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## THE NEUROCOGNITIVE FOUNDATIONS OF PRAYER: A CRITICAL ANALYSIS\*

The state of modern science and the development of research show that the last decades may have witnessed a neuroscientific revolution. The success of this field demonstrates that science has gradually incorporated successive areas of reality into its experimental investigations. On the one hand, such a situation has enabled a broader and deeper study of many phenomena which, until recently, could only be fathomed through philosophical speculation. On the other hand, it has often been necessary to redefine these phenomena in a reductionist spirit, so that they could become objects of scientific research, hence the danger of them losing their very nature and becoming something subtly (or even much more) different. In both situations it is clearly visible that there is a need for intersubjective communicability of every discipline that tries to elucidate a particular phenomenon.

### INTRODUCTION

One of the newer areas of research to emerge in recent decades is neurotheology, developed by Andrew B. Newberg, and the neuroscience of spirituality, the popularisers of which are Mario Beauregard and Wayne B. Jonas. Both fields<sup>1</sup>

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<sup>1</sup> It is not easy to establish the differences in objective, terminology, and research methodology between the two disciplines. In the most general sense, I will use both terms interchangeably in the text. Cf. KYRIACOU 2018.

have supporters as well as opponents in the scientific world. In the article “Towards Neuroscience of Spirituality,” Wayne B. Jonas (2011, 253–262) attempts to define and outline a new area of research: the neuroscience of spirituality. He writes that the research of the neural should be conducted when the subject experiences the attributes of the divine (e.g., in a mystical experience) and that this should be one of the first studies to be undertaken by the neuroscience of spirituality to be able to determine its validity. If the neural patterns of stimulation were the same for neuronal research on spirituality as for research undertaken by neuropsychology (the study of mental phenomena), the two fields would perhaps be identical. However, if these patterns were different, developing a new field of cognition might be justified. It seems that Mario Beauregard’s (BEAUREGARD and PAQUETTE 2006, 186–190; BEAUREGARD and PAQUETTE 2008, 1–4) neurophysiological research on the functioning of the brain under the conditions of a mystical experience indicates different patterns of stimulation in the two research situations mentioned by Jonas.

Nevertheless, critics of the above-mentioned fields emphasize that the research conducted within them can be successfully carried out within other, traditional disciplines.

The current situation in the disciplines taking interest in the human brain, mind, and consciousness is undeniably related to the development of neuroimaging methods (such as PET, SPECT, and fMRI).<sup>2</sup> There is a strong tendency to look for neuronal correlates of all phenomena occurring in our psyche. This seems to be particularly true for manifestations of human spirituality such as religious meditation, prayer, mystical states, and experiences. The problem of mystical states in the context of neurobiological research has been discussed elsewhere (HERDA 2015, 137–153). Here, we are especially interested in the phenomenon of prayer.

It should be emphasized that the issues raised in this work are not novel to science and characteristic only of this day and age. Neither is it anything new to attempt to pinpoint the neurological base of prayer and meditation. Contemplations of religiosity and its various aspects, before being undertaken by natural sciences, were a subject of interest in psychology. In the first half of the twentieth century, the attitude of psychologists of religion to attempts at explaining religious experiences from the perspective of biology was at least critical (e.g., Hermann Faber, Theodor Lipps, Werner Gruehn), due to, among other things, the risk of reductionism (WULFF 1999, 111). The problem of whether religious

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<sup>2</sup> A critical position on this matter is presented by Robert G. Shulman (2013, 4–5).

experiences should be studied through the prism of their physiological conditions existed at least at the turn of the 18th and 19th centuries, when the psychologist Théodore Flournoy encouraged such searches (WULFF 2014, 1–6). However, the research itself is much older. One may mention here, for example, the works of Emanuel Swedenborg from 1749, in which he analyses the existence of good and bad spirits in human life in the context of the functioning of the brain (WULFF 1999, 111).

Nowadays, cognitive scientists attempt to define neurocognitive basis of religious beliefs and practices. One can observe that religious beliefs are shaped early in childhood without any instructions from others. That is one of the reasons for the scientists to acknowledge that this kind of beliefs is based on natural cognitive abilities. They see them as such at the laboratory. On the other hand, philosophers ask the question how the results of scientific experiments influence the problem of rationality of religious beliefs if we accept that they arise from natural cognitive processes (DE CRUZ and DE SMEDT 2023, 14). It shows strongly the necessity of intersubjectively communicability of notions, definitions, theories and results of scientific investigations especially in the face of differences in methodologies of disciplines interesting in explaining the religious phenomena. The article is an attempt at a critical review of chosen neurocognitive findings about religious practice such as prayer in connection with the religious experience it evokes and also their implications for other areas of investigation (like philosophy of religion or theology).

