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Similarity Of Effects On EEG Parameters Of Aramaic, Greek Catholic And Krishnaic Prayers

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Abstract

Background. The effect on the electroencephalogram of Meditation is the subject of numerous studies. Instead, Prayer is for some reason deprived of the attention of researchers. But even these few articles are about Islam. We treat all confessions with equal respect, convinced that God is one, but He has many names and many paths lead to Him. One approach to confirm this belief may be to compare the EEG's immediate response to the Prayers of different confessions. This determined the **purpose** of this study. **Material and Methods**. The object of observation were 4 men: Greek Catholic priest, head of the Church Brotherhood, the supporter of Krishna, and the first author to memorize the authentic Lord's Prayer in Aramaic. In the morning in basale terms (eyes closed) recorded EEG monopolar in 16 loci by 10-20 international system, with the reference electrodes A and Ref on the tassels ears. Among the options considered the average EEG amplitude, frequency, frequency deviation, index, coefficient of asymmetry as well as absolute and relative power spectrum density (PSD) of basic rhythms: β (35÷13 Hz), α (13÷8 Hz), θ (8÷4 Hz) and δ (4÷0,5 Hz) in all loci. In addition, calculated laterality index for PSD each rhythm and the Entropy of relative PSD for each locus EEG. After initial testing, EEG (4-7 times for 25 seconds) was again registered for the next 7 minutes. At the same time, the participants of the study **silently** said the Prayer: the author in Aramaic, Father and Brother in Ukrainian "Our Father …", and Krishnait in Sanskrit "Hare Krishna …". **Results.** EEG parameters were found, according to which the condition of all four study participants before and during Prayer differed

significantly. The neurotropic effects of Prayers are manifested in two inhibitory and three activating patterns. The first inhibitory pattern reflects the decrease in elevated and upper limit levels of PSD of θ-and δ-rhythm in frontal loci and the second reflects decrease in normal PSD levels of β-and θ-rhythm in the frontal, central, temporal and parietal loci. The first enhancing pattern reflects a small increase in normal levels of β-rhythm index and asymmetry and PSD entropy in locus C3, as well as a further increase in elevated δ-rhythm PSD levels in loci P3 and T3. The second enhancing pattern reflects the slight increase in normal PSD levels of θ-rhythm in loci T3, T5, T6, O2 and α-rhythm in locus T5, as well as their indices and entropy PSD in locus O2. The third enhancing pattern reflects a slight increase in amplitude and PSD of α-rhythm in central, frontal, temporal and occipital loci. **Conclusion**. Aramaic, Greek Catholic and Krishnaic Prayers cause the similar immediate changes in a number of parameters of the electroencephalogram.

Key words: Aramaic, Greek Catholic, Krishnaic Prayers, electroencephalogram.

INTRODUCTION

Religion and spirituality have been prominent aspects of most human cultures through the ages; however, scientific inquiry into this phenomenon has been limited. Rim JI et al [23] conducted a systematic literature review of research on the neurobiological correlates of religion and spirituality, which resulted in 25 reports studying primarily religion and spirituality with electroencephalography, structural neuroimaging (MRI), and functional neuroimaging (fMRI, PET). The effects on the electroencephalogram and neuroimaging of Meditation is the subject of numerous studies [3-5,9-16,27,28,31,32,35]. Instead, Prayer is for some reason deprived of the attention of researchers, at least judging by the publications contained in PubMed and PMC. But even these few articles are about Islam [6-8,33,34,36]. The influence of Christian prayer on the EEG has been studied in only a few works [1,2,26,29,30], including the authors of this article [19,20,21]. Occasionally we will mention our study of the effect on the EEG of Holy Water [18,22]. We treat all confessions with equal respect, convinced that God is one, but He has many names and many paths lead to Him. One approach to confirm this belief may be to compare the EEG's immediate response to the Prayers of different confessions. This determined the **purpose** of this study.

MATERIAL AND METHODS

The object of observation were 4 men: Greek Catholic priest Father Volodymyr, head of the Church Brotherhood Ivan, a supporter of Krishna Victor, and your obedient servant, the first author to memorize the authentic Lord's Prayer in Aramaic. December 25, 2015 in the morning in basale terms (eyes closed) recorded (**TA Korolyshyn)** EEG monopolar in 16 loci (Fp1, Fp2, F3, F4, F7, F8, C3, C4, T3, T4, P3, P4, T5, T6, O1, O2) by 10-20 international system, with the reference electrodes A and Ref on the tassels ears. Among the options considered the average EEG amplitude (μV), average frequency (Hz), frequency deviation (Hz), index (%), coefficient of asymmetry (%) and absolute (μV^2/Hz) and relative (%) power spectrum density (PSD) of basic rhythms: β (35÷13 Hz), α (13÷8 Hz), θ (8÷4 Hz) and δ (4÷0,5 Hz) in all loci, according to the instructions of the device (NeuroCom, XAI Medica). In addition, calculated Laterality Index (LI) for PSD each rhythm using formula [14]:

