the Center for Anxiety in the United States. Yet, it seems -from his words- that his biggest pride lies in his work as a clinical psychologist, where he has impacted the lives of thousands of individuals and organizations over the last decades.

If one searches "neuroscience of spirituality" on Google, one of the first entries is an article[1] published by the Journal of Psychiatric Research titled The neuroscience of spirituality, religion, and mental health: A systematic review and synthesis. Remarkably, you are the main author. What led you to this particular field of study?

When I started out in this field, it was incredible how, when it came to anxiety, depression, or OCD, spirituality was usually not talked about. It was just ignored, and I realized that that was a vestige from Freud. Yet, my patients were coming over to me saying, "Hey, can I talk to you about God?" or "Why am I being punished? Initially I felt I was not the right address to talk about these concerns, but at some point, I decided I had to do something about

this. I realized that we should have conversations with our patients and be able to tackle spiritual concerns just like we do any other area of human identity. Here I started my journey as a psychologist and researcher in spiritual psychology and neuroscience.

How do you define spirituality? Do you consider it synonymous with religion?

Spirituality is a broad way of connecting to what we consider sacred, which means something set apart or special. If someone feels a connection to nature that links them to previous generations or a greater force, that's a form of spirituality. It doesn't necessarily have to do with religion; it's about engaging with something beyond the physical world, something metaphysical. Religion, on the other hand, is a specific type of spirituality where people share common beliefs, culture, community, and practices centered around a sacred entity.

Are people, in general, more or less spiritual compared to a couple of decades ago?

This is actually an empirical question, and it's been addressed. There are two noticeable trends. Firstly, there seems to be a deconstruction of religion. We're seeing a decrease in religious involvement, such as fewer people joining religious groups or attending services like church, synagogue, or mosque, especially in the Western world like the United States and Europe (with some exceptions). On the other hand, spirituality remains alive and well. For example, during the COVID-19 pandemic, people were actively searching for some sort of spiritual guidance: the number of Google searches for God skyrocketed in the months during the pandemic. Also, around 40% of patients in my area who seek spiritual support don't identify with any particular religion. So, they are spiritual, but without any religious affiliation.

Is there a relationship between spirituality and well-being?

There are a couple of large-scale trends in the population, and there are also some consistent trends in clinical samples, in other words, people who are going to therapy, taking medication, etc... There's a small but consistent positive effect[2] of spirituality on reducing depression. This means that people who are more spiritual tend to have lower levels of depression and are more likely to feel hopeful, find meaning and purpose, connect with others, and feel a sense of community, which helps them feel less lonely. A second -even bigger- trend is on substance abuse and alcohol abuse. People involved in spiritual and religious life, irrespective of how you slice and dice and define it, are substantially less likely to be involved in alcohol abuse, substance use, behavioral addictions, gambling, sex addictions[3]... And there's a third trend: the suicidality research[4], which is extremely powerful in the United States, and there are several national studies with tens of thousands of adults. Some of these studies were conducted over 30 years and found that if people go to religious services on a weekly basis, they are five times less likely to commit suicide over the course of the study. It seems that rituals that people have can somehow buffer against impulsivity.

> ***"Some studies found that if people go to religious services on a weekly basis, they are five times less likely to commit suicide."***

Good social relationships are said to be the most consistent predictor of a happy life[5], and joining a religious community typically introduces individuals to a new social circle. Could it be that the clinical improvements associated with religiosity are more closely tied to the social interactions fostered within these communities rather than the religious beliefs themselves?

Even if you control for the social aspects, you still see some significant effects. I don't want to overstate the

effects on depression, though. The depression effects are small. However, the effects on suicidality, alcohol, and substance abuse, though, are very large. We're talking about 20-30% of the variance. I mean, they seem to be very highly correlated aspects of life.

Do individuals who adhere to different spiritual paths exhibit psychological and/or neuronal differences?

I haven't seen significant differences in any of my studies, between let's say Catholics and Protestants or Protestants and Jews or Muslims and Hindus. Yet, certain cognitive processes may be a little bit different across religions. The researcher Adam Cohen did this line of research, and showed, for example, that Catholics tend to value their thoughts more than in the Jewish perspective. In other words, there's certain fusing of thought and action, which has implications for morality, or implications for OCD. But this is a very specific thing, and it doesn't seem to be psychopathological in of itself.

Are there evolutionary explanations for the human propensity toward spiritual beliefs and practices? How are these reflected in the brain?

There are reports of apes and monkeys engaging in what seem like peculiar, ritualistic behaviors such as throwing objects or gazing at the sun in a particular manner. Are they trying to connect with something sacred? It's a challenging question to ponder... In human experience, there appears to be a calming effect associated with surrendering and accepting a higher power or presence beyond oneself. There's something in thoughts such as "I'm not in charge here" or "there's something greater than me", acknowledging the existence of something greater than oneself... This surrender may have an effect that is beneficial for hormone regulation such as cortisol and adrenaline levels. In evolutionary psychology, I suppose this could be viewed as adaptive and healthy, contrasting it with the behavior of being in constant vigilance. However, this is just speculation, it's unclear if this is truly advantageous for relationships or overall success in life.

> ***"In human experience, there appears to be a calming effect associated with surrendering and accepting a higher power or presence beyond oneself."***

Is there a God spot in the brain?

Localization of spirituality? Readers should check out Andrew Newberg's work. I'm much more of a clinical psychologist than a neuroscientist, but I would say spirituality, like all human experiences, is more a function of networks and how areas work in tandem with each other as opposed to localization to specific regions. I would be surprised if there were maybe certain aspects of faith that could be localized to certain brain areas, but I suppose it's possible.

Can neuroscientific research contribute to the understanding of mystical or transcendent states described in various spiritual traditions?

I believe neuroscience has the potential to shed light on many aspects of spirituality. It can help us understand the effects of mysticism, belief, and religious practices on our neural systems. For instance, how do people who engage in these practices, beliefs, and communities differ? Are there even any discernible differences? It's important to note that we're often unsure about causation, whether it's the brain influencing spirituality or vice versa. In my work, I delve into correlations rather than definitive cause-and-effect. Neuroscience can reveal the potential connections between neural systems and spirituality, much like other domains such as mathematics or

physical movement. Overall, I find this area of study fascinating. There's one big limitation, though: what are the experimental paradigms that can be used to manipulate, increase, or decrease people's spiritual or mystical transcendent belief practice? Whatever it is, we don't even have that.

Given this challenge, do you agree that psychedelic research is striving to explore more causal mechanisms in this domain?

Psychedelics... The experimental fundamental basis of these clinical processes is not well documented, and not well established. It's not that they don't work, but it's hard to know without more research. We are seeing a lot of excitement in this area and much funding being poured into the study of psychedelics. Perhaps we'll know more over time? My concern is that this class of drug will be utilized – maybe even at scale – without enough data to understand how and why they work. That said, almost all of the major advances in psychopharmacology in the past 30 need further understanding.

> ***"My concern is that psychodelics will be utilized without enough data to understand how and why they work."***

What implications might advancements in neuroimaging techniques have for studying spiritual experiences in the future?

This makes me think of a study by Galanter and colleagues in 2017[6], which looked (using fMRI) at prayer cravings and neural responses among long-term abstainers who went through Alcoholics Anonymous system. This showed that not only was there less craving when exposed to alcohol-related images but also increased activation in the left anterior middle frontal gyrus. That's the type of study where you are localizing a process that is clinically relevant and ties a spiritual factor to a clinical factor in the context of what's being done in the clinical setting. I would love to see more research like that, and neuroimaging techniques can help with that. Unfortunately, there aren't many studies like this one. I mean, when I did my review paper in 2023, how many papers were in here? Only 18 studies made the cut. There's not a ton of high quality literature on neuroimaging which also assesses spirituality in a credible way.

Faith on Spectrum:

Religiosity in Autism Spectrum Disorder

Zîlan Öz

Religion and spirituality are abstract concepts, serving as frameworks for answering fundamental questions about existence, purpose, morality, and the nature of reality. These cognitive constructs rely on the coordinated functioning of a set of neurological structures, named the "social brain"[1]. In the neurotypical brain, these interconnected neural regions seem to seamlessly facilitate social interactions and understanding of others' perspectives, which are essential components of forming social relationships and becoming a part of communities. Importantly, when individuals contemplate existential questions about existence, purpose, morality, and the nature of reality within a religious or spiritual context, the same neural networks associated with this social cognition seem to become active. For example, when individuals engage in religious rituals, reflect on sacred texts, or participate in spiritual practices, brain regions involved in theory of mind, empathy, and perspective-taking may be recruited. This suggests that contemplating existential questions within a religious or spiritual framework may involve similar cognitive processes as those used in social cognition.

Yet, in the case of neurodivergence, characterized by natural variations in brain function and information processing, these mental and behavioral processes may not be as homogenous across individuals. Specifically, as seen in individuals with Autism Spectrum Disorder (ASD), the relationship between neurobiology and religiosity seems to be rather complex. As a contributing factor, research suggests the social network involving the prefrontal cortex, anterior cingulate cortex, temporoparietal junction, and mirror neuron system, does not operate as smoothly in neurodivergent individuals. This, in return, seems to present challenges in areas such as social interaction, empathy, and theory of mind; all of which are regarded as the essential components of religious and spiritual experiences[2].

