

**"CAROL DAVILA" UNIVERSITY OF MEDICINE AND PHARMACY
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**THE NEUROSCIENCES OF THE SPIRITUAL LIFE
Summary**

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LIST OF ABBREVIATIONS AND SYMBOLS

sAA	Salivary alpha-amylase
sC	Salivary cortisol
sIgA	Salivary immunoglobulin A
sIL-6	Salivary interleukin 6
sIL-8	Salivary interleukin 8
PE	Prayer experience
SE	Spiritual experience
SRE	Spiritual / Religious experience
CSTE	Christian spiritual/religious experiences
TPJ	Temporo-Parietal Junction
KLM	Loving Kindness Meditation
M	Mindfulness
TM	Transcendental meditation
OM	Open meditation (equivalent for mindfulness)
CN	Cognitive Neurosciences
CS	Cognitive Sciences
CSR	The Cognitive Sciences of Religion
TTE	Testosterone
EG	Experimental Group
CG	Control Group
sO	Salivary oxytocin
PCOT	Prayer in the Christian-Orthodox Tradition
S/R	Spiritual/Religious
SAI	The state of anxiety inventory
sT	salivary Testosterone
TCI	Temperament and Character Inventory
TEC	The tradition of Eastern Christianity

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INTRODUCTION

The overlapping of RSE and the sphere of medical sciences is an extensive topic in the history of medicine, with distinct periods of practice, discoveries, cultural and geographic particularities. Chronologically, we are dealing with several religious traditions and medical practices in the great cultures of the world, in the great civilizations of history, such as Ancient Greece, China, Egypt or the Roman Empire. However, psycho-medical approaches to S/RE have been outlined in a more consistent manner since the 1970s, through the development of neuro and cognitive sciences. In this new context, while also facilitated by non-invasive imaging technologies, various traditional spiritual or religious practices (yoga, zen, various forms of Buddhist meditation, Christian prayer), but also mental practices recently configured by specialist practitioners, have been ever more thoroughly examined, with the intention of offering new therapeutic procedures (this category could include the relaxation response, MBSR – *mindfulness based stress reduction* or compassion meditation).

In recent decades, neuroscientific approaches to S/RE have developed considerably, aiming to examine aspects such as the nature and particularities of S/RE experiences, neuro-localization, physiological imprints and, of course, their therapeutic potential, in various psychiatric, cardiovascular or immune conditions. At the same time, however, important epistemological and/or methodological obstacles were also identified, such as the difficulty of rigorous, precise scientific definition of key terms such as spirituality or religion, establishing the scientific framework for approaching transcendental reality, on which SRE is based, the management of subjective factors, which come into play in the personal experience of S/R nature.

In the General Part of the paper, we review, systematically and succinctly, the discoveries that contributed to shaping the area of neuroscience of spiritual life (NSL), but also an inventory of the most important results, which strengthened the interest of medical sciences in the neurophysiological and psychometric exploration of SRE. A brief inventory of neuroscientific studies that have examined Christian SRE and those oriented toward the evaluation of Christian prayer practice according to the Orthodox tradition (CPPTO) is also included here.

In the special part, dedicated to the personal contribution, we present three studies that focused on two groups (experimental and control), studies that sought to highlight the psychometric and electrophysiological changes induced by CPPTO, after 8 weeks of daily 25 of minutes practice.

1. GENERAL FRAMEWORK. THE NEUROSCIENTIFIC APPROACH OF SR/E

A systematic review of medical approaches to S/R experiences involves several challenges. One of them concerns the difficulty of accurately defining the concepts of spiritual and religious, another would derive from the dynamics of the relationship between medicine and R/S, which have a long history. We find here many stages and events of medical history, from the pre-Christian period and from Byzantium, from the time of the French revolution and from among the later positivist approaches to be significant.

1.1. Historical milestones and significant scientific results in SR/E research

An inventory of the trials that inaugurate the scientific exploration of S/RE succinctly presents contributions signed by pioneering figures such as Hall, James, Starbuck, Leuba and, in the European space, Janet and Flournoy. The positions of authors such as Osler, Coe, Worchester are also mentioned. In the 1950s and the first half of the 1960s, the first scientific studies on altered moods (trance, sleep) appear, which also take into account yoga and Zen spiritual exercises from Japan, Europe, India and the USA (Kasamatsu, Hirai, Das, Ananda) are carried out. The 60s, 70s and 80s record an expansion of scientific concerns, the appearance of working groups that pursue a systematic approach to these topics, including the publication of *Journal of Religion and Health* and the studies of authors such as Beit-Hallahmi, Moeberg, Frank, Spilka or Bergin, who emphasizes the therapeutic potential of the Christian spiritual life. In the second half of the 60s and in the following two decades, a series of results appeared particularly relevant to the NSL area, regarding the psychophysiological impact of motivation and thinking on health (David McClelland), biofeedback and behavioural psychophysiology (David Shapiro), along with Gary Schwartz's first research into the influence of thoughts on autonomic parameters. Explorations in the 1970s include examining voluntary changes in state of consciousness (Pierre Etevenon), transcendental meditation (Keith Wallace), and the relaxation response (Herbert Benson). Another contribution was provided by the area of psychosomatics, where the impact of emotions and psycho-social content on health was highlighted. Thus, George Engel's contribution regarding the replacement of the classic model of health and care (the bio-medical model) with the bio-psycho-social one was particularly important.

1.2. The establishment of cognitive sciences and the confirmation of the current working paradigm in NSL

The onset of the current configuration of neuroscientific approaches to S/R experiences is closely related to the cognitive revolution. Fields that scientifically investigate the human mind are brought together [7]. In the 70s, when this multidisciplinary approach starts to be established, the contributions provided by philosophy and computational sciences, linguistics and anthropology, experimental psychology, psycholinguistics and neurosciences are brought into discussion, the main concern being the research of cognition and the use of all the perspectives that these areas of science they can offer for the understanding of the human mind and intelligent behaviours [8]. The contribution of technological advance has also been decisive, providing more precision, more possibilities to measure and analyse brain activity. These are magneto-encephalography (1968 [11], 1990 [12]), computed tomography (made in 1971, first used in a hospital in 1973 [13]), SPECT - single photon emission computed tomography (late 1960s [14]) and positron emission tomography (1973 [15]), transcranial magnetic stimulation (1985 [16]), functional magnetic resonance (1991 [17]), devices that will add to the study of psychological, mental, emotional and behavioural aspects, their morpho-functional, clinical, biological correlates [18].

All these will allow the shaping of cognitive neurosciences (or neuro-cognitive sciences), which currently represent the scientific paradigm that provides the current approach, methodology and tools for brain research, including in the case of S/R experiences. Elements of experimental psychology, neuroimaging study, measurements from the spectrum of molecular neurobiology and descriptors of mental activity are used, which associate specific neural activations with cognitive processes.