The structure of the article is as follows. Firstly, some attempts and difficulties related to defining the studied phenomenon, religious experience and prayer in particular will be presented. Secondly, quite detailed analyses of selected experiments and empirical research in the field of neurological correlates and cognitive foundations of prayer will be outlined. Finally, some research results will be analysed in various context and selected implications for future studies will be highlighted.

## CONCEPTS AND TERMS

It is difficult to clearly define the phenomenon of prayer, considering various cultural and religious contexts. In this work, we narrow down the analysis to the circle of Christian culture, and here, encounter various definitions too.<sup>3</sup> For Saint

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<sup>3</sup> In this article, as already mentioned, I discuss the issue of prayer in the context of the Christian religion. References to other religions and philosophical systems appear only from the perspective of identifying possible similarities or differences which appear during specific experimental research.

Teresa of the Infant Jesus, prayer is ascension of the heart, a straight glance towards heaven, an exclamation of gratitude and love, both in suffering and in joy (cf. CCC 2558<sup>4</sup>). Emphasis is placed on the psychological aspect of the prayer, especially emotional and relational ones. Saint John Damascene defines prayer as raising the soul to God or a request directed to him for granting fitting goods (cf. CCC 2559). He employs the notions as God and soul. They are clearly religious terms, not scientific ones.. The Catechism of the Catholic Church says: “Where does prayer come from? Whether prayer is expressed in words or gestures, it is the whole man who prays. But in naming the source of prayer, Scripture speaks sometimes of the soul or the spirit, but most often of the heart (more than a thousand times). According to Scripture, it is the heart that prays. If our heart is far from God, the words of prayer are in vain.” (CCC 2562). In Christianity, prayer is also a covenant relationship between God and the human being in Christ (CCC 2564). The Catechism of the Catholic Church, as the core of catholic faith, underlines a relationship between a human being and God who is belied to be a personal being in Christianity. William James, on the other hand, described prayer as a kind of inner communion or conversation with a power believed to be divine (JAMES 2011, 357; cf. WULFF 1999, 111.). He believed that in prayer, we deal with real religion which is manifested through experiencing divinity.

The terms created on the ground of the theology of spirituality emphasize a particularly emotional relationship between God and the human being in which God, as the omnipotent and transcendent creator, is also the person whom the human being addresses and expects an answer from. The human being experiences God’s intervention in their own life as well. A Christian’s life can become a prayer if he remains in the presence of God (cf. CCC 2565). Prayer understood in this way becomes a kind of religious experience in which a person experiences contact with a deity. On the other hand, it is a type of religious practice that affects the entirety of a person’s life. In each case, we are dealing with a situation of a relationship with the person who is the object of faith, and so this person is as real for the person praying as they themselves are.

The above term cannot, for obvious reasons, constitute the basis of the phenomenon studied by natural sciences.<sup>5</sup> When undertaking experiments, science has

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<sup>4</sup> “For me, prayer is a surge of the heart; it is a simple look turned toward heaven, it is a cry of recognition and of love, embracing both trial and joy.” St. Therese of Lisieux, *Manuscrits autobiographiques*, C 25r.

<sup>5</sup> Harald Walach argues that spirituality as a way of experiencing is an object of interest to science (WALACH 2011, 1–21).

to create an operational definition of the phenomenon, which will establish research methods and pose questions which are cognitively interesting. According to a psychologist of religion, David M. Wulff, prayer is a spoken, sometimes formal address to a deity, an element of which is often a heartfelt petition (WULFF 1999, 161). In the field of neurotheology, prayer is defined as one of the spiritual experiences, next to meditation. Prayer can be a type of meditation if, as Andrew B. Newberg (2011, 156) points out, it is performed in an animated and repetitive manner. Proper prayer is also used as one of the methods of introducing one into spiritual experiences, including mystical ones.

In general, it can be said that prayer is one of the types of religious practices that is often connected with spiritual experiences, so, it is a phenomenon for which one can seek neuronal correlates. Some elements which are foreign to science must be omitted in a term coined for scientific research, e.g., the presence of a transcendent personal God (the question is how we can know about the existence of God), or the existence of a spiritual soul which is a separate being, in a sense independent from the material brain. So we can define prayer as a specific kind of religious practice often altogether with spiritual experience that can be characterized by specific neuronal pattern found as a result of neuroscientific investigation.