THE SOCIAL BRAIN AS THE NEUROBIOLOGICAL FOUNDATIONS OF RELIGIOSITY

In neurotypical individuals, there exists a balance within the social brain network[3], and this balance is considered to facilitate the key maintenance of religious and spiritual belief systems[4]. The prefrontal cortex, for instance, is known for handling decision-making, self-awareness, and moral judgments, which serve as the control center during life's big questions, and moral dilemmas associated with religion and spirituality. Likewise, empathy and compassion, as central aspects of religious experiences of love, forgiveness, and altruism, are orchestrated by the anterior cingulate cortex[5].

But what about understanding others' perspectives and beliefs—a key aspect of religious and spiritual empathy? Here the temporoparietal junction is indicated to be crucial. As indicated by Frith (2006), this brain region facilitates the cognitive process known as theory of mind (ToM). Through ToM, neurotypical

individuals can comprehend others' perspectives and beliefs, which is essential for developing religious and spiritual understanding and empathy. Lastly, the mirror neuron system stands as an important mechanism in the context of religion for facilitating imitation and understanding others' actions. Accordingly, this ability helps us fully engage in religious rituals and feel like a part of the same team during communal experiences[6].

DIVERGING PATHS

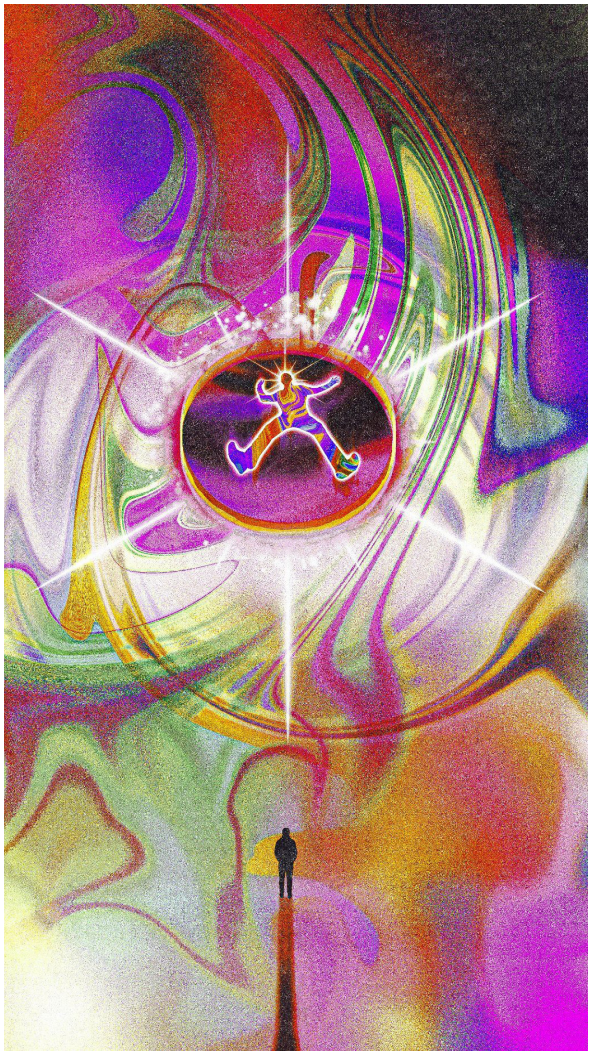
But, then, how does the experience of religion and spirituality differ for individuals with autism spectrum disorder (ASD) compared to those without neurodivergence? Are there specific challenges or benefits?

ASD is not a single developmental condition but a spectrum of related disorders with common core symptoms, caused by the alterations in neural connectivity and cortical network organization during early development[7]. Although highly variable amongst individuals, common features of ASD include difficulties in social interaction and communication, as well as repetitive patterns of behavior or interests. Neurobiological evidence suggests these symptoms arise from aberrant neuronal expansion in specific parts of the cerebrum during the first years of life, followed by an accelerated rate of degeneration in brain volume from adolescence onwards[8]. Since the neurobiological progress and outcomes of this abnormal development are heterogeneous, each individual's experience of ASD becomes unique, resulting in a spectrum of cognitive abilities[9]. This divergence from the neurotypical functioning of the social brain network thereby may affect how individuals with ASD navigate and interpret religious and spiritual concepts.

Viewed through a secular lens as "biologically rooted atheism," ASD is associated with a blind cognition of religion- a general deficiency in cognitive faculties that support key religious concepts, such as agency detection (the attribution of purpose and meaning to objects and events)[10]. Evidence supporting this viewpoint highlights the neurobiological characteristics of ASD, particularly the developmental differences in the social brain. Accordingly, the atypical operation of this neural network leads autistic individuals to struggle with understanding the abstract nature of religious thinking/rituals and being rather "literal-minded" individuals[11].

BROKEN MIRRORS: A BARRIER TO FAITH IN AUTISM?

While the existing literature offers conflicting findings, several theories support the idea of limited faith in autism spectrum disorder (ASD). One such theory is the broken mirrors theory, which emphasizes the evidence of dysfunctional mirror neurons in autism. Studies indicate that ASD is marked by unusual functional connectivity (reduced sensitivity) in brain regions housing these neurons, like the inferior frontal gyrus and superior parietal lobe[12,13]. As a cognitive result, it is postulated that these individuals may lack the neural foundations to empathize with and perceive intent in others, including those attributed to supernatural agents[14]. However, it's important to note that the broken mirrors theory is widely criticized for being overly simplistic, and has been challenged by evidence suggesting that autistic individuals don't necessarily exhibit mirror neuron dysfunction[15].



THE TOM TROUBLE

The impaired ToM in autism further strengthens the argument that ASD neurocognition inherently sabotages the formation of typical relationships with religion and exhibits atypical local connectivity patterns within the crucial mentalizing brain region - the temporoparietal cortex- during ToM tasks[16]. This neurofunctional abnormality is thus regarded as a barrier for these individuals to fully engage with religious concepts or experience spirituality. While the role of ToM has been criticized for being overemphasized in literature exploring the nature of religion in autism, consistent evidence within research findings supports its significance[17]. Abundant supporting evidence posits that individuals with ASD may face additional challenges in fully engaging with religious concepts and practices; including attributing mental states to others (i.e., god knows everything), forming empathy and compassion, and grasping metaphorical language and expectations associated with religious rituals[18].

SENSORY OVERLOAD OR SPIRITUAL SENSATION?

A complementary perspective to these viewpoints is the Intense World Theory (IWT), which suggests that hyper-reactive and hyperconnected microcircuits in the neuropathology of ASD contribute to an intensified perception of sensory and affective experiences[19,20]. Indeed, research on human adults with ASD has shown heightened neuronal activity, particularly in regions such as the amygdala, somatosensory cortex, and prefrontal cortex[21]. Such functioning of these microcircuits may result in overwhelming sensory and emotional experiences of their environment, proneness to escape from the perceptionally and affectively intense world[22]. Consequently, they may struggle to form typical relationships with religion, as the sensory overload impedes their ability to engage in religious practices and concepts effectively. However, though the IWT offers valuable insights, it also faces criticism and requires further empirical validation to fully understand its indications in ASD.

CHALLENGING ASSUMPTIONS ON ASD AND ATHEISM

On the other hand, such perspectives positing ASD to be inherently associated with atheism can be epistemically dangerous, and distressing for the individuals. Considering the unique experience of the disorder for each individual, the applicability of neurobiological, cognitive, and behavioral findings may not necessarily align with every individual with ASD. The under-studied aspects of the abovementioned perspectives should be carefully evaluated to prevent perpetuating self-reinforcing misconceptions in people with ASD, potentially discouraging them from embracing faith or even leading to their discrimination from society.

For instance, in neurotypical individuals, religious thoughts don't solely stem from neurocognitive faculties like Theory of Mind (ToM) but also arise from a complex interplay of cultural influences and ontological knowledge. When investigating religion in autism, it's important to recognize that impaired social abilities such as mentalizing and empathy do not fully explain the ASD profile and may be partially acquired in some individuals. Indeed, research indicates that some higher-functioning individuals with ASD do develop ToM, though its effectiveness depends on the complexity of tasks and ToM can be developed through specialized education[23]. Nonetheless, it's evident that individuals' conceptions of God are influenced by family and cultural teachings rather than exclusively by the ToM[24]. In individuals with ASD, too, although cognitive faculties may hinder their readiness to grasp religious ideas, doctrines, and values; cultural teachings hold the potential to shape the content of their beliefs.

COGNITIVE BARRIERS OR SPIRITUAL GATEWAYS?

In addition to the importance of ToM, there are other counterarguments that challenge the notion of 'weak religiosity' in autism. One argument is that perhaps, a socially less competent, neurodivergent brain is a blessing when it comes to communicating with bodiless agents[25]. In the end, the lack of social skills emerges as a problem only when there is the need to process the verbal and body-language information of social agents. However, having faith in religious and other transcendent cultural systems does not necessarily require these abilities but is more about forming simpler relationships with bodiless and abstract figures[26]. Furthermore, consistent research shows that people with ASD report experiencing sensations of presence, and visual perceptions without actual sensory input[27]. which is theoretically attributed to the aforementioned hyper-reactive microrcircuits[28]. This is significant because the inherent tendency to immerse oneself into transcendent spheres via imagination can paradoxically

facilitate their relationship with religion[29]. Therefore, compared to the more socially adept neurotypical population, autistic cognition might be actually of benefit in embracing religious/spiritual beliefs.