The studies carried out in the 80s more clearly outlined the field of NSL. It is related to the explorations seeking to identify some psycho-physiological effects of meditative practices, carried out by Goleman and Davidson, to the study of MBSR - mindfulness based stress reduction (Jon Kabat-Zinn) and Zen (James H. Austin), as well as those related to Michael Persinger's neurolocalization hypothesis, which linked S/R experiences to parietal lobe activity. Some results regarding the neural networks of empathy (Batson), the psychophysiological influence of forgiveness (Enright and Worthington), the polyvagal theory (Porges), the impact of moral emotions on the SNS (Keltner), and the conserved transcriptional response to adversity (Cole) are also mentioned. It is about the explorations to identify some psycho-physiological effects of meditative practices, carried out by Goleman and Davidson, about the study of MBSR - mindfulness based stress reduction (Jon

Kabat-Zinn) and Zen (James H. Austin), as well as those related to Michael Persinger's neurolocalization hypothesis, which linked S/R experiences to parietal lobe activity. Also mentioned are some results regarding the neural networks of empathy (Batson), the psychophysiological influence of forgiveness (Enright and Worthington), the polyvagal theory (Porges), the impact of moral emotions on the SNS (Keltner), and about the conserved transcriptional response to adversity (Cole).

1.3. S/RE oriented cognitive neuroscience

Cognitive neurosciences will provide a generous framework for empirical research and accurate evaluation of S/R experiences, which also imply highly structured cognitions and the integrated activity of complex neural networks. An event organized in 1996¹ and four research papers [20, 21, 22, 23] are considered landmarks that founded the approach of S/R experiences in the manner of cognitive sciences [24], which will later be called *Cognitive Science of Religion* [25].

Certain aspects still remain problematic. (An example is the debate regarding the positions for [26] and against [27] the use of the cognitive sciences of religion to clarify the phrase aimed at *spiritual care*). However, the possibilities for examining S/R experiences offered by the neurocognitive sciences are important. Psychophysiology and experimental psychology sought to clarify the role of emotions in interpersonal relationships, addressing, from the perspective of cognitive neuroscience, sympathy [37], empathy, attachment [38], imitation or emotional contagion [39] or topics from this spectrum.

In the second decade of the 21st century, increasingly rigorous approaches appear, the neurobiology of spirituality [45], the neuroscience of spirituality [46], the neuroscience of religious experiences [47] or the neuroscientific study of spiritual practices [48] and an increasingly thorough study of moral emotions and virtuous behaviours: altruism [49], *kindness* [50], generosity [51], *caring* [52, 53], *pity* [54], and even love [55]. Other studies, with similar approaches, aim to clarify the relationship between empathy and altruism [56], or between sympathy, pity and empathy [57]. The neuropsychological particularities of kindness are also neuro-cognitively investigated [58] and the possible links between generosity and the state of happiness [59, 60]. The framework provided by cognitive

¹ We refer to the conference entitled „Cogniție, cultură și Religie” (“Cognition, Culture and Religion”), organized at the Department of Comparative Religion at Western Michigan University in February 1996, with E. Thomas Lawson (considered to be the founder of cognitive approaches to religion) as chairman, and psychologist Justin Barrett, anthropologist Pascal Boyer, specialist Brian Malley, philosopher Robert McCauley, and anthropologist Harvey Whitehouse as speakers.

neuroscience has allowed investigations related to interpersonal neurobiology [61], social interaction and interpersonal attachment [62], but also to the psycho-pathology of excessive empathy [63], or in the case of extreme altruism [64].

1.4. The neurosciences of spiritual life - areas and working topics

The approaches of moral emotions, of virtuous conducts/behaviours, bring more and more into the discussion the exploration of S/RE. The beneficial effects of love in medical care [65], possible cyanogenic changes induced by the practice of *loving-kindness* [71], meditation [72] and compassion [73] or the practice of prayer [74] are scientifically examined. In addition to these, NSL also include fundamental research: contemplation [76], mindfulness [77], the experience of compassion [78], but also those concerns that seek to clarify a formal scientific framework for the study of S/R experiences [65].

Through developments of this kind, the field of neurosciences and NSL have increasingly acquired a social relevance, expanding the concern of medical sciences beyond the problem of disease, health or prevention, towards approaches aimed at the quality of individual life [84] and socio-cultural [85].

(An inventory of these historical moments, which concern NSL, is briefly presented and structured in 9 annexes of the thesis, totalling 50 pages.)

2. META-ANALYSES OF THE RELATIONSHIP BETWEEN S/RE AND HEALTH

The number of articles addressing the impact of R/S experiences on health has grown considerably in recent decades. A meta-analysis reveals this steady increase, examining studies published in PubMed on the subject [86]. Other meta-analyses provide various evaluations of the results obtained in the field of medical evaluations of S/R experiences. In Chapter II of the paper, we mention the results of several such meta-analyses. One of these, made by Harold Koenig [87], is remarkable for the number of articles, inventorying 3,300 medical studies (1,200 of them published between 1872 and 2000, and another 2,100 studies published between 2000 and 2010), highlighting correlations between religion/spirituality and various aspects of health. The cyanogenic influences of S/R practices in hypertension, coronary and cerebral-vascular diseases, dementia and Alzheimer's disease, but also in the regulation of endocrine and immune function, as well as a beneficial impact on the evolution

of cancer, at the level of general health, in the quality of mobility and physical capabilities and, more generally, in terms of life expectancy, in cultivating positive emotions, optimism and hope, in well-being, shaping the adaptive response to stress, reinforcing the sense of a meaningful life, but also positive character traits, increased self-esteem, and low rates of depression and suicide, substance abuse and anxiety, marital instability, and delinquency [87].

Such meta-analyses illustrate not only the considerable extension of scientific interest, but also the increased resolution with which the neurophysiological processes accompanying S/R experiences are examined and the increasing attention that CSE receives from the medical scientific world.

3. PSYCHO-ELECTROPHYSIOLOGICAL EXPLORATIONS OF THE IMPACT OF CHRISTIAN PRAYER (CR). THE CURRENT STAGE

3.1. Christian prayer: difficulties of systematic scientific/medical/empirical approach

The experience of prayer, located at the core of S/RE, raises considerable epistemological and methodological obstacles, related both to the formulation of scientific definitions and to the clarification of the methodological framework of empirical, psychological and medical exploration.

Prayer is commonly defined as a universal action or act, "corporate or personal", manifested through various "forms and techniques", present "in all religions, of all times", and expressing "people's communication with the sacred, with what is considered holy - God or gods, with the transcendent plan or with supernatural powers" [101]. A synthesis, made on the basis of several sources, indicates 27 distinct types of prayer (according to content and manner of expression), illustrating the variety of forms of this experience and the difficulty of defining it: adoration, confession, contemplation, expression of gratitude, meditation, focused prayer on overcoming some obstacles or mystical experience [99].

Aspects of this kind are indicated generically, in the scientific literature that examines prayer, by the term *multidimensionality of prayer*, a topic currently analysed in attempts to systematize the categorisation of prayers aimed at facilitating scientific research [103-105]. However, despite these difficulties, recent decades have seen a significant increase in interest in this subject. It is illustrated by the frequency of the word prayer in search engines. In *The National Library of Medicine*, the word "prayer" has an ever greater frequency in scientific

publications, starting in 1945 (18 occurrences), increasing annually, with a few exceptions, until 2021, when it reached 3268 uses [i].

3.2. Scientific analysis on the RE effects

An important number of studies have evaluated the effects of various types of prayer on health, with notable results in pain management [109], in coping strategies [110], in improving cardiovascular reactivity [111], or in the case of patients who have followed therapeutic procedures of aquatic rehabilitation [112]. Other research shows that praying to the Supreme Being, recited or listened to, has beneficial effects on patients with religious beliefs undergoing surgery [113], but also on the mood of doctors and patients [114].