LI, % = Σ [200•(Right – Left)/(Right + Left)]/8

We calculated also for each locus of EEG the Entropy (h) of relative PSD using formula [17] based on classical CE Shannon's formula [25]:

$hEEG = - [PSD\alpha \cdot \log_2 PSD\alpha + PSD\beta \cdot \log_2 PSD\beta + PSD\theta \cdot \log_2 PSD\theta + PSD\delta \cdot \log_2 PSD\delta]/\log_2 4$

The baseline was formed from four 25-second recordings over 7 minutes. After initial testing, EEG (4-7 times for 25 seconds) was again registered for the next 7 minutes. At the same time, the participants of the study **silently** said a Prayer: the author in Aramaic "Oh, breathing Life, your Name shines everywhere …", Father Volodymyr and Brother Ivan in Ukrainian "Our Father …", and benefactor Victor in Sanskrit "Hare Krishna …".

Results processed using the software package "Statistica 5.5".

RESULTS

Reference values of EEG parameters are taken from the database of Truskavetsian Scientific School (n=88). Assuming that the parameters in the range $-2\sigma \div +2\sigma$ are normal, we state that all four study participants are characterized by elevated basal level PSD of **theta-rhythm** in the loci F8 and Fp2 as well as **delta-rhythm** in the loci Fp2, F4, F3, P3 and T3. If the upper threshold is lowered to 1σ, locus C3 is added to this profile (Fig. 1). On the other hand, common characteristics of the study participants are significantly reduced levels of **alpha**-rhythm PSD in the loci T5, C3, C4, T6, F3, F4, Fp2, T4 and O2 (Fig. 2).

Apparently, this is the result of many years of Prayer practice. By the way, the first author since 2011 at least twice a day says "Our Father ..." in Ukrainian, Latin, Greek, German, English, Spanish, Italian, French, Polish and Russian, as well as an authentic Lord's Prayer in Aramaic, which is incomprehensible why it differs from the canonical Christian Prayer by 9/10 (?).

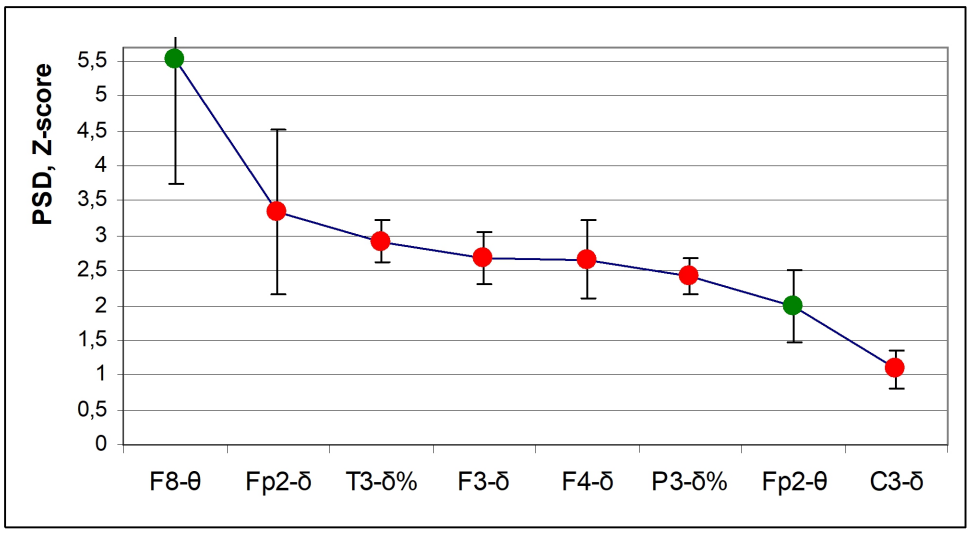

Fig. 1. The basal level of theta- and delta-rhythm PSD of study participants, significantly higher than the reference