In conclusion, exploring the relationship between ASD and religiosity from a neuroscientific standpoint seems to offer us insights that would not otherwise immediately spring to mind. Such a lens allows us to recognize the neurobiological bases of their supposedly weak relationship with spirituality and religions, embrace the diversity of experiences within the ASD population, and deepen our understanding of various forms of spiritual expression. As mentioned earlier, religion and spirituality are deeply rooted in human cognition, and influenced by the functioning of our neurological structures, especially those linked to social cognition and empathy. However, for individuals on the autism spectrum (ASD), their relationship with such abstract concepts is arguably more complex and/or unique. While some individuals on the autism spectrum may find traditional religious practices challenging due to difficulties in social interaction and communication, there's plenty of reason to believe that others discover solace and meaning through their own distinctive forms of spiritual expression. Therefore, it's crucial to approach the study of religion in autism with sensitivity, acknowledging the diversity of experiences within the ASD population, instead of readily embracing understudied expressions or doctrines that can be dangerous. Ongoing research in this field has the potential to reveal further understanding of both autism and religious experiences, leading to a society that's not just understanding, but downright educated, empathetic, and inclusive.

The mystical effects of **PSYCHEDELICS** on the brain

Meike Jongen

Nikita Cijsouw

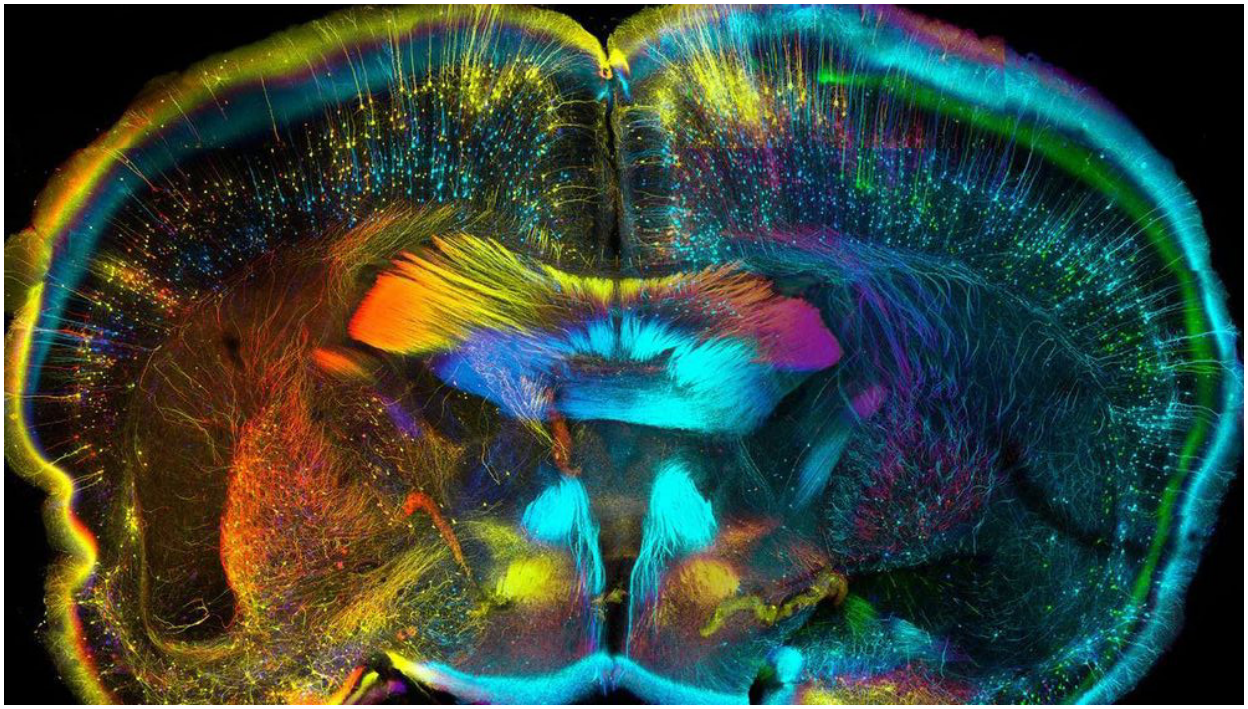
Thousands of years ago in India, a potion made of a plant named soma was thought to give Hindu gods their power and could even grant mortals immortality. Indigenous West African tribes have been practicing the spiritual discipline Bwiti for a very long time. They use a psychedelic stimulant derived from the Iboga tree as a divine medicine, which, when consumed in small doses, keeps hunters alert for long periods of time. Indigenous groups of Mexico have used the psychedelic cactus peyote for over 5000 years, which has been thought to induce supernatural visions. To this day, the Native American Church still uses it as a sacred medicine. Stories from these ancient cultures show that psychedelics have been used for thousands of years in various parts of the world and that they are deeply rooted in spiritual beliefs and ceremonies[1].

In 1979, Grinspoon and Bakalar defined classic psychedelics as "A drug which, without causing physical addiction, craving, major physiological disturbances, delirium, disorientation, or amnesia, more or less reliably produces thought, mood, and perceptual changes otherwise rarely experienced except in dreams, contemplative and religious exaltation, flashes of vivid involuntary memory, and acute psychosis."[2] Classic psychedelics can induce strong changes in subjective experience, meaning the emotional and cognitive impact of a human experience. Mystical-type experiences are one type of these subjective experiences and can be induced by the administration of classic psychedelics in optimal settings[1]. In this article, the workings of classic psychedelics in the brain and the use of classic psychedelics to invoke mystical experiences are further explored.

PSYCHEDELICS IN THE BRAIN

Classic psychedelics are compounds that have an agonistic effect on the serotonin 2A receptor (5-HT2aR)[3]. While some other serotonin receptors, like the 5-HT2c receptor and the 5-HT1a receptor, also have a role in psychedelic effects, the 5-HT2aR is thought to be the main receptor involved in classic psychedelic effects[3,4]. Subsequently, studies have shown that 5-HT2aR antagonists can block the effects of the classic psychedelic psilocybin, further proving that 5-HT2aR is involved in classic psychedelic effects[5]. Serotonin receptor activation after the binding of psychedelics activates certain immediate early genes[6]. These genes encode transcription factors, upregulating other genes that are often involved at the synapse and affect synaptic structure and neurotransmission. This mechanism is what, most likely, invokes the psychedelic effects[7].

On the level of the whole brain, under normal conditions, stable networks provide communication between brain areas. The networks include sensory, motor, and cognitive processes and seem to have features that make them unique between individuals. Separate scans from the same individual can be identified with about 99% accuracy in large scan databases; this uniqueness of an individual's scans is called a "connectome fingerprint". Identifying



someone through their connectome fingerprint is mostly dependent on the connectivity between higher-order brain regions that are involved in self-referential processing and attention[8,9]. Classic psychedelics such as psilocybin, ayahuasca, and LSD, can decrease activity within and between the normally stable networks, especially in brain regions involved in self-referential processing[10]. One of the acute effects of psychedelics is the reorganization of large-scale, long-range networks into new, local-range networks[11]. This means that the use of psychedelics, such as psilocybin and LSD, creates brain networks that are clearly distinct from brain networks during normal consciousness. These distinct brain networks seem to have increased connectivity and integration, in a way that is correlated with subjective reports of "ego"[12], possibly because the networks involved in self-referential processing have also changed. These changes in the networks are associated with subjective psychedelic effects, such as "dissolution of the self or ego" and mystical or spiritual experiences[13].

Oscillations in the brain are caused by the rhythmic and repetitive activity of neurons and are important for the communication between brain areas. Additionally, the more synchronized this activity, the higher the power. Classic psychedelics are also able to reduce broadband oscillatory power (i.e., decreased brainwave amplitude), especially in low-frequency oscillations, such as alpha oscillations[14]. Alpha oscillations are known to modulate processes like attention and information selection processes that are usually observed in higher-frequency oscillations. They influence top-down cortical control, which is necessary for integration and processing in brain networks[15]. During psilocybin-induced spiritual experiences, there are alpha oscillations between the parahippocampus, retrosplenial, and lateral orbitofrontal cortices[16]. Additionally, "disintegration of the self or ego" through psilocybin is associated with decreases in alpha power in the posterior cingulate cortex[17]. Thus, psychedelics can change electrocortical mechanisms, like decreasing alpha synchrony, which then decreases integration between networks. This may also be critical for the formation of new, temporary, local networks that are observed during the acute phase of classic psychedelic effects[11].

While classic psychedelics themselves mainly interact with the serotonin 2A receptor[3-7], the effects are further visible in network structures[8-13] and low-frequency oscillations[11,14-17]. As mentioned before, the changes in the brain that psychedelics induce can cause the "dissolution of the self or ego", meaning that a sense of union with an ultimate reality underlying all of the perceived existence replaces the normal sense of self. This loss of self is also often seen in mystical-type experiences[1].