3.3. *Intercessory prayer*

Intercessory prayer (IP) is a category that has been intensively studied in recent years and it refers to the situation in which a person prays for another person. On the one hand, IP seems to offer more possibilities for scientific evaluation of the effects of prayer, which promises clearer objectification possibilities, the patient most often not knowing that someone is praying for him. On the other hand, the interest in IP evaluation is also explained by the high percentage of workers in social assistance, highlighted by several surveys [117, 118]. In this regard, the findings are divided. There are articles that find no connection between IP and the subjects' health, while others claim the opposite.

Some studies are briefly presented in this research paper. A study, done by Byrd (1988), focused on a number of 339 patients (EG of 192 and CG of 201 patients, all with coronary disease), shows that EG patients required less assisted ventilation, antibiotics and diuretics, compared to CG patients [119]. Another (double-blind) study examined the possible effects of IP on some patients with psychological and rheumatic conditions. The medical status of each patient in EG and CG (which made up 19 pairs of patients) was evaluated at an interval between 8 and 18 months after the IP intervention, with no significant differences identified between the two groups of patients [120].

Two isolated cases of clinically well-documented unexplained cures are also mentioned, indicating possible effects of IP, but these too require careful scientific evaluation.

3.4. Meta-analyses of studies on the psycho-medical effects of prayer

Several meta-analyses have investigated and evaluated the research findings of the past decades regarding the link between PE and health, some identifying strong correlations, others noting that the data are still inconclusive. A 2009 meta-analysis examined the effectiveness of using prayer as a coping strategy to improve mental health symptoms, with 60% of the 598 studies reviewed indicating that PE was associated with improved mental health [133].

However, there are also meta-analyses finding that the evidence of the beneficial effects of PE or IP are still limited. Therefore, many articles recommend the need for a clearer evidence of the effects of prayer [136], including cases of unexplained healings from the recent clinical inventory [137], as well as experimental studies based on clear conceptual models, which use operationally precisely defined constructs, and longitudinal investigations that adequately measure control variables [138].

3.5. EEG analysis, brain and electrophysiological imaging of Catholic prayer

Several recent studies have followed the changes (psychological, electro and neuro-physiological changes) induced by PE specific to the Christian tradition: increased levels of activity in the caudate nucleus in praying persons, suggesting stimulation of the dopaminergic system of the dorsal striatum [139], in TPJ – important in autobiographical memory and in relating to others, in the anterior region of the CPFM, engaged in inter-personal interactions, suggesting that in the case of Christians, prayer, as a relationship with the Supreme Being, resembles the experience of an inter-personal relationship [140]. Other studies have shown increases in the alpha power and an intensification of brain activity in regions associated with well-being (left side of the frontal and central regions) [142], intensifications of activity in the Right Medial Orbitofrontal Cortex (MOFC), Right Caudate Nucleus (right CN), left medial prefrontal cortex (left MPFC), left insular cortex (left IC) (zB 13), left caudate nucleus (left CN) [143].

We pointed out that there is a small number of articles that explore prayer in the Eastern Christian tradition (PECT), this being one of the reasons that led to the present research.

4. GENERAL HYPOTHESIS, WORKING HYPOTHESES AND TESTING THEM

The main purpose of the research is to identify the changes (psycho-emotional and electro-physiological) that could be induced by the practice of prayer according to the Christian-Orthodox tradition (PCOT), carried out individually, daily, 30 min., for 8 weeks. The changes were highlighted by psychometric, EEG and physiological measurements (salivary markers) applied to a number of 33 volunteers divided into two groups (Study Group = SG and Control Group = CG).

4.1. The experimental plan. Independent variable and dependent variables

The independent variable of the task (experimental task) is the practice of PCOT, for SG. *The dependent variables* were grouped into three sets: (psycho-emotional), perceived stress, anxiety as a state, coping strategies; (EEG parameters) in alpha, beta, gamma1 and gamma2 register; (physiological indicators) salivary markers: Alpha amylase, IgA, Cortisol, testosterone, oxytocin, interleukin-6 and interleukin-8. (We called these indicators *dependent variables* here, evaluating possible changes given by PCOT –*independent var.*)

Experimental conditions - The subjects performed the experimental task (PCOT) at home, a manner more appropriate to Christian prayer, this experimental plan facilitating the effect of the independent variable, and the validity of the possible results in the usual life, extra-laboratory, conditions.

4.2. General hypothesis and working hypotheses

The present research has as its **general hypothesis** that the individual practice of prayer in the Christian-Orthodox tradition (PCOT) induces psycho-physiological changes. Subsequently, we aim to test **3 sets of (causal) working hypotheses. Practicing PCOT daily, 30 minutes daily, for 8 weeks causes:**

- **psycho-emotional changes, implying decreasing anxiety and perceived stress, improving coping mechanisms (Set 1):** significant reduction of the global score on the *Hamilton Anxiety Scale*, applied by the evaluator (Hypothesis 1.1), of the GAD 7 score, obtained by self-assessment (Hypothesis 1.2.), of the subjectively perceived stress level on the *Visual Analogue Scale of Perceived Stress*, obtained by self-assessment (Hypothesis 1.3.) of the global score on the *Perceived Stress Scale* (PSS-10), applied by the evaluator (Hypothesis 1.4.), strengthens coping mechanisms and increases the global COPE score, obtained through self-assessment (Hypothesis 1.5)

- **changes in EEG activity, amplifying the signal in the alpha, beta, gamma1 and gamma2 registers (Set 2):** increases in brain electrical activity in the *alpha* register (Hypothesis 2.1), in the *beta* register (Hypothesis 2.2), in the *gamma1* register (Hypothesis 2.3) and in the *gamma2* register (Hypothesis 2.4)

- **physiological changes of some salivary markers (Set 3):** decrease in Alpha Amylase levels (Hypothesis 3.1); Cortisol (Hypothesis 3.3), Testosterone (Hypothesis 3.4), Interleukin 8 IL-8 (Hypothesis 3.7), increase of Immunoglobulin A (Hypothesis 3.2); Oxytocin (Hypothesis 3.5) and changes in Interleukin 6 (Hypothesis 3.6)

4.3. Testing the working hypotheses

For testing, we designed three studies, carried out on the same SG and CG groups (having the same composition), a number of 33 people (17 people in the Control Group – CG, and 16 people in the Study Group – SG).

To test the first set of working hypotheses, 5 scales, pre- and post-experience, were applied, to subjects from the two groups CG and SG. The responses, statistical and comparative analysis as well as the interpretation of the results are contained in *Study 1*.

To test the second set of working hypotheses, the subjects of the two CG and SG groups were placed, in the laboratory, in two measurement sessions (conducted before and after the 8 weeks of POCT experience). The measurement protocol provided for 10 intervals, with durations between 2 and 12 minutes, using the g.USBamp 16-channel biosignal amplification brain-computer interface system. Primary data analysis, benchmarking, results and discussion constituted *Study 2*.