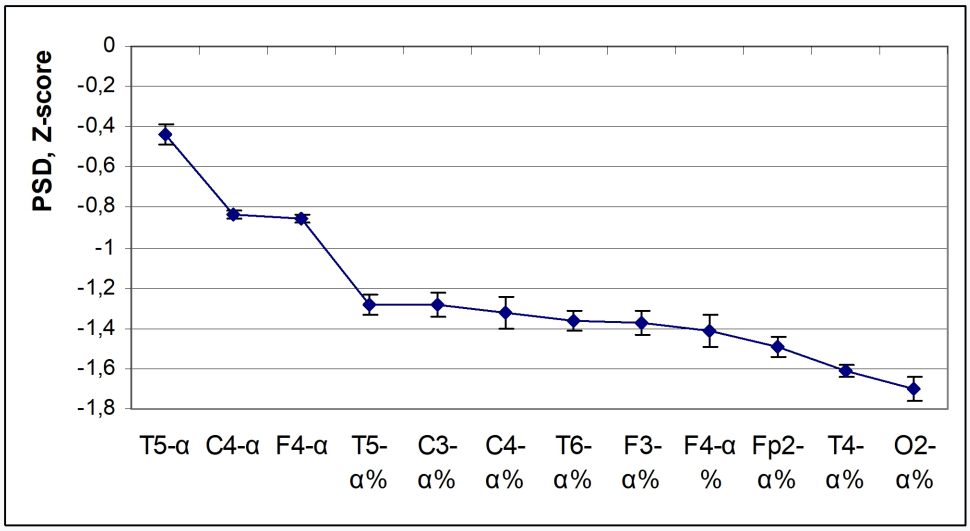

Fig. 2. The basal level of alpha-rhythm PSD of study participants, significantly lower than the reference

The long-term effect of Prayer on EEG as well as HRV and GDV will be the subject of a separate article, and in this one we focus on **immediate** neurotropic effects.

The neurotropic effect of Prayer was assessed by the following algorithm. We first calculated the average of four 25-second basal recordings taken over 7 minutes (**Baseline**). The **direct differences** between 4-7 recordings taken during the next 7-minute Prayer and the **Baseline** were then determined. Finally, we calculated the average of the direct differences, which was considered a measure of the **Effect** of Prayer on a particular EEG parameter.

Table 1 contains parameters whose changes are statistically significant ($p \leq 0,05$). Retrospectively, Entropy PSD in locus O2 was also included, which **unexpectedly** appeared in the structure of the discriminant model.

Pseudo-coloring is used for the convenience of visual perception of information (**δ-rhythm, θ-rhythm, α-rhythm, β-rhythm** as well as **Entropy**).

Table 1. EEG Variables, their Means and Changes caused by Prayer. Parameters are ranked by direct differences of Z-score (see following table)

Variables	Reference level (88)	Mean±SE		Difference, Mean±SE (36)
		Baseline (28)	Prayer (36)	
T3-θ PSD, %	8,4±0,4	7,4±0,7	10,1±1,1	+2,1±0,7
T6-θ PSD, %	6,5±0,3	4,3±0,95	6,5±1,1	+1,5±0,6
Entropy PSD in locus T6	0,74±0,02	0,44±0,06	0,57±0,06	+0,07±0,02
Entropy PSD in locus C3	0,83±0,01	0,85±0,02	0,89±0,01	+0,04±0,01
T3-δ PSD, %	20,2±1,4	57,6±3,9	60,6±3,3	+5,2±2,6
P3-δ PSD, %	19,8±1,3	49,7±3,2	53,7±3,0	+4,9±2,2
β-rhythm Asymmetry, %	19,8±1,5	22,4±3,9	28,6±3,9	+5,3±1,5
α-rhythm Index, %	49,9±3,3	28,1±3,7	34,9±3,8	+10,3±2,8
T5-θ PSD, %	7,3±0,4	5,6±1,0	7,7±1,3	+1,3±0,6
O2-θ PSD, %	4,9±0,3	4,9±0,8	6,5±0,9	+0,9±0,4
C3-α PSD, %	41,8±2,0	17,8±1,1	22,6±1,3	+5,5±1,1
F4-α PSD, %	40,9±2,1	13,9±1,5	18,4±1,5	+5,4±1,0
C4-α PSD, %	41,6±1,9	17,5±1,5	20,8±1,3	+4,6±1,4
T6-α PSD, %	38,0±2,4	6,9±1,1	13,5±1,9	+5,4±1,1
F3-α PSD, %	41,9±2,1	15,0±1,2	18,9±1,6	+4,5±1,1
β-rhythm Index, %	87,9±1,9	94,4±1,2	97,0±0,5	+3,5±1,1
θ-rhythm Index, %	25,2±4,5	17,7±3,5	26,2±3,6	+8,5±3,6
Fp2-α PSD, %	39,8±2,1	10,5±0,9	13,5±1,7	+3,8±1,3
T4-α PSD, %	38,1±2,1	6,7±0,7	10,9±1,3	+3,7±1,9
T5-α PSD, $\mu V^2/Hz$	134±16	68±8	102±14	+26±11
O2-α PSD, %	54,5±2,6	12,6±1,6	17,7±2,1	+3,6±1,2
T5-α PSD, %	36,8±2,3	9,6±1,1	13,5±1,8	+3,0±1,1
C4-α PSD, $\mu V^2/Hz$	202±19	55±3	72±6	+16±6
F4-α PSD, $\mu V^2/Hz$	179±16	46±2	60±5	+13±4
α-rhythm Amplitude, μV	22,1±1,5	10,3±0,3	11,5±0,6	+1,1±0,5
Entropy PSD in locus O2	0,69±0,02	0,57±0,06	0,64±0,05	**+0,01±0,01**
P4-β PSD, %	25,5±1,8	17,2±2,3	16,2±1,7	-3,0±1,5
C3-β PSD, %	27,2±1,7	24,2±1,9	20,7±1,0	-3,2±1,3
C4-β PSD, %	27,4±1,7	21,7±1,7	18,7±1,2	-3,0±1,3
F3-β PSD, %	26,3±1,7	17,0±1,6	14,4±1,0	-3,5±1,3
β-rhythm Laterality, %	-8±3	-36±6	-40±6	-6,2±3,1
P4-θ PSD, $\mu V^2/Hz$	35,5±2,7	41,5±2,9	37,8±3,7	-5,9±2,8
P3-β PSD, %	27,4±1,9	21,0±1,8	17,7±1,3	-4,4±1,2
F8-β PSD, $\mu V^2/Hz$	69±7	47±12	36±7	-22±11
F4-θ PSD, $\mu V^2/Hz$	38,7±2,6	37,1±4,7	34,9±3,2	-7,3±2,4
F7-β PSD, $\mu V^2/Hz$	77±9	68±12	55±6	-26±9