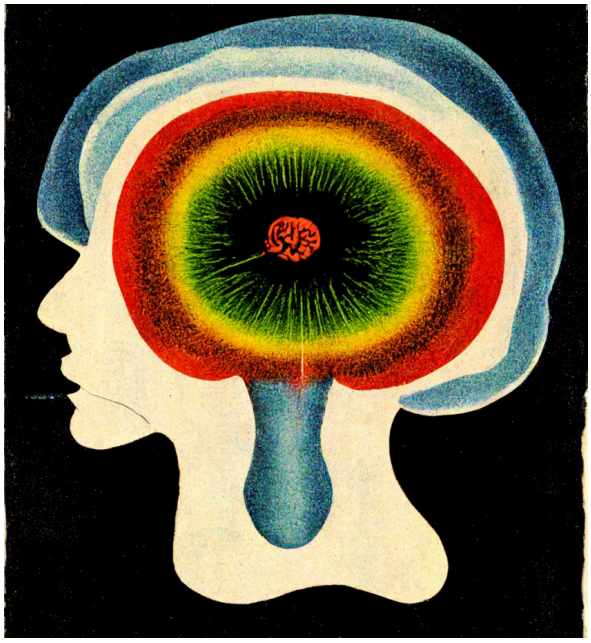
USING PSYCHEDELICS TO INVOKE MYSTICAL EXPERIENCES

Psychedelics are known to be able to help invoke mystical experiences[1]. Mystical experiences are characterized by a sense of unity with all people and things, a feeling of reverence, and an authoritative truth value. They are often associated with a profound sense of interconnectedness1. Such experiences can be associated with large and sometimes lasting changes in an individual's behavior and perception[1]. According to some, the profound sense of interconnectedness caused by mystical experiences even forms the basis of the world's ethical and moral systems[18-20]. However, these experiences can be difficult to study because they do not frequently occur and can be quite unpredictable[1].

The use of psychedelics, such as psilocybin and LSD, has been shown to increase the chances of having a mystical experience. During an early study, widely known as the Good Friday Experiment, either psilocybin or nicotinic acid was administered to seminary students[21]. Significantly more students in the psilocybin group subsequently had mystical experiences, when compared to the students in the control group[21]. The experimental design of this study has been criticized, however, because of the lack of diversity among participants and the choice of control substance. Additionally, participants were explicitly told that some would receive psilocybin while others would receive a different substance. This knowledge may have created expectancy effects, influencing the way participants interpreted and reported their experiences[1]. However, later studies with improved designs demonstrated dose-dependent increases in mystical experiences with psilocybin[22,23]. Long-term follow-ups found lasting positive changes in behavior and perception[22,23]. These findings show that psilocybin can indeed lead to increases in mystical experiences, causing lasting changes in behavior.

Although most research on mystical experiences after psychedelic use has been performed using psilocybin, some studies have used LSD or ketamine in their experiments. Similarly to psilocybin, LSD increases the occurrence of mystical experiences, in both healthy participants and patients with life-threatening diseases[24,25]. Ketamine has also been shown to produce stronger mystical-type effects than midazolam, an active control[26]. However, research on the effects of these psychedelics on mystical experiences remains limited.

In conclusion, mystical experiences can be explored thanks to the profound effects of classic psychedelics on the brain, which are demonstrated by changes in receptor activation, brain networks, and oscillatory patterns. Our understanding of the complex connection between psychedelics and the human mind is improved through the integration of historical use, cultural practices, and modern scientific research.



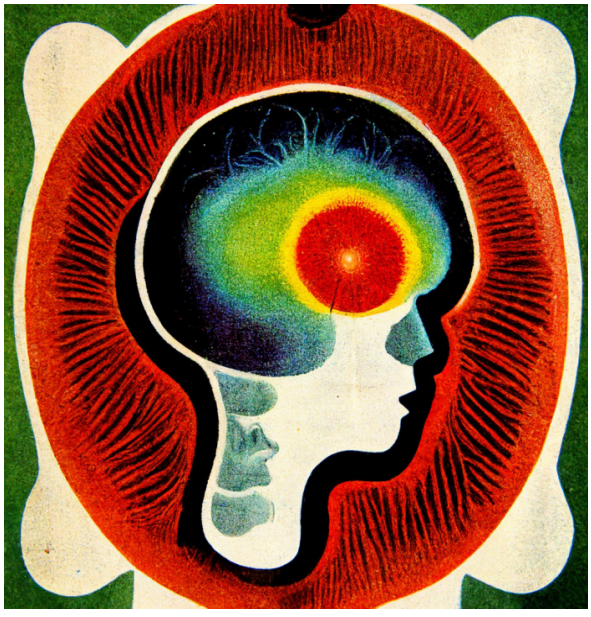



Illustration: ULALALAU
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Spirituality and Cyberspace

The Role of VR in Inducing Spiritual Experiences

Afon (Mohammad) Khari

Spirituality has been approached, historically, from diverse perspectives, ranging from religious studies (the examination of traditional rituals and beliefs) to psychology, focusing on understanding the psychological mechanisms underlying spiritual experiences. While these disciplines have contributed valuable insights, the emergence of neuroscience as a key player in this field offers a unique and effective approach, offering the ability to investigate the neural correlates of spiritual experiences and understand the mysteries of the human mind and its connection to transcendental experiences. Also, Virtual reality (VR) has been used as a novel tool in this exploration, offering opportunities to induce altered states of consciousness and simulate spiritual encounters within controlled environments[1]. This article explores VR's role in eliciting spiritual experiences, weighing its effects on neural processes and the perception of the divine. Through an exploration of VR's potential to facilitate shifts in consciousness, the intricate interplay between technology, spirituality, and the human psyche will be investigated.

Informed by the cognitive science of religion (CSOR), Hornbeck and Barrett (2008) propose that virtual reality (VR) may serve as a conduit to spiritual experiences due to parallels in cognitive processes. They argue that VR-hosted phenomena, similar to supernatural concepts, challenge intuitive expectations and trigger emotional responses, suggesting that the human mind engages with VR in a manner similar to how it interacts with spiritual or religious ideas. For instance, the phenomenon of virtual touch, as outlined by Hornbeck and Barrett, combines counterintuitive representations with strategic information to evoke emotionally resonant experiences, similar to spiritual encounters[2].

Furthermore, in the modern world, there has been a noticeable shift in spiritual practices and beliefs, with new forms of spirituality emerging alongside traditional rituals and traditions. This shows spirituality's dynamic nature and why we need to adapt research methodologies accordingly. We can better understand the universality of spiritual experiences and how they are shaped by cultural, social, and technological factors by studying the neural processes controlling old and new forms of spirituality. Viewed from the perspective of neuroscience, we can explore how VR influences the perception and manifestation of spirituality in contemporary society.

VR 'S APPLICATIONS

Virtual reality (VR) environments are considered valuable tools in neuroscience research and therapy[3] due to their capacity to utilize interactive, multimodal sensory stimuli in order to replicate real-world scenarios with high ecological validity. This allows researchers to study the effects of various stimuli on neural processes and subjective experiences. As a result

of recent advancements in VR technology, the induction of altered states of consciousness and the facilitation of spiritual experiences have been expanded. Having the ability to create highly realistic and immersive environments that can evoke psychological responses in users is one of the key aspects of VR's capacity. For example, VR experiences that simulate peaceful natural settings or ancient sacred sites can transport users to alternative realities and prompt feelings of wonder and transcendence. VR can also effectively alter users' perceptions of time, space, and self-awareness as it manipulates sensory inputs, such as visual and auditory stimuli, and facilitates the transition into altered states of consciousness.

Moreover, VR enables individuals to engage in spiritual practices and rituals in virtual environments, thereby enhancing their spiritual experiences. For instance, VR meditation applications help users immerse themselves in tranquil landscapes, which allows for deeper states of spiritual connection and mindfulness. Similarly, virtual pilgrimage experiences enable individuals to embark on spiritual journeys to holy sites around the world without leaving their homes, which fosters a sense of spiritual communion and exploration.

Also, the immersive nature of VR allows individuals to suspend disbelief and fully immerse themselves in virtual environments, hence deeper engagement with spiritual content. Additionally, personalized VR experiences cater to individual preferences and beliefs, and enhance the relevance and resonance of spiritual encounters. Finally, the emotional and psychological impact of spiritual experiences can be heightened by the sense of presence and embodiment afforded by VR technology, which leads to shifts in consciousness and perception.

Group VR experiences can produce ego attenuation and connectedness comparable to psychedelics as shown in studies such as those by Glowacki et al., suggesting VR's potential to elicit self-transcendent experiences[4]. Similarly, Navarro-Haro et al. conducted a pilot study evaluating the feasibility and acceptability of VR for facilitating mindfulness practice, which indicated promising results in reducing negative emotional states and enhancing relaxation[5]. These studies point out the diverse applications of VR in modulating psychological states and promoting introspection and its potential as a therapeutic tool in spiritual contexts.

Virtual reality (VR) has also been used as a promising tool for managing anxiety and stress, as demonstrated by studies such as Tarrant et al. (2018)[6]. Their pilot study compared a nature-based mindfulness VR experience to a resting control condition and found that both interventions significantly reduced subjective anxiety symptoms. However, uniquely, the VR intervention led to a physiological reduction in anxiety, as evidenced by shifting proportional power in EEG activity from higher to lower Beta frequencies, and a reduction in broadband Beta activity in the anterior cingulate cortex6. This suggests the VR's therapeutic potential in anxiety management and stress reduction programs. Additionally, Uyanık et al. (2022)[7] highlight the utility of EEG signals in emotion recognition within VR environments. Their study proposes an improved approach for EEG-based emotion recognition that can achieve an average accuracy of 76.22% ±2.06 in classifying positive and negative emotional states using DE features extracted from different wavebands. These

findings stress the potential of VR and EEG-based approaches in enhancing emotional well-being and mental health interventions.

THE NEUROSCIENCE OF SPIRITUAL EXPERIENCES

Spiritual experiences are characterized by a sense of interconnectedness, transcendence, and ineffability, often associated with altered states of consciousness[8]. Neuroscientific research has begun to unfold the neural correlates underlying these phenomena, and explain the mechanisms through which spiritual experiences manifest in the brain.