To test set 3 working hypotheses, saliva samples were taken from CG and SG subjects (pre- and post-experience, after 8 weeks of PCOT practice), and pre- and post-test levels of salivary markers were compared. The primary data (continuous variables), the statistical analysis and the interpretation of the results being part of *Study 3 - Possible physiological changes induced by the practice of prayer in the Christian Orthodox tradition*, were published in *Fiziologia*².

² Research study in publication process in the journal *Fiziologia*, May 2023.

5. PARTICIPANTS AND GENERAL RESEARCH METHODOLOGY

5.1. Research location

The information meetings regarding the research project and the meeting for the signing of the informed consent statement were held at the UMPCD. The presentation meeting of the cognitive, emotional, psycho-behavioural and spiritual coordinates of PCOT, intended for SG subjects (Power Point – 25 slides, see Annex I), with a duration of 3 ½ hours, was also held at UMPCD. EEG measurements, psychometric testing and collection of saliva samples, organized pre- and post-experimentally, for all subjects participating in the research, were carried out at the UMPCD (Physiology Laboratory). The individual experience (PCOT practice), carried out daily, for 30 minutes, during 8 weeks, for each of the subjects in the SG, took place at the home of each subject.

The recordings and the analysis of the EEG data were processed at UMPCD and the Technical University "Gh. Asachi" in Iași.

5.2. Participants

The study included a group of 33 healthy adults recruited through online recruitment notices.

The 33 subjects (24 women, 9 men, aged 20-57 years, the average age being 38.9 years) were divided into two groups (CG Control Group = 17 participants, 12 women and 5 men, the average age of 38.6 years; Study Group SG = 16 participants, 11 women, 5 men, the average age of 39.2 years). The division into the two groups was made on the basis of a directed interview, with the following criteria: people who live in Bucharest, with no experience in PCOT, no history of brain disorders, non-smokers, no weekly volunteer practice (more than 8 weeks, in the last half a year), without chronic conditions and who do not follow drug treatments.

To make up the study group, for the participants interview, three additional criteria were introduced, regarding the independent variable: subjects should know the general information on the Christian-Orthodox religion and spirituality (declared membership to Orthodox Christianity); subjects should not be constant (daily), but only occasional PCOT practitioners; subjects should be willing to fulfill the requirements of the experimental task (individual practice of PCOT, daily, for 30 minutes, over a period of 8 weeks).

Finally, the volunteer subjects in SG and CG were chosen in such a way that the two groups had a similar gender and age structure to reduce the number of random variables.

STUDY GROUP					CONTROL GROUP			
PT Code	ST Code	Gender	Age	o	Age	Gender	ST Code	PT Code
1	25	F	42		45	F	28	12
2	23	F	21		20	F	7	13
3	6	F	41		38	F	10	18
4	12	F	57		56	F	22	15
5	13	F	33		30	F	19	16
6	2	F	37		38	F	20	17
7	27	F	39		39	F	17	22
8	5	F	51		49	F	8	19
9	26	F	35		34	F	24	20
11	3	F	40		42	F	18	30
23	29	M	37		38	M	31	27
25	4	M	41		42	M	21	28
24	16	M	32		32	M	32	32
10	14	F	48		46	F	11	21
14	15	F	41		42	F	33	33
26	9	M	26		27	M	1	29
31	30	M	47		47			

Table 5.1. Age and gender structure of CG and SG. The numbers in the table represent the working codes of the subjects (PT code – the codes used in the Psychometric Tests; ST code – the codes used in the Saliva Tests)

5.3. Ethical considerations regarding the present research

The research was carried out after the approval of the project by the Ethics Commission of the UMPCD. All selected participants were informed about the stages of the study. (Document no. 176 / 05.09.2018)

5.4. Conducting the research and used methods

The preparatory stage for conducting research. Between November 2017 and March 2019: Fundraising necessary for the purchase of some devices (November 2017 – December 2018). Collected amount: 17520 RON and 2350 EURO; Purchase of the necessary materials (December 2018); Saliva kits (worth 10,356 RON); Helmet with 16 sensors and accessories (worth 18,778.20 RON); Signing of the Collaboration Protocol between UMPCD and TUIAȘI (December 2018 - February 2019) for EEG recording and primary data processing with

specialized hardware and software; Research approval by the UMPCD Ethics Commission (January 2018).

5.6 Research stages, diagram and timeline

Stage I (weeks 1-2) – Signing the consent statement.

Stage II (week 331.03-07.04.2020) - Pre-test measurements (pre-experiment)

Stage III (week 4) – SG participants watched a presentation (3 ½ hours) on the the experimental intervention (2 hours of presentation based on a 25 slides ppt and 1 ½ hour of questions and answers session) regarding the psycho-emotional and cognitive-behavioural coordinates of PCOT.

Stage IV (weeks 5-12) The experimental intervention for subjects in SG.

Stage V (weeks 13-15 / 8.06-02.07.2020) Post-test measurements for SG subjects, when measurements were performed no later than one week after the end of the experimental interval, with GS instructed to continue PCOT up to and including the day of measurements.

Stage VI - the processing and interpretation of primary data.

6. FIRST STUDY: EVALUATION OF POSSIBLE PSYCHOMETRIC CHANGES INDUCED BY THE PRACTICE OF PRAYER IN THE ORTHODOX CHRISTIAN TRADITION

6.1. General aim

The general objective of the study is to highlight the psychological changes in the field of stress/anxiety induced by the practice of PCOT.

6.2. Preliminary data

After applying the questionnaires, which was done by a resident psychiatrist, the data were entered in an Excel format document.

CODE	GENDER	AGE	EDUCATION	A1	A2	A3	A4	A5
1	2	42	7	1	1	1	1	1
2	2	22	5	1	1	2	0	0
3	2	43	7	1	1	1	2	1
4	2	58	8	1	1	0	0	0
5	2	33	7	1	2	3	1	0
6	2	37	8	2	2	3	0	0

Photo. 6.2.1. Extracted from the primary data centraliser. In the first column, there are the codes associated with each subject from SG and CC, from 1 to 33 (When applying the

questionnaire, it was not known whether the subjects belonged to SG or CG). Next, there are the columns corresponding to gender, age, and education level for each subject, and the first five items (A1-A5) of the Hamilton scale, for which the subjects' responses are completed.

6.3. Statistical analysis tools

Having distributions that do not meet the condition of normality and a limited sample ($N < 30$, the Study Group having 17 subjects and the Control Group 16 subjects) we used the *median* and *means, non-parametric tests for the median* (Wilcoxon signed-rank test), *t-tests* for paired data and the *Mann–Whitney test for independent samples*.

6.4. Statistical analysis and interpretation of results. Hamilton Anxiety Scale

Overall, we identified a similar evolution of the subjects from SG and CG, by recording a decrease in the score on the Hamilton scale, which does not definitively highlight that the PCOT practice contributed to the decrease in the level of anxiety in SG.