θ-rhythm Laterality, %	-5±3	-11±7	-25±7	-10±3
T4-β PSD, %	31,3±1,9	16,4±3,0	12,0±1,5	-7,6±1,9
β-rhythm Deviation, Hz	1,29±0,08	1,48±0,12	1,14±0,10	-0,32±0,14
C4-β PSD, μV²/Hz	88±5	74±9	63±5	-20±8
T3-β PSD, %	34,1±1,9	21,3±2,6	14,7±1,7	-8,5±1,8
C4-θ PSD, μV²/Hz	38,3±2,5	44±7	39±5	-11±3
δ-rhythm Asymmetry, %	32,8±2,8	38,8±3,1	27,5±1,7	-13,3±3,5
Fp1-β PSD, μV²/Hz	66,5±3,4	64,5±8,9	56,4±4,6	-17,0±6,9
C3-β PSD, μV²/Hz	96±5	85±11	66±4	-28±9
C3-δ PSD, μV²/Hz	95±9	183±21	155±16	-49±14
F3-δ PSD, μV²/Hz	95±10	347±35	301±31	-56±24
F3-β PSD, μV²/Hz	86±5	82±11	62±4	-31±8
T6-β PSD, μV²/Hz	93±8	114±28	94±22	50±22
T3-β PSD, μV²/Hz	103±10	108±21	65±7	-67±14
F4-β PSD, μV²/Hz	76±4	75±10	60±6	-25±8
T4-β PSD, μV²/Hz	80±6	95±21	51±8	-65±13
Fp2-θ PSD, μV²/Hz	21,8±1,5	49±7	41±4	-17±5,5
F4-δ PSD, μV²/Hz	89±19	324±49	234±29	-126±32
Fp2-δ PSD, μV²/Hz	110±25	902±281	559±124	-571±256
F8-θ PSD, μV²/Hz	12,5±0,9	60±15	47±7	-24±10

At the next stage of the analysis, the actual values (V) were recalculated into Z-scores (Table 2) by the formula:

$Z = (V-N)/\sigma_N = (V/N-1)/Cv$, where

N is normal (reference) level of the parameter, borrowed from the database;

σ_N is standard deviation;

Cv is variability coefficient.

This approach makes it possible to assess, firstly, the direction and extent of deviation of the actual level of the parameter from the reference (normal), and secondly, to rank the severity of the impact of Prayer on individual parameters (Table 2).