Bohil et al. highlighted VR's compatibility with neuroimaging techniques such as functional magnetic resonance imaging (fMRI), allowing researchers to study changes in brain activity during immersive VR experiences[3]. This convergence of VR and neuroscientific methodologies offers a promising avenue for investigating the neural substrates of spiritual encounters. Researchers can examine the complex interplay between neural processes and spiritual experiences by presenting multimodal stimuli in VR environments, thereby advancing our comprehension of the human psyche's transcendental dimensions.

For example, studies investigating the effects of meditation, a practice often linked to spiritual experiences, have shown distinct patterns of brain activation. fMRI scans of individuals engaged in meditation have indicated increased activity in regions of the brain associated with attention, self-awareness, and emotional regulation, such as the prefrontal cortex and insula. This suggests that meditation may modulate neural pathways involved in subjective experiences of spirituality, which in turn leads to feelings of connectedness, transcendence, and inner peace.

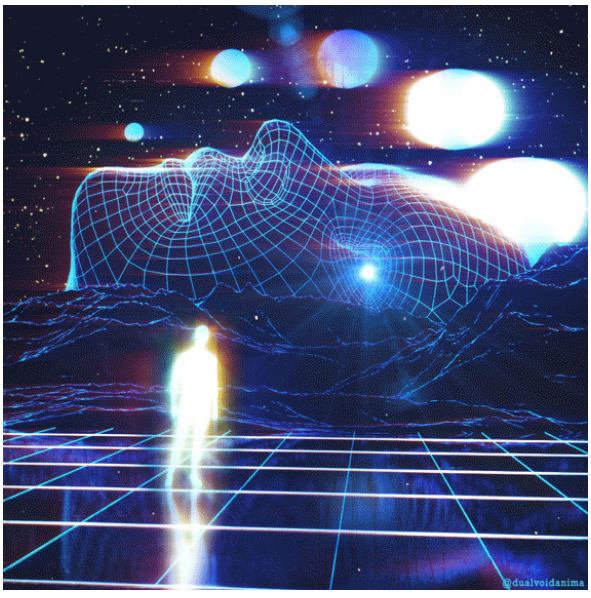
Furthermore, research exploring the neural basis of religious rituals has uncovered insights into the brain mechanisms underlying religious experiences. These findings suggest that religious rituals may evoke profound shifts in brain function to reach heightened states of spiritual awareness and connection to the divine. For instance, studies examining the brain activity of individuals engaged in religious rituals, such as prayer or chanting, have exhibited alterations in neural connectivity and activity within regions implicated in social cognition, reward processing, and emotional regulation.

Moreover, investigations into the effects of psychedelics have shown the neurochemical and neural mechanisms underlying altered states of consciousness and highlighted the potential role of neurotransmitter systems such as serotonin and glutamate in mediating spiritual experiences and suggested avenues for further research into the neurobiology of spirituality. Studies using fMRI and other neuroimaging techniques have revealed changes in brain activity and connectivity following psychedelic administration, particularly in regions involved in perception, emotion, and self-referential processing.

EXAMINING THE IMPACT OF VIRTUAL ENVIRONMENTS ON NEURAL PROCESSES

Virtual environments' ability to create highly immersive and customizable simulations makes them unique platforms for studying the impact of environmental stimuli on neural processes and subjective experiences. Unlike traditional laboratory settings, virtual environments can:

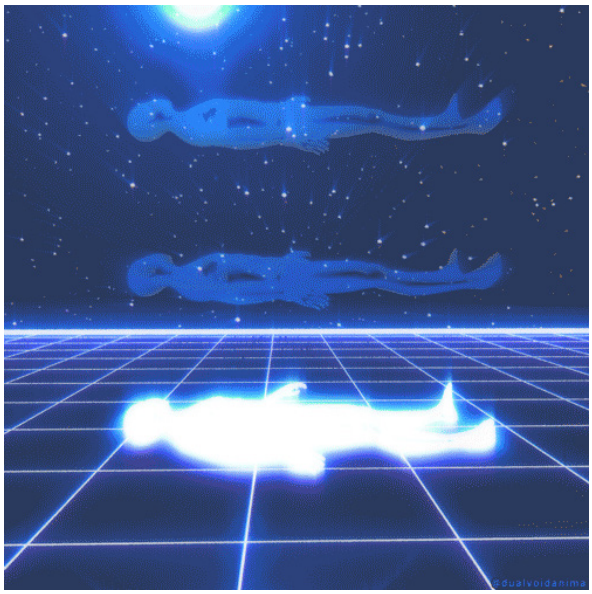
- Replicate diverse real-world scenarios with unprecedented reliability and control, allowing researchers to precisely manipulate environmental variables and study their effects on brain activity and behavior,
- Offer the flexibility to create novel and challenging stimuli that may not be feasible or ethical to replicate in real life, enabling researchers to explore a wide range of experimental paradigms and hypotheses,



- Be tailored to individual preferences and characteristics, facilitating personalized interventions and experiences for participants.

Glowacki et al. developed the Isnessdistributed (Isness-D) VR framework as a means to explore the therapeutic potential of experiential phenomenology, particularly in eliciting self-transcendent experiences (STEs) similar to those induced by psychedelic drugs[4]. Isness-D leverages the immersive nature of VR to blur conventional self-other boundaries, which enables participants to transcend their individual identities and experience a sense of interconnectedness and unity with others. This framework facilitates collective experiences within shared virtual spaces, where participants perceive their bodies as luminous energetic essences with diffuse spatial boundaries. By creating moments of 'energetic coalescence,' Isness-D fosters a new class of embodied intersubjective experiences and allows individuals to fluidly merge with others and include multiple perspectives within their self-representation, providing the opportunity to explore the neural mechanisms underlying self-transcendence and connectedness in laboratory settings. Isness-D has demonstrated its efficacy in eliciting mystical-type experiences (MTEs) comparable to those induced by psychedelic drugs through rigorous evaluation and analysis, which emphasizes its relevance and potential impact in the field of neuroscience and spirituality.

Furthermore, recent research, such as the study conducted by Mostajeran et al., has provided convincing evidence of the positive impact of exposure



to immersive virtual nature environments on both affective and cognitive domains[9]. In their experiment involving 27 participants, exposure to a 3D model of a typical forest environment in virtual reality resulted in notable improvements in cognitive performance, as measured by trail-making tests and digit span tests, compared to a control environment. Moreover, participants reported higher levels of perceived restorativeness and positive affect after experiencing the virtual nature environment, which implies that virtual environments can not only enhance cognitive functioning but also positively influence mood and subjective well-being.

The therapeutic potential of virtual environments in promoting overall mental health and emotional well-being offers innovative approaches for interventions aimed at improving mood and cognitive function.

THE ROLE OF PRESENCE IN VIRTUAL REALITY EXPERIENCES

Slattery emphasizes the parallel between virtual reSlattery emphasizes the parallel between virtual reality experiences and altered states of consciousness induced by psychedelic substances[10]. She suggests that the perceptual shifts and suspension of disbelief required to enter virtual worlds mirror the cognitive processes involved in psychedelic experiences. This technoetic perspective emphasizes the impact of VR on subjective consciousness and suggests that such environments can elicit experiences similar to those encountered during psychedelic journeys. VR has the potential to facilitate spiritual experiences by altering the neural processes underlying subjective consciousness by immersing users in virtual environments that challenge conventional perceptions of reality.

Moreover, the study done by Riva and colleagues on affective interactions using VR highlights the crucial role of presence in eliciting emotional responses within virtual environments[11]. The study demonstrates that VR's ability to induce a sense of presence contributes significantly to its effectiveness as an affective medium as participants interacting with emotionally charged virtual environments reported experiencing corresponding emotional states. This circular interaction between presence and emotions suggests that VR has the capability to modulate emotional states by manipulating the level of presence experienced by

users. Overall, these findings provide further evidence of VR's capacity to induce emotional and cognitive experiences, offering new ways to understand the intersection of technology, consciousness, and spirituality.

ETHICAL CONSIDERATIONS AND FUTURE DIRECTIONS

While VR holds great promise in inducing spiritual experiences and explaining the neural mechanisms underlying consciousness, ethical considerations must be carefully addressed. Hill-Smith emphasized the transformative potential of cyberpilgrimage experiences and the need to ensure their authenticity and integrity in the digital realm[12]. As VR technologies continue to evolve, it is imperative to maintain ethical standards and safeguard against potential misuse or exploitation.

Future research directions in this growing field may involve exploring the therapeutic applications of VR in spiritual practices, such as meditation and mindfulness training. Arai et al. proposed leveraging VR and augmented reality (AR) technologies to create immersive environments informed by spiritual traditions, facilitating introspection and self-transcendence[13]. By integrating biofeedback and adaptive environments, researchers can tailor VR experiences to individuals' unique psychological and spiritual needs.

Building on that, Chaudhary (2019) explores how augmented reality (AR) technologies, like virtual reality (VR), blur the lines between the real and digital worlds. As AR evolves, it offers tools for creating immersive experiences, similar to VR, democratizing content creation. Moreover, the integration of AI in AR environments, as envisioned by Chaudhary, holds the potential to re-enchant the world. By incorporating advanced AI agents, such as digital avatars, into AR experiences, human perception of reality may be reshaped, ushering in a new era where technology and enchantment converge[14].