The analysis of the values of the 14 items, *a1 - a14*, revealed significant differences in *both groups*, pre- and post-test, regarding *a9* ("anxious mood"), *a2* ("relaxing difficulties /muscle tension"), *a5* ("prosexo-mnesis difficulties"), *a6* ("depression"), *a8* ("changes on analysers"), *a10* ("respiratory difficulties"). There were also statistically significant differences in CG subjects only, who at post-test showed changes in *a9* item ("cardiovascular symptoms"), suggesting that other factors may have contributed to the improvement in CG subjects' responses.

	anxious mood (a1)	relaxing difficulties /muscle tension (a2)	prosexo-mnesis difficulties (a5)	depression (a6)	changes on analysers (a8)	respiratory difficulties (a10)
<i>CG</i>	$P = 0,005 < P = 0,01, z = -2,804$	$P = 0,013 < P = 0,05, z = -2,496$	$P = 0,035 < P = 0,05, z = -2,111$	$P = 0,004 < P = 0,01, z = -2,889$	$P = 0,02 < P = 0,05, z = -2,333$	$p = 0,034 < P = 0,05, z = -2,121$
<i>SG</i>	$P = 0,005 < P = 0,01, z = -2,81$	$P = 0,001 < P = 0,01, z = -3,307$	$P = 0,034 < P = 0,05, z = -2,121$	$P = 0,007 < P = 0,01, z = -2,714$	$P = 0,035 < P = 0,05, z = -2,111$	$P = 0,014 < P = 0,05, z = -2,46$

Table 6.4.1 Significant differences recorded between values of a1, a2, a5, a6, a8, a10, among subjects in GS and GC, pre- and post-testing.

However, the change that appeared in SG at post-test, regarding item a3 ("fears/phobias"), suggesting that the practice of PCOT after the experimental design could have reduced the intensity of fears/phobias among the subjects in SG, is significant. The result could be a starting point for a future study on the ways in which PCOT changes the intensity of the item corresponding to "fears/phobias". Moreover, possible correlations between the modification of this item in SG and the decrease in salivary cortisol level could be evaluated, with relevance regarding the effect of PCOT. In addition, the change appearing in GS at post-test regarding item

a14 ("appreciation of anxious mood at the interview") is also significant, suggesting a possible influence of PCOT.

	Fears/Phobias (a3)	Approximating the anxious mood at the interview (a14)
<i>control group</i>	$P = 0,102 > P = 0,05,$ $z = - 1,633$	$P = 0,414 > P = 0,05,$ $z = - 0,816$
<i>Study group</i>	$P = 0,046 < P = 0,05,$ $z = - 1,999$	$P = 0,002 < P = 0,01,$ $z = - 3,162$

Table 6.4.2. Significant differences recorded between the values of a3 (“fears/phobias”) and a14 (“approximating anxious mood”), among subjects in SG, pre- and post-testing.

However, these possible correlations require future studies.

6.5. Statistical analysis and interpretation of results. The COPE Test

Important results were obtained from the analysis of the data corresponding to the *COPE* Test. The Wilcoxon paired-samples test did not provide statistically significant differences. However, several coping mechanisms are greater in SG compared to CG: *e act* (“the active approach” to coping) in pre-testing; *e res* (“control/abstain”), in pre-testing; *e pos* (“positive interpretation and growth”) post-testing; *e rel* (“religious approach/religious coping”), post-testing.

	pre-testing <i>e act</i>	pre-testing <i>e res</i>	post-testing <i>e pos</i>	post-testing <i>e rel</i>
CG/SG	$P = 0,025 < P = 0,05, z = -2,256$	$P = 0,041 < P = 0,05, z = -2,067$	$P = 0,023 < P = 0,05, z = -2,276$	$P = 0,035 < P = 0,05, z = -2,112$

Fig. 6.5.1. Coping items for which the average is significantly higher in SG vs CG.

Overall, it can be said that, although the study did not reveal a statistically significant influence of the practice of PCOT regarding the global score on the COPE scale, however, in SG, in post-testing, changes in some values were observed, regarding the two strategies of coping, respectively the positive interpretation and the religious approach and in certain items of the Hamilton scale.

6.6. Remarks

The results that we can consider relevant to the COPE inventory are post-testing *e pos* (the “positive interpretation” coping mechanism of the COPE) and post-testing *e rel* (“the religious

approach coping mechanism” of the COPE), even in the case of a reduced sample volume, which weakens the test results, the result still remaining significant, showing an effect size [149]. However, the changes recorded in SG in post-testing, on the two coping strategies, "positive interpretation" (**e pos**) and "religious approach" (*e rel*), do not change the final conclusion, as no significant inter-group differences are recorded at post-testing. They can only provide a picture of the dynamics within SG on the two coping mechanisms.

6.7. Study limits

The present study has some significant limitations, related to the recruitment of subjects and the composition of CG and SG, the unusual subject matter in the Romanian space, the length (daily, 8 weeks, for 30 min) and the requirements arising from the particularities of the experimental tasks such as the choice a quiet space at home, for PCOT, the thorough participation in the read prayers. In addition, the conditions of the experimental plan (which aimed to conduct the prayer in the private space, in privacy) did not allow the supervision of the subjects in the SG by the specialized staff, a fact that could have caused the interference with some random variables. To these, limitations of the chosen assessment tools were added in the present study. For example, the Hamilton scale does not differentiate between state anxiety and anxiety as personality trait.

The other hypotheses formulated in this study, namely *hypotheses 2, 3 and 4* regarding the significant reduction of the GAD 7 score, the subjective perceived stress on the *Visual Analogue Scale of Perceived Stress*, and the global score on the *Perceived Stress Scale* (PSS-10), through daily PCOT actions, 8/30, were not confirmed.

An intuitive correlation, namely that PCOT strengthens coping strategies based on positive interpretation and religious approach, corresponding to decreases in anxiety, could be examined for further research.

7. SECOND STUDY: POSSIBLE ELECTROPHYSIOLOGICAL CHANGES INDUCED BY THE PRACTICE OF PRAYER IN THE ORTHODOX CHRISTIAN TRADITION

7.1. General objective and working assumptions

The general objective of the second study of the present research was to highlight the possible changes in the alpha, beta and gamma register that appeared as a result of the PCOT practice. We formulated four working hypotheses: PCOT 30/8 causes an increase in brain electrical activity in the alpha register (hypothesis 2.1), beta (hypothesis 2.2) and gamma1 and

gamma2 (hypotheses 2.3 and 2.4) in SG subjects, evidenced by the level measured in post-test compared to the level measured at pre-testing.

7.2. Participants and Methods

The subjects presented in Chapter 5, Section 5.2, participated in this study. EEG recordings were performed in two stages, pre- and post-test, before and after the 8-week experimental interval (individual PCOT) intended for the subjects in the SG. Electrical brain (EEG) and cardiac activity were recorded using the g.USBamp biosignal amplification brain-computer interface system with 16 channels of signals being simultaneously sampled at a maximum frequency of 37.4 kHz at 24-bit resolution. The placement of the electrodes on the scalp of the subjects was done according to the international 10-20 system. Recordings followed a 10-interval unfolder (EEG Measurement Protocol), followed in the following order listed in Table 7.1.