#### MODELS OF NEURONAL CORRELATES OF RELIGIOUS EXPERIENCES AND PRACTICES

Like any other mental activity, prayer is also associated with specific patterns of neuronal stimulation. Even though, as highlighted by Andrew B. Newberg (2011, 154), there is no causal relationship between the functioning of the brain and spiritual experiences, it is the neurobiological research that provides a new and, at the same time, critical research perspective. The fundamental assumption in the experiments undertaken in neurotheology is that both phenomenological and neurophysiological information is essential for a complete understanding of religious experiences or practices. The adoption of a purely religious or scientific worldview impoverishes our perception of the world to a one-sided perspective.

One of the essential objectives of the neuroscience of spirituality is to identify the neuronal correlates of all the activities and states which determine the state of a person's religious life. Several standpoints are present here, which Newberg terms "models of brain activity." In the context of spirituality, some researchers assign a unique role to the temporal lobes because, among others, in this area, the

elements of the limbic system are located, such as the amygdala and hippocampus, which are mainly responsible for emotional responses and memory. They contribute to social interactions, such as caring for offspring and creating lasting bonds with others. The temporal lobes also participate in functions related to cognition and linguistic abilities. One may encounter opinions whereby the temporal lobes are responsible for the so-called “brain module of God”.<sup>6</sup> The temporal lobe is particularly predisposed as a candidate for a spirituality correlate because of the location of epileptogenic foci in *temporal lobe epilepsy* (TLE), which has often been referred to as sacred disease (especially “Dostoyevsky epilepsy”: ecstatic seizures).<sup>7</sup> The hypothesis regarding possible epilepsy can be seen when an attempt is made to explain the extract from the Acts of the Apostles recounting the conversion of Paul of Tarsus. According to the supporters of this hypothesis, the concomitant symptoms in Paul’s behaviour indicate a clear neurological basis for his experiences and are characteristic of temporal-lobe epilepsy seizures (LANDSBOROUGH 1987, 659–664). Arthur Stern, a neurologist, has a different attitude. He claims that the one-time event near Damascus and the conversation between Paul and Jesus, which is too complicated for the epileptic aura, in no way justify a thesis about any of the Apostle’s epileptic seizures (cf. *ibid.*).<sup>8</sup> For the first time, a correlation between temporal lobe epilepsy and religious experiences was noticed in the late 19th century by James C. Howden (1873, 491–497; cf. DEWHURST and BEARD 2003, 78–87), who found a patient with TLE to be religiously converted after having had the experience of being carried to heaven as a result of a generalized epileptic attack. In 1899, another case of religious experience in the context of epilepsy was reported. This

<sup>6</sup> Recent research rather points to a dispersed model of neuronal correlates of religious practices, so there is no specific structure that we could define as a God module in the brain. Cf. ALBRIGHT 2003, 735–744).

<sup>7</sup> Jerzy Vetulani states that “it is believed that Dostoyevsky’s epilepsy was of great importance for the creation of religious systems. People suffering from them are characterized by the so-called Geschwind syndrome. Its symptoms are:

1. Hypergraphia—a tendency towards excessive writing or verbal communication of one’s thoughts and beliefs.

2. Viscosity—striving to have a group of faithful students spreading the idea.

3. Propensity for outbursts of temporary anger (usually without application of violence).

4. Hyper-religiosity—great interest in the matters of religion and morality, creating appropriate laws.

5. Extreme approach to sexuality—complete renunciation of sexual activity or a very promiscuous lifestyle. We can assume that this type of epilepsy is not a disease, but a feature which facilitates, thanks to the increased activity of the brain, learning about certain matters which are unattainable to an average mind.” (VETULANI 2011). See COLES 2013.

<sup>8</sup> James Brorson and Kathleen Brewer undertake discussion with D. Landsborough’s theses. See: BRORSON and BREWER 1988, 886–887.

concerned a patient who, after an epileptic seizure, claimed that God had entrusted him with the mission of revealing God's law to the world. The studies using neuroimaging methods, conducted by William P. Spartling in 1904, indicate that 4% of patients with temporal-lobe epilepsy show an increased interest in religion within hours or days following the seizure (following Beauregard 2011, 57-73). Other studies indicate that 0.4-3.1% of TLE patients describe religious experiences during a seizure and 2.2% after an epileptic seizure.<sup>9</sup> According to their subjective feeling, the patients claim that these are experiences of God's presence, visions of God and the saints, and God's voice, heard by them. However, considering the research results, it may turn out that finding any strong correlations between TLE and religious experiences is an overly hasty conclusion. Experiments that attempt to induce magnetic stimulation of these parts of the brain cortex (e.g., the *God helmet* by Michael Persinger<sup>10</sup>) may shed some light on the potential connection between abnormalities in the temporal brain region and religious experiences. However, so far, no confirmed and unequivocal conclusions on this topic have emerged.