In conclusion, virtual reality offers unprecedented opportunities to explore the neuroscience of spirituality and induce altered states of consciousness. By harnessing the immersive nature of VR, researchers can study the neural processes underlying spiritual experiences and their therapeutic potential in promoting well-being and personal growth. As VR technology continues to advance, it holds promise as a transformative tool for exploring the depths of the human mind and its connection to the divine.

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SINCE 1953

DR. SIDDHARTH RAMAKRISHNAN:

" I'm fascinated by the transactional psychology of what's going on when the tarot reader is interpreting the cards while the listener is interpreting them in their own way."

Kate Schwarz-Roman

Dr. Siddharth Ramakrishnan is a Neuroscientist, and the Jennie M. Caruthers Chair in Neuroscience at the University of Puget Sound in Washington, USA. Ramakrishnan's expertise spans electrophysiology, animal models, bio-electronic devices, and cellular membranes. A Fellow of the UCLA Art/Sci Center, his collaborations with artists have led to exhibitions and documentaries that blend the worlds of art and science. He is the creator of NeuroTarot, a deck of tarot cards with neuroscience-related imagery for users to "gain insight using the imagery, while also learning something about the brain". His book, 'The Neuroscience of Tarot: From Imagery to Intuition to Prediction' will be released this November 2024.

Tarot cards, often regarded as a mystical tool of divination, originally stems from a mid-fifteenth-century deck of playing cards with Italian roots [1]. The allure of tarot has changed with the modern use expanding beyond divination into the realm of mindfulness, self-reflection, spiritual guidance, decision-making, and creative inspiration. A standard 78-card deck comprises of the Major Arcana (22 cards) with names and associated symbols ranging from the 'The Moon', 'The Sun', and 'The Stars' to 'Death', 'The Wheel of Fortune', and 'The Lovers'. With a Minor Arcana (56 cards) comprising of four suits; modernly referred to as Cups, Swords, Wands, and Pentacles, each suit has numbers ace through 10, a Page, Knight, Queen, and King. Commonly,

a card is pulled with the intention of a question at hand. It is then up to the reader to interpret the advice or story the card provides. For example, pulling the three of swords, an image of a heart with three daggers piercing it, may suggest you are enduring heartbreak. As a neuroscience student and practicing tarot reader, my mind is in a constant battle; questioning if it is just a high statistical probability of pulling cards that have accurately reflected my questions or if I am communicating with forces beyond my conscious understanding. I had the privilege to sit down with Dr. Ramakrishnan to discuss what might be going on inside the brain when we read and interpret these cards.

What parts of our brain are involved and, what processes, are happening at each step of a tarot reading?

Well, you first pull a card, it goes to the retina and then the occipital lobe. At that point, you do not even recognize anything, you just get a photographic image of the picture in front of you. It goes to your temporal and then the parietal lobe, which are where associations and recognition of the object happen. Then from these lobes, it goes into your hippocampus to start getting images and metaphors aligned. This is where your language center gets involved in attaching words to meaning. That's all within the first stage of 'What does this card look like' and 'What could it mean'?

We then move into the cingulate cortex where the integration of this information is going to happen. The intuitive bit is coming from the caudate nucleus. Your caudate nucleus will use unconscious information to make that leap into the next step. So, if I'm making a choice - or the example I used in my book is; I went to buy a house and intuitively knew that this was the place I wanted... Why did I know it? It's almost like blind decision-making is happening at the caudate nucleus. You're integrating information from previous associative matrices. Meanwhile, your orbital frontal cortex provides you with information on your current internal emotional state. You're putting it together very quickly - they say that the time difference between an intuitive decision and a more logical step-by-step decision is almost 8 seconds. This is quite significant in terms of evolution. We need to make those quick life-or-death decisions, which is why we have intuitive processing. Your insight is more of a reflection on what you have just seen. You might go back and say, why am I interpreting this card this way? That's the frontal lobe thinking and rationalizing the leap (to understanding how you interpreted the image). Your intuition seems to be involved with the cingulate cortex. Then your interoception involves more of the insular and your amygdala. It will feed into that emotional center of your orbital frontal cortex. It will tell you, my heart is beating fast or my stomach is feeling tight, which probably means I'm anxious. All of that information is being fed in to adjust your experience.

> ***"Intuition seems to be involved with the cingulate cortex, and interoception involves more of the insular cortex and amygdala."***

Your background is very interdisciplinary with work on animal models, electrophysiology, cellular research, and biotechnology - how did you get to the point of investigating and writing about tarot cards?

I didn't hear about tarot until my 20s - I came to the US and my sister sent me a deck of tarot cards. I had been a practicing neuroscientist and at the same time, we were reading a lot of tarot together. So, I've always wondered, what am I doing when I am reading these cards? What was going on in my head? The primary motivation for the book was trying to grapple with, that it's only an image, it's just a 2D image...but still, it can evoke so many stories and narratives in us. I have been trying to parse out how we get from viewing these figures to creating an actual interpretation. And, whether there was any scientific literature on those kinds of things, and surprisingly, there was. Not specifically for tarot but for a lot of other intuitive abilities.

Are you primarily looking at intuition?

The book walks through perception first. When you look at an image on a card; how is it perceived and then how do you form associative metaphors? How does it then evoke mental imagery? When I close my eyes I'm not going to see the actual image, I might see a little bit of it, but I'm also making my own narratives and associative images. I then talk about intuition and insight; for example, when you're a very young surgeon who's not got a lot of practice, you might be following the book, whereas if you're an expert you kind of rely more on the feel of things. You will just know that something is different or off. It's similar to a tarot reader - when you're starting, you rely on the little book to look up the meanings, but after some time you don't need to look at the book constantly. Then, we talk a lot about interoception; how do you feel when you look at the card? If you shuffle and split the deck into the three and you pick one, do you force yourself to take that instinctual one, or another card? You can feel your heart racing differently during these moments. So, I am trying to tease apart these things, to see how someone is making those decisions, and how those decisions feed into their intuition. Finally, we wrap it up with some interesting new research on neuro-forecasting. For example, when asked which song will be the most popular six months from now, you might say it will be 'song A', but your brain activity might be saying 'song D'. Researchers find that the activity associated with 'song D' is pointing towards the song that will be the most popular[2]. You can see this using songs, stock markets, or which movies will be the best, by crowd-sourcing that information[3].

> ***"When you have to choose a tarot card, you are listening to your body, and you can intentionally notice your heartbeat."***

I notice that if I am drawn towards a specific card and I deny myself choosing it, I feel discomfort and end up going with my original intuitive choice.

Yeah - you're just very attuned to your body. If you break it down, you can intentionally notice your heartbeat. We have the ability to tell someone exactly how many beats per minute they have. If you start noticing it, when you have to choose a card, you are listening to your body, which is really fascinating.

Is that like how my body might know the decision before my mind makes the decision?

This effect can be shown in two or three different areas of the brain. The nucleus accumbens is associated with positive reward and behavior suggesting you know already before you consciously know. Our avoidance behavior is where your insular and amygdala have already decided that this is not something you want to move forward with or buy, even before you consciously tell anybody about it. But the minute the insular gets involved... The insular receives your body signals and is where your mental representation of internal structures is. So, the minute you say the insular is involved, that means inherently your body knows it is important.

When I am reading I am often quite surprised with how well the card applies to the question I asked. What does confirmation bias have to do with reading tarot?

I'm sure that there is some confirmation bias because ultimately your brain is the one that interprets the card. The issue I find is when you are doing a reading for someone else. We talk a little in the book about social cognition and how there is the reader who is interpreting it and the querent who is receiving the information. What is the dichotomy between that? And is the questioner actually prepared to receive some of those answers? It seems two parts of your brain are in competition with each other about this - your default mode network and your fronto-parietal network. The default mode network plans for the future actions and choices you are going to make. Whereas your fronto-parietal network is applying the roadblocks; saying, this makes no sense to me, I don't believe your interpretation, it

must be something else. So, it's almost a competition between the two that decides how you are going to interpret a particular reading. I find it very fascinating and complex to see how all of these groups of research kind of come together in a reading!

I struggle with this - giving other people readings. I know they may interpret the cards differently because I do not know how it is relevant to their lives.

I have learned from other tarot readers, meeting them at conferences, tips on giving others readings. A nice technique is to ask the questioner what they see in the card, what stands out for them. Then use that as a cue to interpret the cards. They will be looking at it very differently than you are, which again, ties into that social cognition aspect.

What you are speaking about is a phenomenon called mentalizing and our ability to mirror. If I see you looking sad, then I might change my face to mirror the response of your emotions. We then have other structures in our brain that do mentalizing. You're not only thinking about what is making you sad or what situations could arise, but also you may be thinking about how the person comes to you, their tone of voice, and the questions they ask. They are creating those mental narratives of what it means for them while you are mentalizing to understand their behavior. This is kind of one of the roots of empathy.

What are you most interested in when researching tarot?

I am fascinated by this social aspect of it. I would really like to understand what is happening when the tarot reader is interpreting the cards while the listener is interpreting them in their own way. Instead of the individual, I'm fascinated by the transactional psychology of what's going on. Or what goes on when one thing is said and it changes how another person perceives it. That's what I would really like to explore.

How do you approach discussion with scientists when they may feel topics like tarot and spirituality are too woo-woo?