<i>Interval 1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>			<i>9</i>	<i>10</i>
<i>BLEO 1</i>	<i>BLEC 1</i>	Personal Experience (<i>PE</i>)	<i>BLEO 2</i>	<i>BLEC2</i>	Vizualizatio n(<i>VI</i>)	<i>BLEO 3</i>	Cold Pressure/EGS			<i>BLEO 4</i>	<i>BLEC3</i>
2 min.	2 min.	12 min.	2 min.	2 min.	2 min.	2 min.	HandIN	PAIN	HandOU T	2 min.	2 min
Base line Open eyes The subjects were asked to look at a white wall.	Base line Closed eyes The subjects were asked to close their eyes.	In this stage, the subjects were asked to proceed with the personal experience. In this stage, the subjects in the Control Group were instructed to think of a loved one they are attached to (from childhood or the present), while subjects in the Study Group practiced, during this interval, PCOT, in a manner similar to that of the experimental intervention period. Participants were instructed that laboratory personnel, who measured EEG activity, did not know which group the subjects belonged to.			Subjects were asked to look at a photograh.		In this stage the subjects were asked to insert a hand into a bowl of cold water at -4° C, up to over the wrist. Subjects were told to keep their hand in the water as long as they could. They will have to signal (announce verbally) when they feel pain and remove their hand from the water when they can no longer bear the pain.				

Table 7.2.1. EEG Measurement Protocol Intervals



In interval 6 (photo), the subjects in the two groups were projected, on the white wall in front, a photograph (Photo 1), with the help of a video projector. The photograph was viewed by the subjects for 2 min. In the post-test, under similar conditions, the subjects looked at another photo for 2 minutes (Photo 2).

7.3. Collecting EEG data

For the recording and processing of electrical brain activity, we used a high-performance and precision biosignal amplifier g.USBamp (g.tec Medical Engineering Ltd) that supports 16 biosignal channels sampled simultaneously with a maximum frequency of 37.4 kHz, at a 24-bit resolution. Processing of recorded signals was done with g.Bsanalyze (g.tec Medical Engineering Ltd), an interactive software for multimodal biosignal processing and analysis in clinical research fields.

7.4. Primary data

Signal processing provided numerical primary data, entered into Excel tables.

	Ch10	3,730676354	2,830304244	2,031095048	2,37707038	3,483888034	3,003323843	2,363217412	2,374074008
	Ch11	4,12777894	1,931595695	1,759773873	2,070363193	2,473822297	3,950078894	2,23281339	2,134340789
Gamma2	Ch12	3,521645714	1,777710779	1,63526645	2,167232272	2,851907318	5,422050453	3,321595079	2,745920536
		BLEO1				BLEC1			

Photo 7.4.1. For each of the 10 intervals, the processing of the recorded data provided a number of numerical values (one to four).

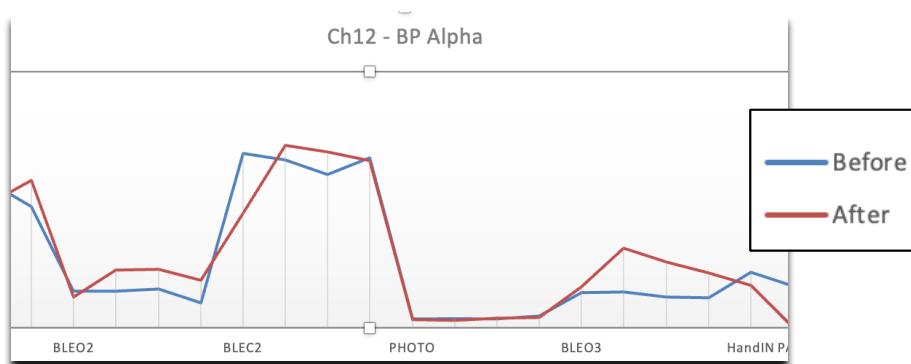


Photo 7.4.2. In addition to the numerical values, the primary data contain graphs corresponding to these values, for each individual sensor.

7.5. Statistical analysis tools

The tools used for the statistical analysis of the primary data are *non-parametric tests* for the median (Wilcoxon signed-rank test), *t-tests* for paired data, and *S.E.M bar charts*. (*Standard Error of the Mean*).

7.6. Results

Applying the Wilcoxon sing-rank test revealed significant differences in the median value in the case of SG subjects, pre/post-experience. The intended experimental design (PCOT, 30 min./

day, for 8 weeks), revealed changes in the *alpha* and *gamma2* registers, but not in the *beta* and *gamma1* registers, confirming working hypotheses 2.1 and 2.4. Working hypotheses 2.2 and 2.3 are not confirmed. The obtained corresponding P values for the *Wilcoxon sing-rank test* are:

$$P_{\alpha} = 0.0001, P_{\beta} = 0.9111, P_{\gamma_1} = 0.1085, P_{\gamma_2} = 0.0015$$

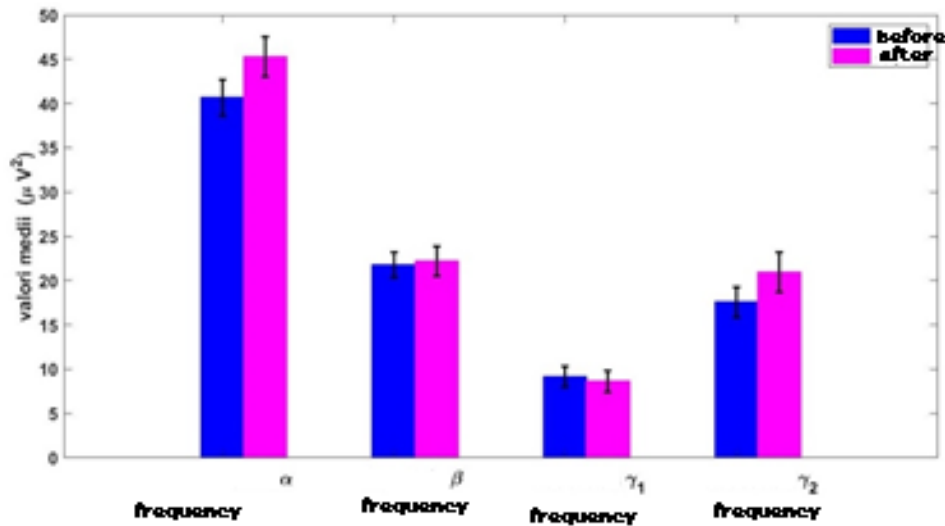


Figure 7.6.1. Great mean values \pm S.E.M. for frequencies (all channels) at SG.

7.7. Discussions

Increases in electrical activity in the alpha register (8–12 Hz) correspond to an "idling state", with the reduction of sensory information processing [178], a non-directive meditation [179], but also various stages of rest, without this state of relaxation meaning an empty mind [179]. The intensification of activity in the alpha band is present in some types of meditation [180] and in connection with mindfulness sessions [181] (*M* - technique also called open *MD* meditation, of non-directive monitoring of thoughts). Regarding S/RE, two studies report increases in activity in the gamma register in subjects practicing Buddhist meditation [193] or Vipassana, Himalayan Yoga and Isha Shoonya (in this case it is the register between 60 and 110 Hz, corresponding to the gamma2 band) [176]. The results obtained, i.e. increases in the alpha and gamma register, could be significant, considering that Christian prayer in general, and Christian-Orthodox prayer in particular, do not represent a relaxation technique, having an important cognitive and attentional component (text and attention task), as well as specific body postures. Regarding S/RE, two studies report increases in activity in the gamma register in subjects practicing Buddhist meditation [193] or Vipassana, Himalayan Yoga and Isha Shoonya (in this case, the register is between 60 and 110 Hz, corresponding to *gamma2* band) [176]. The obtained results, i.e. increases in the alpha and

gamma register, could be significant, considering that Christian prayer in general, and Christian-Orthodox prayer in particular, does not represent a relaxation technique, having an important cognitive and attention component (text and attention task), as well as specific body postures.