Another group of researchers is more in favour of recognizing the frontal lobes as neuronal correlates of spirituality. Andrew B. Newberg (2011, 172) recalls that early research concerning meditation indicated activity in the frontal lobes. Like the temporal lobes, these areas have an essential role in implementing speech and regulating emotions. Patrick McNamara (2011, 62) stresses that the frontal lobes are significant in experiencing the decentralization of the *self*, which seems to be fundamental in religious experiences and practices, where we deal with a more powerful reality transcending a human being. Still, it is difficult, especially from

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<sup>9</sup> Eliot Slater and Alfred William Bear indicate that religious experiences occur much more often in patients with temporal epilepsy. As a result of the conducted research, they established that 26 out of 69 examined patients exhibited various symptoms of religiosity because of TLE. Cf. DEWHURST and BEARD 2003, 78–87. Also compare the results of other studies: DEVINSKY and LAI 2008, 636–643.

<sup>10</sup> Michael Persinger and his team conducted an experiment to show that mystical experiences can be artificially induced by influencing the temporal lobe with a weak electromagnetic field (in right, left, or both hemispheres). Forty-eight students participated in the study. They were divided into four groups, three of which were exposed to an electromagnetic field with a value of 1 microtesla ( $\mu\text{T}$ ). The fourth group was the control group. All the participants were told that they would be exposed to a weak electromagnetic field. As a result of the experiment, it turned out that three-fourths of the study participants in the test groups claimed that they had felt someone's presence during the experiment. However, as many as one-third of the people in the control group had similar experiences. In addition, more unusual sensations appeared in those who had their right hemisphere stimulated or both hemispheres stimulated than in those who only had the left hemisphere of the brain stimulated. In 2005, Pehr Granqvist's attempt to repeat Persinger's experiment was unsuccessful (this time, the experiment was carried out in double-blind conditions, which was not used in Persinger's experiment). Cf. BEAUREGARD 2011, 57–73.

the perspective of knowledge about the functioning of other brain areas, to search for biological correlates of spirituality only in the frontal lobes.

It seems that adopting an integrated model of neural correlates of religious experiences and practices is the most legitimate solution, especially considering the complexity of these phenomena. Emphasis is placed on the potential involvement of various brain structures in realising spiritual mental states such as the temporal, frontal, and parietal lobes, elements of the autonomic nervous system, the limbic system as well as the thalamus and basal ganglia. It is impossible to identify one specific centre, because of the relationships between various brain areas, e.g., the activity of the frontal lobes affects the functioning of the thalamus and the limbic system, and the thalamus interacts with the frontal lobes, creating an attention network.

#### PRAYER IN THE CONTEXT OF EXPERIMENTAL NEUROSCIENTIFIC RESEARCH

While looking for neuronal correlates of religious practices and experiences, one can concurrently reduce these phenomena to the level of biology and acknowledge that they are nothing other than the result of specific brain activity, just as foam is the result of sea wave impacts, without being an autonomous unit. It can also be assumed that these phenomena arise from the interaction between the functioning of the human brain and the culture it creates (cf. SCHJØDT et al. 2009, 199-207). However, some representatives of neurotheology acknowledge that religious experiences can be something real, something which happens in human existential reality. In such a case, people assign meaning to this aspect of their life. Ismael Apud and István Czachesz underline that social sciences are “the ones that allow us to attribute a religious or sacred quality to an experience.” (APUD and CZACHESZ 2019, 338–362). However, neurocognitive sciences try to explore the field by recording the brain’s functioning in specific situations like praying, meditating or mystical experience. Moreover, as stressed by Apud and Czachesz, many different psychological perspectives see religious experience as something distinguished from other conscious experiences (ibid.). What is important, scientific investigation of different aspects of religiosity can make them more objective, interpersonal communicable and interchangeable.