I've been thinking about this a lot and the way I'm approaching it for discussion with scientists is to think about the younger generation. They are saying that there are more young people who believe in spiritual practices and esoteric practices than they believe in science. A lot of this is because of rising uncertainty in the world. People with uncertainty in their lives will tend to rely more on faith and spiritual-based practices. So if you believe in scientific thinking, to be able to talk about it to younger people, you need to explore these questions. Otherwise, you're just isolating a whole segment of society.

> ***"People with uncertainty in their lives will tend to rely more on faith and spiritual-based practices."***

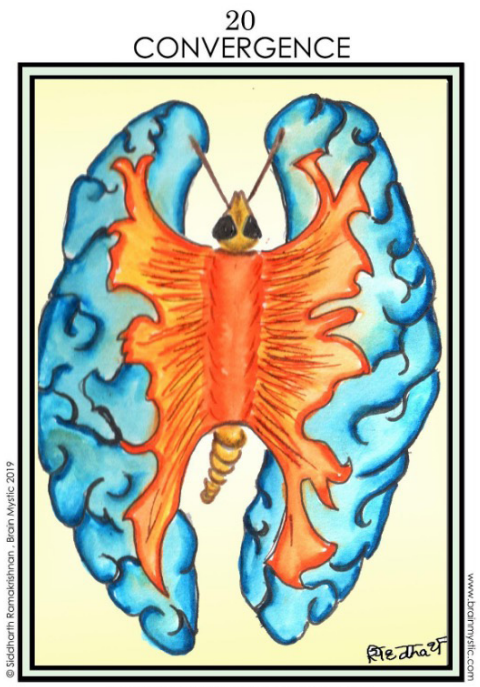
The other thing is a lot of scientific thinking and the scientific method is a colonial practice. It is a way of experimentation that people have undertaken and over time has gotten so much power that they have ignored indigenous practices and knowledge that's been generated for thousands of years. Pretty much every religion you think about like Hinduism, Jainism, Buddhism, Catholicism, Jesuit, or Islam with Sufism, all delve into mystic questioning and ask: what is consciousness? and, what does it mean to be transcendent? They have been teasing it apart in small minute bits. So, there is a wealth of information out there being ignored because the scientific way of knowing is considered to be the only way of knowing. I think a lot of scientists are coming around to the fact that it's not the only way of knowing, or I hope that is where it is headed. Especially with all of the research coming out on psychedelic practices. I'm hoping that this will also allow a more open exploration of civic spirituality. Finally, I think with technology it is just easier now

to explore things like what's happening in the brain when you are meditating. It is just becoming more possible to ask those larger questions.

What's your advice for someone entering a career in neuroscience?

I would say, if you have other interests, don't lose them. When I started my PhD, I became involved with the art-science network. There's definitely groups of people out there who think beyond the traditional scientific or humanistic boundaries. I think if you want to find a home at the intersections - you should be able to! I also think that, going forward a lot of knowledge is easily available, so I think folks at the intersections of disciplines is where the real interesting investigation is going to happen. I mean, neuroscience by itself is inherently interdisciplinary... But to answer those large questions like what is consciousness? what is being human? I don't think you can answer those with the productionist method. We have other ways of looking at things and I hope the new generation will be able to fit things together in a more design thinking ethos.

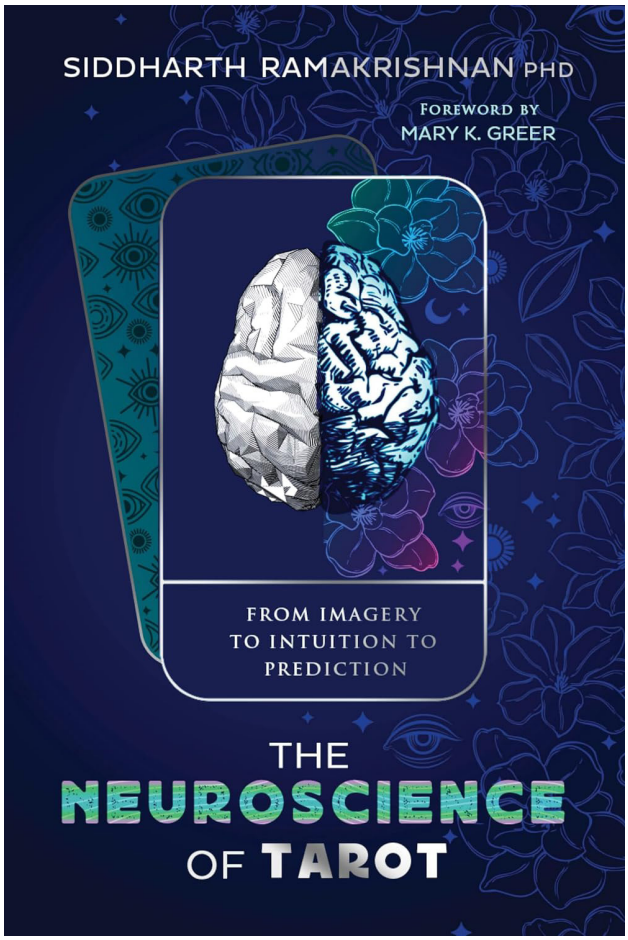
This interview was edited and condensed for clarity.



CORPUS CALLOSUM

Like a butterfly needs both wings to fly freely, we need both sides of the brain. The corpus callosum interfaces the two cerebral hemispheres

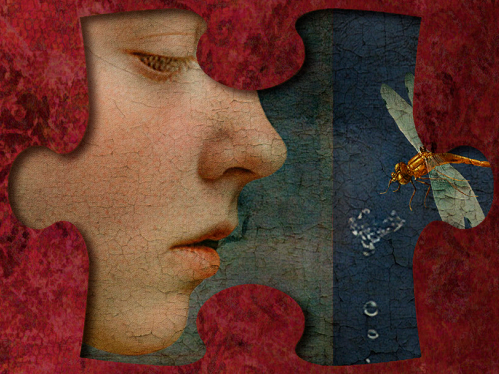
Dr. Ramakrishnan's version of the 'Judgement' tarot card in his NeuroTarot card deck.



Do you want to know more about The Neuroscience of Tarot: From Imagery to Intuition to Prediction?
Scan the QR

Through sacred rites we seek to intertwine
Our essence with the pulse of nature's song.
In every leaf, in every pine,
We find the echoes of where we belong.

Eventually, in the union of the earth and soul,
The spirit finds its home, forever whole.



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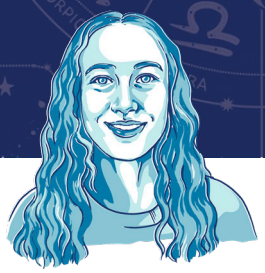
HOROSCOPE
& The Barnum effect

Meike Jongen



Nikita Cijsouw

What fate is written for you in the stars? Even if you don't strongly believe in astrology, it's still fun to read what your zodiac sign or birth chart says about you. It's especially fun if a horoscope just happens to describe you or your life perfectly, making you think "That's so me!" In these cases, the Barnum effect is most likely at play.

According to the Encyclopedia Britannica, "the Barnum effect is the phenomenon that occurs when individuals believe that personality descriptions apply specifically to them (more so than to other people), despite the fact that the description is actually filled with information that applies to everyone[1]." The acceptance of these "Barnum statements" has been researched quite a lot in relation to astrology and horoscopes. In one study[2], high school students were given a Barnum profile, supposedly written by an expert astrologer, and 54% of the students found the profiles to be an excellent description of their personalities, with 92% rating the profiles at least good. Even people who are skeptical about astrology are likely to accept Barnum statements or horoscopes, as long as they're positive enough[3].

However, Barnum acceptance is more than just gullibility. Instead, believing in horoscopes and the Barnum effect seems to be more of an information-processing bias where people can't discriminate between unique and universal character descriptions[4,5]. So even if horoscopes are not exactly cold-hard science, one question remains: what do the stars say about your future as a neuroscientist? Find out here!

ARIES

March 21 - April 19

Aries, it looks like your rival from a different lab is closing in on a big publication. Focus your energies on wrapping up your data analysis and solidifying your findings before they beat you to the punch. Your competitive spirit will help you excel in the race of scientific discovery.

TAURUS

April 20 - May 20

Wealth and prosperity are coming your way, Taurus! Your lab will be granted all the funds you have applied to. Your stubborn determination and patience have finally paid off. Now you can access all the resources you need to set up successful experiments!

GEMINI

May 21 - June 21

Brace yourself for an unexpected setback, Gemini, because the recruitment of participants for your new experiment will not go as quickly as you had anticipated. Stay patient and optimistic, for soon enough, they'll trickle in, allowing you to proceed smoothly with your research. Trust in the resilience of your plans; success is just around the corner.

CANCER

June 22 - July -22

Cancer, your supervisor has given you some negative feedback about your experiments lately. However, you should not let this negativity get the best of you! With your creativity and intuition, you are more than capable of adjusting your experiments until both you and your supervisor are happy with them.

LEO

July 23 - August 22

Leo, as a passionate and ambitious leader you have successfully led your team to a scientific breakthrough! Although your results were not exactly what you expected, your hard work will soon be rewarded. The only thing left to do, is to write everything down. This will definitely be an article in a top journal!

VIRGO

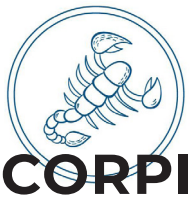
August 23 - September 22

Virgo, this will be a very significant time for you, like $p<0.001$ significant! Because you are not only a logical but also a practical thinker, your experiments turned out great. Keep working diligently and more success will await you in the future!