7.8. Limitations of the study

Some limitations of the study stem from the insufficiency of recorded data. For example, comparing individual CG and SG data that were acquired pre/post-experience for three distinct stages (BLEO1, BLEC1 and PE) was not possible due to insufficient data. The EEG measurement protocol provided 4 numerical values for intervals 3 (PE) and 6 (VI) and a single value for Interval 8 – Cold Pressure (PAIN/HIP). In the case of interval 8 (PAIN/HIP), a single numerical value does not allow either the calculation of the standard deviation or of S.E.M. to highlight variability/accuracy.

Further studies should provide for a larger number of subjects (SG and CG), more values for each step in the Measurement Protocol, and the extension of PCOT (Personal Experience) range for SG subjects for a more detailed analysis that would selectively include channels that correspond to sensors located in certain regions of interest.

8. THIRD STUDY: PHYSIOLOGICAL CHANGES INDUCED BY THE PRACTICE OF PRAYER IN THE CHRISTIAN-ORTHODOX TRADITION

In the third study of the present research, we examined whether 30/8 PCOT causes physiological changes by following the levels of salivary markers commonly used as indicators for the physiological response to stress, in states such as anxiety or depression, but also in the evaluation of therapeutic potential of medical or Spiritual/Religious interventions (S/RE): Salivary Cortisol, Salivary Alpha-amylase (AAs), Immunoglobulin A (IgA), Oxytocin, Testosterone, and the cytokines interleukin 6 (IL-6) and interleukin 8 (IL-8).

Study 3 was published in detail in the journal *Fisiologia* in the May 2023 issue.

The working hypotheses focused on the decrease in the levels of Cortisol and sAA, increases in the levels of Immunoglobulin A (IgA), Oxytocin, Testosterone and changes in the levels of cytokines IL-6 and IL-8, post-testing, compared to the time of pre-testing, in the subjects from SG, after 30/8 PCOT.

8.1. Collection of saliva samples

The collection protocol provided for the movement of the volunteers to the laboratory premises, the sampling being carried out one hour after waking up, prior to which several conditions

were met: the absence of alcohol and coffee consumption 12 hours before sampling; avoiding tooth brushing the evening before harvesting, not smoking before 12 hours before sampling, not consuming food or alcohol at least 8 hours before, the absence of sustained physical effort in the morning of sampling. In an interval of 3 hours, samples collected from CG and SG subjects - in sterile Salivette sampling vials (Sarstedt, Italy) - were placed in ice boxes with isothermal cover, transported and centrifuged (6000 rpm min.) in the cold for 20 minutes. The storage of the supernatant samples of each sample was carried out in sterile 1.5 ml Eppendorf tubes, stored at -20°C, for a period of 30 days. In the obtained samples, the mentioned parameters were dosed, in accordance with the protocol specified by the manufacturer of each specific kit. The results were related to the salivary albumin concentration (determined by the ELISA technique, using a Diametra reagent kit (Italy) and a semi-automatic ELISA analyser STAT FAX 303, USA).

8.2. Relevant results

After the elimination of the contaminated/inappropriate samples, the measurements of each parameter and the statistical analysis revealed two variables of interest with statistically significant changes post-testing compared to the time of pre-testing, in the case of SG subjects the decrease of Salivary Cortisol (sC) and an increase of Interleukin 6 (IL-6), none of the other hypotheses being validated.

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	Cortisol	IL-6
Wilcoxon test (left)	0.9898	0.0183*
Wilcoxon test (right)	0.0113**	0.983
Wilcoxon test (both)	0.0226***	0.0366***

Table 8.2.1. Wilcoxon Test values for Cortisol and salivary IL-6 corresponding to subjects in SG, pre- and post-testing.

Regarding the SG subjects, the median of the values of salivary Cortisol concentrations, after completing the experimental interval, was significantly lower (15.77) compared to the median values obtained at the time of pre-testing (18.10), and the median values of IL-6 concentrations salivary was significantly higher (15.28) compared to the median values obtained at the time of

pre-testing (14.37). No statistically significant results were obtained for the other salivary markers. We discuss results in the context of similar studies, highlighting some specific limitations of studies that evaluate the physiological changes induced by spiritual/religious experiences, especially those that use salivary markers, also formulating some recommendations for increasing the methodological quality of future studies.

8.3. Discussions

The decrease in the level of salivary Cortisol could be correlated with the decrease in anxiety assessed by the Hamilton Scale, indicated by items *a3* and *a14*, reported in Study 1, but also with the intensification of the electrical activity of the brain, in the alpha register highlighted in Study 2, in the case of SG. On the other hand, the absence of conclusive global results, in the inter-group evaluations, correlates with the weak differentiation of CG vs. SG, pre and post-testing, found in Study 1 - regarding psycho-emotional changes and in Study 2 regarding EEG activity. This points to the need for future studies with rigorous experimental designs and the role of measurement protocols that can increase the methodological quality of S/RE examinations.

There are studies that found a decrease in salivary cortisol levels as a result of an S/RE practice. One of them focused on the practice of mindfulness (in the case of a study group consisting of war veterans) [38], and another evaluated yoga-nidra exercises in patients suffering from insomnia [39].

Other studies, focused on S/RE, reported increased levels of IL-6 as a result of Yoga practice, in the case of a group of 38 people (19 men, 19 women, 5 hours/day with a vegetarian diet) [49] and in a group of elderly subjects (65-85), with weaker immune activity, after 8 weeks of MBSR sessions, suggesting that mindfulness practice could improve the effects of aging.

The results obtained in this study indicate that RTCO 30/8, causing a statistically significant decrease in salivary Cortisol and an increase in IL-6m suggesting that PCOT could improve the physiological response to stress and the inflammatory response, in certain situations. However, further studies are needed to see to what extent PCOT influences IL-6 in non-elderly adults.

9. CONCLUSIONS AND PERSONAL CONTRIBUTIONS. THE NEUROSCIENCES OF CULTURE AND HEALTH

9.1. Neuroscientific exploration of S/RE

In the last decades, through the contribution of neuro-cognitive sciences but also through the advance of imaging technologies and molecular diagnostic techniques, the study of S/RE has gained important elements. There is already great evidence regarding the impact of S/RE on health

in general, and neurophysiologically in particular. A number of important results (concerning psycho-somatics, psycho-physiology or self-induced neuroplasticity) have attempted to provide various explanations regarding the impact of inner mood on autonomic response [200], the link between affiliation motivation and immune response [201], the influence of adverse environmental stimuli [202] and thought content [203] on heart rate. Other more recent findings, also relevant to S/RE, have brought into discussion specialized neural networks on empathy and the effects of exposure to altruism [206], the influence of forgiveness on psycho-physiological parameters [207] and the role of moral emotions and social connectivity in health [208], the polyvagal theory regarding the impact of the feeling of safety on the autonomic response [209], the influence of coping mechanisms in the transcriptional response to adversity [210], but also telomere plasticity [211] and self-induced epigenetics [212]. All this shows the extension of concerns and the refined and integrative descriptions proposed by recent medical research, which emphasize the relevance of certain practices in neuro-physiological processes.