Uffe Schjødt (cf. SCHJØDT et al. 2009, 199-207) and his research team attempted to design and conduct a study on brain activity during religious practices, in which the interaction between social cognition and religious faith is visible. They considered prayer to be the best example of such practices. Realis-

ing that there are various types of prayer, they took into consideration only two: spontaneous prayer and formalized prayer in the form of a specific formula. Considering various traditions and denominations, they deemed this division of prayers to be the most basic and universal one. They assumed that in both cases brain activity would differ in such a way that, in the context of spontaneous prayer, the areas of the brain which are related to social cognition would be much more active, such as the anterior medial prefrontal cortex, Brodmann area 38, and the temporal-parietal junction. Such a pattern of activity is dictated by the fact that a praying person establishes a relationship with a divine entity being real to them, and which they expect to be able to answer their requests. These areas should, according to the authors of the study, be less active in the case of a formalized prayer, because this type of prayer involves reciting some fairly abstract formulas and lacks content with a personal reference.

Twenty people (14 women and 6 men), aged 21 to 32, took part in the experiment (SCHJØDT et al. 2008, 165–168). They were Danish Orthodox Christians: members of a Protestant church called the *Inner Mission* (Danish: *Indre Mission*). Their orthodoxy manifests itself especially through religious practices, in which they, or at least the older generation, remain hermetic to various charismatic influences. The experimental and control conditions were defined as follows: in the experimental conditions, the subjects were asked to pray in a formalized manner, by reciting the *Our Father* prayer, as well as spontaneously. In the control conditions, on the other hand, the subjects either recited a known nursery rhyme or asked Santa Claus for various things for Christmas. The subjects performed five tasks, each of which lasted thirty seconds and was repeated six times. All prayers and recitations were performed in silence while each subject lay in an fMRI<sup>11</sup> scanner. All the participants of the study declared faith in God

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<sup>11</sup> The fMRI (functional magnetic resonance) method is directly related to the discovery of the phenomenon of nuclear resonance by Felix Bloch and Edward Purcell in the 1940s, for which they received the Nobel Prize in 1962. The study subject is placed in a strong magnetic field. Under its influence, the protons in the atoms in which the number of these particles is odd, align with the direction of the external field. Then, these protons break out of equilibrium with a short electromagnetic pulse with a frequency that causes resonance (radio frequency). As a result of the EM pulse, the proton begins to rotate, which causes the emission of radio waves with a frequency equal to the precession frequency. After the impulse ceases, the proton aligns itself again with the field direction and the sent radio signal weakens. The returned signal is captured by a scanner, and since each tissue returns a signal with slightly different characteristics, it is possible to distinguish between various tissues and brain structures. After processing the signal, it is possible to visualize a given cross-section of the brain. This procedure captures the state of the various chemicals present in the brain. It turns out that the blood containing oxygen has magnetic properties different from the blood devoid of oxygen. The presence of deoxygenated blood (*deoxyhaemoglobin*) amplifies the

and a lack of faith in Santa Claus. Everyone also prayed in both a formalized and spontaneous way daily, with varying frequency. Moreover, all the participants believed that God, in one way or another, answers their prayers.

The results of the study carried out using functional magnetic resonance imaging demonstrate that the areas of the brain which were activated, especially during spontaneous prayer, were the *praecuneus*,<sup>12</sup> Brodmann area 38, the left temporoparietal junction, and the left medial prefrontal cortex (MPFC) (SCHJØDT et al. 2009, 199–207). The areas active during a formalized prayer were the right dorsolateral prefrontal cortex, the right parietal cortex, the left part of the cerebellum, and the posterior part of the lower temporal cortex (ibid.).

STRUCTURE OF THE BRAIN	FUNCTIONS
praecuneus (cf. CAVANNA and TRIMBLE 2006, 564–583)	creativity, capability of self-reflection, so-called lucid dreams, episodic memory, visual-spatial coordination, conscious information processing
left Brodmann area 38 (Latin: <i>temporopolar cortex</i> ) (Brodmann's Interactive Atlas; Brodmannarea.info; CHABARDÉS 2005, 1818–1831)	temporal lobe epilepsy, theory of mind (social cognition), autobiographical memory, storage of sensory impressions
left temporoparietal junction (SCHJØDT et al., 2009, 199–207)	processing information related to social cognition, e.g., causes and purposes of behaviour
left medial prefrontal cortex (MPFC) (GROSSMANN 2013, 1–6; EUSTON et al. 2012, 1057–1070)	theory of mind, planning of actions, processing information related to the consequences of behaviour, control of emotional states
right dorsolateral prefrontal cortex (MANNARELLI et al., 2015)	metamemory, formulating cognitive assessments, switching categories, flexibility in approaching various situations, extracting information from long-term memory, moving the focus of attention, engaging attention at the new target
right parietal cortex (cf. MALHOTRA et al. 2009, 645–660)	working memory related to spatial orientation, imagination, system of reference in relation to one's own body based on visual impressions, deliberate movements
cerebellum	coordination of deliberate movements, regulation

signal emitted by the water molecules clustered around the blood vessels and thus becomes a natural contrast to the MRI signal. This phenomenon was described in the early 1990s by Seiji Ogawa, who called it blood-oxygen-level-dependent contrast. The signal is the starting point for mapping the activation of brain structures induced by cognitive activity.