LIBRA

September 23 - October 23

Libra, beware of your new supervisor's attempts to pile extra tasks on top of your normal workload. Stand firm and assert your boundaries; don't let them exploit your goodwill. Remember your worth and ensure that any additional workload aligns with your capabilities and priorities.



SCORPIO

October 24 - November 21

Scorpio, you will find yourself tasked with reviewing an article featuring a questionable experimental setup. Despite pressure from the author to rush your decision, maintain your integrity and evaluate the work critically. Trust your judgment; don't allow anyone to undermine your credibility or rush your decision-making process.

SAGITTARIUS

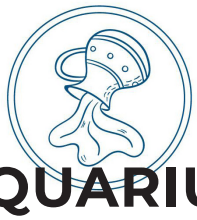
November 22 - December 21

New adventures lie ahead of you, Sagittarius! A research position opened up abroad and it sounds exactly like the adventure you were waiting for! With your lively and passionate spirit, this will be a great adventure for you, both personally and professionally!

CAPRICORN

December 22 - January 19

Capricorn, it is time to celebrate! After enduring pushback and incorporating feedback from both peer reviewers and editors, your article has finally been approved for publication. Take a moment to bask in this achievement and recognize the perseverance that led you to this point. Your dedication and resilience have paid off, and you should indeed be proud of your accomplishments.



AQUARIUS

January 20 - February 18

Be careful, Aquarius; the stars have shown that your experiments might not turn out as planned. Thankfully, you are an innovative and assertive person who is more than capable of turning the tables around and dealing with any possible problems so that, in the end, you still succeed!

PISCES

February 19 - March 20

Although you may not be the best of friends with your current colleagues, you should not worry, Pisces. Change is on the horizon as your supervisor prepares to bring in a new PhD student. According to the stars, you will instantly connect with this new colleague, and since you are both intuitive and compassionate scientists, your collaboration will likely lead to a nicer working environment for everyone in the lab and maybe even some major experimental findings.

ALUMNI RESEARCH

Beyond the spiritual brain

Welcome to this special section of our journal, where we investigate the intersection of spirituality and neuroscience further. This section emerges from the rich tradition of inquiry cultivated by the students within or related to our program, which reflects their ongoing dedication to understanding the complexities of the human mind. In this issue, we present a collection of thought-provoking articles that study the spiritual dimensions of brain function. Our selection showcases diverse perspectives and methodologies and offers insights into how spiritual practices and experiences interface with cognitive processes.

Kai Schüren's investigation into the impact of meditation on episodic memory opens the discussion by examining the potential cognitive benefits of mindfulness practices and clarifies the promising yet nuanced findings in this field. Ana Deutsch's exploration of psychedelic-induced mystical experiences widens the lens and explores the deep psychological and therapeutic implications of altered states of consciousness. This piece invites us to reconsider conventional understandings of subjective experiences within scientific inquiry. Kaya Lücker's study challenges conventional wisdom by proposing a positive perspective on mind wandering and suggests that this seemingly disruptive cognitive phenomenon may play a role in memory consolidation and neural restoration. Franck Porteous studies the dynamics of interpersonal communication and investigates how emotional sharing influences inter-brain synchrony during conversation and offers fresh insights into the neural underpinnings of social interaction. It also highlights the complex interplay between emotion, cognition, and social bonding. Francesca van Baarzel's research explores the fascinating link between interoceptive sensibility and gut microbiota and unveils potential connections between bodily awareness and microbial diversity. This piece opens new avenues for understanding the complex interplay between mind, body, and environment by bridging the domains of psychology and biology.

As you read these articles, we invite you to join us in exploring the captivating interface between spirituality and neuroscience, where ancient wisdom meets cutting-edge research.

The Impact of Meditation on Episodic Memory - Mindful Awareness of the Past, Present and Future
KAI SCHÜREN - LITERATURE THESIS

The practice of meditation and the associated mental state of mindfulness awareness have become a popular topic in western cognitive research. Among treatment potential for psychological disorders, meditation and mindfulness have been related to enhanced attention and memory. Recent scientific literature has increasingly focused meditation implications on human episodic memory, which is centred around self-experience in time and space. Hypothetically, this quality of episodic memory is likely to be shaped by meditation routines, which cultivate non-judgemental awareness for present moment experiences. Here, recent behavioural and neuroscientific research articles related to the topic were reviewed to establish whether mindfulness could indeed enhance episodic memory. The results of the empirical studies included in this literature review vaguely indicate beneficial effects of meditation and mindfulness awareness on episodic memory retrieval. However, discrepancies between the study designs and replicability issues call for caution in the interpretation of these findings. An interdisciplinary integration with Buddhist and Hindu traditional teachings is proposed in addition to a critical discussion of the methodology and confounding aspects of attention and stress in the articles reviewed.

Psychedelic-induced Mystical Experiences: Relationship to Positive Outcomes and Role in Psychedelic Science
ANA DEUTSCH - LITERATURE THESIS

Mystical experiences induced by classic psychedelics have received a lot of attention in the scientific community as important factors driving the success of psychedelic-assisted therapy. This thesis reviews evidence for a mediating role of mystical experiences in achieving positive clinical outcomes for a variety of disorders, namely substance use disorders, depression, and cancer-related anxiety and distress, as well as for improving wellbeing and life-satisfaction in healthy populations. While these experiences have repeatedly been found to be correlated to positive outcomes, other aspects of the subjective psychedelic experience might play an equally or even more important role. The contribution of psychological insight and emotional breakthrough is also presented, and a model that incorporates all these factors is suggested. This work also addresses an ongoing debate in the field on whether science should study mystical experiences, and whether the beneficial effects of psychedelics can be dissociated from such subjective effects. Perspective from philosophy and neuroscience are used to argue in favor of studying mystical experiences.

The positive effect of mind wandering: during local sleep, our mind wanders to consolidate memory
KAYA LÜCKER - LITERATURE THESIS

Mind wandering (MW) is often associated with a disruption of our ongoing cognitive processes resulting in impaired performance. But since MW is demonstrated to be highly prevalent in daily live, a growing number of researchers try to find positive effects of mind wandering that explain its evolutionary purpose. In this review we will propose a theoretical framework that complements and unifies literature and proposes a positive effect of mind wandering. Our framework suggests that mind wandering might be a result of local use-dependent sleep in task relevant brain areas. This local sleep might enable a suppression of perceptual processes and induce sharp wave ripples to facilitate a MW brain state while consolidating memories and restoring brain processes. The memory consolidation during mind wandering explains the prevalent and sudden occurrence of MW episodes and changes the traditional negative association of MW into a positive and useful brain mechanism.

A*ssessing the Influence of Emotional Sharing on Inter-Brain Synchrony During Conversation with EEG Hyperscanning*

FRANCK PORTEOUS - RESEARCH PROJECT

The ability to entertain conversations with one another is essential for constructing a social world. Conversations present people with a multimodal sensory context that fosters reciprocity and where shared content influences the underlying neural activity of both parties in the interaction. The present study investigates how sharing an emotional versus neutral conversation affects co-occurring interbrain synchrony. We ask whether the emotional nature of the conversation leads to different amounts of inter-brain synchrony compared to neutral conversations. This study narrows its investigation by focusing on the canonical beta frequency band, which is well associated with sensorimotor neural activity and associates it with behavioral measures of turn-taking. We parametrize the power spectra of 35 dyads to extract data-driven criteria relative to neural beta activity and precise our inter-brain synchrony analysis with these criteria. We find no difference in computed inter-brain synchrony across conversation contexts but note that turn-taking instances are significantly higher during neutral sharing. Given the results, future research is suggested to better characterize how emotional sharing influences neural beta activity and subsequent behavior during conversation and how these, in conjunction, weigh in with measured IBC.

The Relationship between Interoceptive Sensibility and Gut-Microbiota in Healthy Subject

FRANCESCA VAN BAARZEL

Objective: Interoceptive sensibility, one's believe of accurate interoception, is a prerequisite for healthy psychological functioning. In the search of contributors to interoceptive sensibility, the gut-brain axis presents itself as a potential candidate. However, no research haslooked into the relationship between interoceptive sensibility and the gut-microbiota yet. Presumably, interoceptive sensibility, Prevotella-to-Bacteroides (P/B) ratio and gut-microbial
diversity are all positively associated with each other.
Method: Seven participants filled out the Multi-Dimensional Assessment of Interoceptive Awareness (MAIA) in order to assess interoceptive sensibility. Fecal samples were collected to determine their fecal microbiome composition through 16s RNA sequencing. Gut-microbial diversity was calculated (Shannon index) as well as P/B ratio.
Results: Positive correlations were found between Shannon index and MAIA subscale scores (expect for Noticing). Only, the correlation between Shannon index and Trusting was significant. Non-significant negative associations were found between the P/B ratio and MAIA subscale scores with the exception of Not-Distracting and Not-Worrying. Lastly, a negative non-significant correlation was found between the Shannon index and P/B ratio.
Conclusion: This study suggests future confirmative research into the relationship between the gut-microbiota and interoceptive sensibility in healthy subjects. Interoceptive sensibility may be positively associated with gut-microbial diversity, whilst negatively associated with Prevotella-to-Bacteroides ratio. Also, gut-microbial diversity and Prevotella-to-Bacteroides ratio might be negatively associated. No affirmative conclusions can be drawn from this study.

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A Look at the *Why* in Spirituality

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Notes

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