However, there are many unclear aspects regarding the ways in which ES? They prove to be beneficial, since, for example, in the case of pain reduction, they do not seem to be mediated by opioid pathways [170], while appreciating that the psychological mediation of prayer is not clearly demonstrated [136]. Observations such as these prove the need for caution both in the results obtained and in the formulation of interpretations.

In general, and with regard to the study of prayer, it is recommended that studies which provide for better designed experimental designs, more careful formulation of working hypotheses, thorough examination of the epistemological framework and empirical design, for a better evaluation of the effects of prayer, including those aimed at situations of miraculous healings be developed [137].

9.2. Evaluations of the impact of prayer and PCOT on health

We have briefly presented studies reporting psycho-emotional and neuro-physiological changes induced by S/RE. Recent meta-analyses add to these evaluations, reporting beneficial effects of prayer on health [86], and on pain management [213, 214]. In this context, studies on PCOT also signal the presence of relevant medical changes. However, we noted the absence of studies that examine the possible changes induced by PCOT, carried out in usual experimental frameworks for this subject (task independent variable, experimental interval of 6-8 weeks, dependent variables of physiological, psycho-metric and electro-physiological order or imaging). A possible explanation for the absence of these studies targeting prayer in general and PCOT in particular is related to the already noted fact that prayer presents a multidimensional structure, being present in individual or collective forms. On the other hand, it is also about fitting spiritual

experience into the matrix of the cognitive sciences, an undertaking that raises, as we have seen, many difficulties. Thus, some authors assess a certain inadequacy of the study of S/RE through sciences, implying that studies aimed at the healing effects of prayer are full of assumptions, challenges and contradictions, and that the limitations of scientific approaches will inevitably mark this area of work [74].

9.3. Personal contribution

In the Romanian space, but also at the international level, there is no systematic presentation of the area of neuroscience focused on either S/RE research/examination in general or the Christian one in particular, and their impact on health.

First of all, the present paper makes a significant contribution to the research in the field through **the systematic presentation of the most important historical stages and representative figures regarding the onset, history and representative contributions in the neuroscientific/neuropsychological-physiological study of S/RE**. These are Chapters 1, 2 and 3 and Annexes 1 to 9 (105 pages).

Another personal contribution of the present work is the **approach, for the first time in the Romanian medical research area of PCOT according to an experimental plan usually used in neurophysiological research of S/RE** (control group, study group, independent variable of task, with an experimental interval of 8 weeks, set of dependent variables and pre- and post-test measurements subjected to statistical analyses).

Several working hypotheses, formulated in the three studies (psychometrics, EEG and salivary markers), regarding possible changes induced by PCOT among subjects from SG, in the post-testing compared to the pre-testing moment, were validated. PCOT 30/8 correlates with a decrease in salivary Cortisol (sC) levels and an increase in IL-6, with changes in the alpha and gamma2 register, $P\alpha = 0.0001$, $P\gamma_2 = 0.0015$, respectively. In addition, some post-testing changes were highlighted in the SG subjects, regarding a3 item ("fears/phobias") and a14item ("assessment of anxious mood at the interview") on the Hamilton scale (anxiety), and in the environments values corresponding to coping mechanisms - *e pos* ("positive interpretation and growth") and *e rel* ("religious approach/religious coping"), from the COPE test. These suggest possible changes driven by PCOT practice among SG subjects.

However, overall, we did not reveal a significant influence of PCOT practice among SG subjects, post-testing, compared to pre-testing, regarding the global score on the Hamilton scale (anxiety) and COPE or salivary markers (IgAs, Os, Ts, AAs, IL-8) and EEG activity corresponding to *beta* and *gamma1* bands.

For this reason, no clearer conclusions can be formulated regarding the existence of changes induced by PCOT.

The clinical and therapeutic relevance underlines the importance of the neuroscientific study of S/RE, being also supported by other findings regarding the desirable and undesirable effects of cultural experiences on the brain, on neurophysiology and on the quality of life [95, 215], sustaining the need to develop research in this area, along with the conceptual and methodological refinement.

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Scientific articles with a medical approach, in BDI publications

- (1) Mihalache, AS; Zăgrean, A-M; Bălan, DG; Stoleriu, I; și Zăgrean, L. **Possible physiological changes induced by the practice of prayer in the christian-orthodox tradition.** *Physiology* (BDI). 2023;104(1): 28-46;
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- (2) Mihalache AS, Zăgrean L. **Compassion vs. empathy. Necessary distinctions in approaching medical care,** *Romanian Medical Journal* (BDI), vol. LXVIII, Issue 3, September 2021, 354-367. DOI: [10.37897/RMJ.2021.3.5](https://doi.org/10.37897/RMJ.2021.3.5);
- (3) Mihalache, AS; Zăgrean, L; **Free will – an approach from the perspective of neuroscience,** *Romanian Journal of Medical Practice* (BDI), vol. XVI, nr. 3 (80), 2021, 327-332, DOI: [10.37897/RJMP.2021.3.6](https://doi.org/10.37897/RJMP.2021.3.6);
- (4) Mihalache, AS; **How do We Live and what is the World We Live in Like? Some Possible Neuroscientific Evaluations on the Anthropology of the Spiritual Life in the Context of the Contemporary Society,** *Global Journal of Anthropology Research* (BDI), 2017, vol. 4, Issue 2, pp. 55-65. DOI: <http://dx.doi.org/10.15379/2410-2806.2017.04.02.04>.

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- (1) Mihalache, AS; **Die Wissenschaft über das Innenleben und die Selbstquantifizierung (Știința interiorității și cuantificarea eului),** *International Journal of Orthodox Theology* (BDI), 2023, vol. 16, Issue 3, pp. 20-55;
- (2) Mihalache, AS; **Die Revolution (Mc)Mindfulness: Einige Betrachtungen aus der Perspektive der christlichen Spiritualität (Revoluția (Mc)mindfulness: câteva considerații din perspectiva spiritualității creștine),** *International Journal of Orthodox Theology* (BDI), vol. 12, Issue 1, 2021, pp. 25-51;
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- (3) Mihalache, AS; **Medicine and Christian spirituality,** *The Relationship Between Theology, Philosophy and Science - an Eastern Christian Perspective*, Basilica, 2021, pp. 344-364;
- (4) Mihalache, AS; **Some challenges for the spiritual life in today's world setting. A reading at the frontier between neuroscience and the philolocal experience of Eastern Christianity,** in vol. *Antropologie și Spiritualitate*, Romanian Academy, 2016, pp. 91-114;
- (5) Mihalache, AS; **The Experience of Compassion – Possible Long-term Changes in Cortex Areas. A Few Recent Findings in the Field of Neurosciences,** *Cognitive Sciences – An Interdisciplinary Approach*, Tudorel Dima and Mihaela Luca (editors), Prouniversitaria, Bucharest, 2015, pp. 211-227. (A summary of this article was the subject of a scientific communication with the same title held on 29th of October, 2015, at *The 6th conference of the*

National Neuroscience Society of Romania, SNN2015, "Neuroplasticity in health and disease", UMFCB, București, 29-31 Octombrie, 2015 (<https://snn2015.snn.ro/>).

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