<sup>12</sup> It is the structure of the brain within the parietal lobe. It lies at the junction of both hemispheres of the brain. Cf. CAVANNA and TRIMBLE 2006, 564–583.

(cf. MALHOTRA et al. 2009, 645-660)	of muscle tension, memory of certain reflexes
the posterior part of the lower temporal cortex ("Inferior temporal cortex". Scholarpedia)	object recognition, visual information analysis

The results confirmed the earlier assumptions that the pattern of neuronal activity for spontaneous prayers covers three areas characteristic of the theory of mind, and thus social cognition.<sup>13</sup> For this reason, researchers compare this type of prayer (interaction with a being believed to be God) to typical human interactions, where God takes the place of a real entity. Other studies have shown that the left medial prefrontal cortex (MPFC) as well as the temporoparietal junction are areas which are activated during human interactions, as opposed to human-computer interactions (SCHJØDT et al. 2009, 199–207). While the posterior MPFC is specifically related to the processing of one's own and others' intentions, there are signs that the temporoparietal junction is more involved in analysing behaviour, social causes, and adopted goals (ibid.). The activity of the praecuneus, on the other hand, may indicate the processing of information about oneself – one's own expectations, desires, emotions – and, therefore, factors which are deeply rooted in the context of prayer.<sup>14</sup>

Other studies in the field of the neuroscience of spirituality have been conducted by Nina Azari (AZARI et al., 2001, 564–613) and her team. They scanned the brains of twelve Christian fundamentalists (members of the Evangelical Church in Germany) as they recited Psalm 23 from the Bible using the PET<sup>15</sup> method, while they observed the activity of the praecuneus, the dorso-medial frontal cortex, the dorsolateral prefrontal cortex, and the medial parietal cortex: areas responsible for self-reflection and visual memory as well as planning and evaluating actions and behaviours. The results led the researchers to conclude that religious experiences are a type of cognitive process for which neuronal correlates can be identified. These results obtained, and the fact that people usual-

<sup>13</sup> The areas specific to information processing in the field of social cognition do not become active during formalized prayer, such as *Our Father*.

<sup>14</sup> Such aspects also arise in many other circumstances, which is why the praecuneus activity was also observed when formulating requests to Santa Claus.

<sup>15</sup> The positron emission tomography (PET) method is one of the tomographic methods of examining internal organs. Here, images of the cross-sections of the examined organs are obtained thanks to the use of X-rays. A marker is introduced into the blood of the examined person—a substance containing a radioactive element (15O, 18F, or other). This element emits a positron during its decay (identical to the electron, but with the opposite electric charge). The emitted positrons collide with encountered electrons, which causes annihilation and emission of two quanta of gamma rays. The radiation is recorded by detectors placed around the head, which allows for creating a map of a given organ and indicates places with lower and higher blood supply.

ly turn to religion in difficult situations that they cannot deal with themselves, show, according to Azari and her team, that humans have a certain natural predisposition towards religious experiences (AZARI et al., 2001, 1649-1652).

Using the PET method, Andrew Newberg and his colleagues conducted a similar experiment on Christians reciting the Rosary (BULBULIA and SLINGERLAND 2012, 564–613). They concluded that this type of prayer (much like eastern meditation)<sup>16</sup> is correlated to the activity of areas in the brain which are responsible for the functions of our attention, spatial orientation, and planning. It also turned out that Christian prayer (as opposed to eastern meditation) activates a neuronal pattern responsible for focusing one's attention on a particular object. As a result of the experiments they conducted, the researchers also found that various types of Christian prayer (e.g., praying in tongues, reciting the Rosary) activate different areas of the brain, which is in line with the research conducted by Uffe Schjødt's team.

It is difficult to clearly interpret the data obtained by neuroimaging methods, especially in view of the fact that they help us investigate mental phenomena only indirectly (see SHULMAN 2013, 4-5). Uffe Schjødt and his team emphasize that it is difficult to formulate an answer to the fundamental question of whether the activity of the brain areas involved in social cognition is the result of belief in the existence of God, or rather the expectation of receiving an answer from God to one's prayer. However, it seems unlikely that one would expect an answer from God without believing in his existence in the first place. The first condition is, therefore, necessary (but not sufficient) for the occurrence of the second condition. Researchers indicate that, in view of the doubts mentioned above, the experiment ought to be slightly modified. Next to God and Santa Claus, a third addressee should appear – a real person (e.g., a parent) – who, for obvious reasons, would not be able to answer the requests directed at them. They predict that in this third situation, they would observe activity within the MPFC, as it is speculated to be responsible for sensing the reality of a particular object. The temporoparietal junction, however, would most likely remain inactive since it is thought to control the expectation of a response from our interlocutor (SCHJØDT et al. 2009, 199-207).

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<sup>16</sup> Research on various types of meditation is presented by Thilo Hinterberger and his team. See HINTERBERGER et al. 2011, 129-155.

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## CONCLUSIONS

Analyzing the results of selected experiments in the field of cognitive research on religious practices, several general statements can be formulated. First, religious practices are the result of the normal functioning of human cognitive processes shaped by evolutionary mechanisms. Second, acquiring and holding religious beliefs and engaging in religious practices are based on the same cognitive mechanisms as other mental and cognitive behaviours. Third, from the point of view of the cognitive science of religion, religious behaviour is normal human behaviour.

Taking the above into consideration, it can be stated without any controversy that today the problem is not the question of whether prayer or any other religious experience has its neuronal correlates, as every experience has been characterized by a certain pattern of neuronal stimulation (it possesses its own representation). The question is whether resorting to neurocognitive science in the context of prayer provides cognitively valuable answers about the nature of the phenomenon. One may ask if the knowledge about the stimulation of specific brain regions during a prayer brings anything new and essential to the attempts at understanding it. Furthermore, another question can be asked about the risks, legitimacy, and grounds for reducing prayer (and, therefore, the reality of religious faith) to the level of biological correlates and the functioning of the nervous system.<sup>17</sup>

William James emphasized in 1902 that religious states may have a real physiological base, but the knowledge of their correlates tells us nothing about their role in spirituality (WULFF 1999, 111). On the other hand, David M. Wulff, a psychologist of religion, states that probably, there is no need to convince any reader that neurophysiology plays the greatest role in producing the most spectacular of the phenomena discussed here, but apart from such a generalization, it would be difficult to force us to define exactly what is happening in the brain in such cases (*ibid.*, 110). As Patrick McNamara said, “Although cognitive neuroscience has much to offer to the scientific study of religion or religion studies, religion, in turn, has much to teach the cognitive neuroscientists.” (MCNAMARA 2009, x).

As can be seen clearly, prayer today, as well as other religious experiences and practices, is becoming one of the interdisciplinary issues in the explanation of which neuroscience and cognitive science play a significant role (despite all

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<sup>17</sup> Of course, in the literature there are numerous attempts to explain religiosity in a naturalistic way, e.g., the works of Richard Dawkins, Daniel Dennett, or Sam Harris (e.g. DAWKINS 2006).

the reservations).<sup>18</sup> This is the point at which it is no longer possible to conduct partial research in different fields of knowledge (like neurocognitive science of religion on one side and disciplines like philosophy of religion or religious studies on the other), between which there will be no information exchange and collaboration. It is difficult not to agree with Czachesz (see APUD and CZACHESZ 2019) who underlines that in religious experiences there are many factors like neurological, cognitive, historical, social, and cultural which interact. Therefore, it is necessary to develop a specific cognitive platform equipped with a terminological dictionary, intersubjectively communicable both for a theologians, social scientists and philosophers as well as for a neuropsychologists, neurobiologists, and neurocognitive scientists. Otherwise, neurocognitive research will have little importance outside neurocognitive science, and theological inquiry outside theology.

The results of neurocognitive experiments discovering the neural correlates of religious experiences may provide important premises for explaining religious beliefs on the basis of the cognitive science of religion (CSR). It can be an important factor in answering the question whether religious belief is an adaptation or merely an evolutionary by-product in the ongoing discussion between the CSR supporters and those who advocate for the evolutionary theory of religion.

As De Cruz and De Smedt (2023, 13–14) note, until recently, CSR representatives dealt with religious practices and folk religious beliefs. Currently, however, they are also examining the cognitive basis of formal religious beliefs, which raises the question of whether religious beliefs can be considered rational if they arise as a result of natural cognitive processes. This reveals another large area of discussion between cognitivists of religion and representatives of natural theology.

If we talk about prayer as a religious practice, it is worth noting that people practicing it believe that their prayer is addressed to someone with whom they can enter into dialogue. Therefore, the question arises again about the content and rationality of religious beliefs. The discussion on this topic can take place on various philosophical ground. By adopting moderate naturalism, we assume neither theism nor metaphysical naturalism, which opens the door for discussion about the cognitive processes underlying religious beliefs (without having to reduce the latter) and their rationality. It is obvious that science based on methodological naturalism cannot assume the existence of a divine being as a basis for recognizing the rationality of religious beliefs or explaining the phenomenon of religion with its practices. One way might be to examine the natural features of human cognition in the context of religion from a perspective that provides more

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<sup>18</sup> As Helen De Cruz and Johan De Smedt notice that neurocognitive scientists have already managed to naturalize the phenomenon of religion. See DE CRUZ and DE SMEDT, 2023, 14.

possibilities, such as non-reductive emergentism. We can talk here about functional emergentism. However, in the context of mental phenomena based on evolutionarily shaped neural processes, psychophysical emergence seems promising, as researchers note. However, due to the limited scope of the article, a detailed analysis of this concept remains material for future work.

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THE NEUROCOGNITIVE FOUNDATIONS OF PRAYER:  
A CRITICAL ANALYSIS

## Summary

In recent decades, there has been a significant increase in the interest taken by experimental researchers in issues that have traditionally belonged to the sphere of interest of the philosophy of mind, the philosophy of cognition, and even the theology of spirituality. The availability of new research methods, as well as the increase in the knowledge of the world, has opened another door to the reality in which we live. By studying the functioning of the human brain in specific laboratory conditions, scientists are looking for the answers to questions that have been troubling us for centuries: what consciousness is, how do we recognize intentions, and what are spiritual experiences?

This article deals with the topic of prayer as a specific religious experience in the context of neurocognitive research. In the 20th and 21st centuries, the frequency of such studies has increased

significantly; for example, through the experiments of Nina Azari, Mario Beauregard, and Andrew B. Newberg. Selected experiments in the field of the neuroscience of spirituality and their results are discussed. Important philosophical questions about how we define prayer and other spiritual experiences in the context of the above research, the interdisciplinary nature of the research, as well as emerging problems and implications, e.g., the risk of reducing these phenomena to their biological base, the explanations of religious practices and experiences in cognitive science of religion have also been raised.

**Keywords:** prayer; spiritual experiences; religion; neurobiology; neurocognitive science; brain, neuroimaging methods; neuronal correlates.

## KRYTYCZNA ANALIZA NEUROKOGNITYWNYCH PODSTAW MODLITWY

### Streszczenie

W ostatnich dziesięcioleciach nastąpił znaczny wzrost zainteresowania badaczy eksperymentalnych zagadnieniami, które tradycyjnie należały do kręgu zainteresowań filozofii umysłu, filozofii poznania, a nawet teologii duchowości. Dostępność nowych metod badawczych, a także wzrost wiedzy o świecie otworzyły kolejne drzwi do rzeczywistości, w której żyjemy. Badając funkcjonowanie ludzkiego mózgu w specyficznych warunkach laboratoryjnych, naukowcy szukają odpowiedzi na nurtujące nas od wieków pytania: czym jest świadomość, jak rozpoznajemy intencje i czym są doświadczenia duchowe?

Artykuł podejmuje temat modlitwy jako specyficznego doświadczenia religijnego w kontekście badań neurokognitywistycznych. W XX i XXI wieku częstotliwość takich badań znacznie wzrosła; na przykład poprzez eksperymenty Niny Azari, Mario Beauregarda i Andrew B. Newberga. Omówiono wybrane eksperymenty z zakresu neuronauki duchowości i ich wyniki. W tekście postawiono ważne pytania filozoficzne o to, jak definiujemy modlitwę i inne doświadczenia duchowe w kontekście powyższych badań, o interdyscyplinarność badań, a także o pojawiające się problemy i implikacje, np. ryzyko sprowadzenia tych zjawisk do ich podłoża biologicznego. Poruszono także tematykę kognitywistycznego wyjaśnienia doświadczeń i praktyk religijnych.

**Słowa kluczowe:** modlitwa; doświadczenia duchowe; religia; neurobiologia; neurokognitywistyka; mózg, metody neuroobrazowania; korelacje neuronalne

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