Table 2. Z-scores of EEG Variables and their Changes caused by Prayer. Parameters are ranked by direct differences of Z-scores

Variables	Variability coefficients	Z-scores±SE		Difference, Z±SE (36)
		Baseline (28)	Prayer (36)	
T3-θ PSD, %	0,390	-0,29±0,21	+0,53±0,35	+0,65±0,21
T6-θ PSD, %	0,477	-0,71±0,31	0,00±0,35	+0,48±0,18
Entropy PSD in locus T6	0,199	-2,02±0,38	-1,14±0,40	+0,44±0,14
Entropy PSD in locus C3	0,114	+0,30±0,16	+0,66±0,15	+0,42±0,15
T3-δ PSD, %	0,635	+2,92±0,30	+3,15±0,26	+0,41±0,20
P3-δ PSD, %	0,620	+2,43±0,26	+2,76±0,25	+0,40±0,18
β-rhythm Asymmetry, %	0,717	+0,18±0,28	+0,62±0,28	+0,38±0,11
α-rhythm Index, %	0,625	-0,70±0,12	-0,48±0,13	+0,33±0,09
T5-θ PSD, %	0,548	-0,42±0,26	+0,09±0,32	+0,32±0,15
O2-θ PSD, %	0,559	-0,02±0,29	+0,58±0,34	+0,32±0,16
C3-α PSD, %	0,449	-1,28±0,06	-1,02±0,07	+0,30±0,06
F4-α PSD, %	0,470	-1,41±0,08	-1,17±0,08	+0,28±0,05
C4-α PSD, %	0,439	-1,32±0,08	-1,14±0,07	+0,25±0,07
T6-α PSD, %	0,602	-1,36±0,05	-1,07±0,08	+0,24±0,05
F3-α PSD, %	0,469	-1,37±0,06	-1,17±0,08	+0,23±0,06
β-rhythm Index, %	0,197	+0,38±0,07	+0,53±0,03	+0,20±0,06
θ-rhythm Index, %	1,679	-0,18±0,08	+0,02±0,08	+0,20±0,09
Fp2-α PSD, %	0,492	-1,49±0,05	-1,34±0,09	+0,19±0,06
T4-α PSD, %	0,512	-1,61±0,03	-1,39±0,07	+0,19±0,05
T5-α PSD, $\mu V^2/Hz$	1,136	-0,44±0,05	-0,21±0,09	+0,17±0,07
O2-α PSD, %	0,453	-1,70±0,06	-1,49±0,09	+0,15±0,05
T5-α PSD, %	0,580	-1,28±0,05	-1,09±0,08	+0,14±0,05
C4-α PSD, $\mu V^2/Hz$	0,871	-0,84±0,02	-0,74±0,04	+0,09±0,04
F4-α PSD, $\mu V^2/Hz$	0,864	-0,86±0,02	-0,77±0,03	+0,08±0,03
α-rhythm Amplitude, μV	0,657	-0,81±0,02	-0,73±0,04	+0,08±0,03
Entropy PSD in locus O2	0,261	-0,67±0,31	-0,28±0,30	**+0,07±0,08**
P4-β PSD, %	0,649	-0,50±0,14	-0,56±0,10	-0,18±0,09
C3-β PSD, %	0,573	-0,19±0,12	-0,41±0,07	-0,20±0,08
C4-β PSD, %	0,583	-0,21±0,12	-0,41±0,09	-0,21±0,09
F3-β PSD, %	0,609	-0,58±0,10	-0,74±0,06	-0,22±0,08
β-rhythm Laterality, %	σ=27,1	-1,03±0,24	-1,19±0,21	-0,23±0,11
P4-θ PSD, $\mu V^2/Hz$	0,716	+0,23±0,11	+0,09±0,15	-0,23±0,11
P3-β PSD, %	0,633	-0,37±0,10	-0,56±0,08	-0,25±0,07
F8-β PSD, $\mu V^2/Hz$	1,165	-0,27±0,15	-0,41±0,08	-0,28±0,14
F4-θ PSD, $\mu V^2/Hz$	0,630	-0,06±0,19	-0,15±0,13	-0,30±0,10
F7-β PSD, $\mu V^2/Hz$	1,083	-0,11±0,14	-0,26±0,07	-0,31±0,11

θ-rhythm Laterality, %	σ=27,6	-0,20±0,25	-0,72±0,25	-0,36±0,12
T4-β PSD, %	0,584	-0,81±0,16	-1,06±0,08	-0,42±0,10
β-rhythm Deviation, Hz	0,584	+0,26±0,16	-0,20±0,13	-0,43±0,19
C4-β PSD, μV²/Hz	0,479	-0,33±0,21	-0,60±0,13	-0,48±0,19
T3-β PSD, %	0,509	-0,74±0,15	-1,12±0,10	-0,49±0,10
C4-θ PSD, μV²/Hz	0,611	+0,23±0,31	+0,04±0,22	-0,49±0,13
δ-rhythm Asymmetry, %	0,812	+0,22±0,12	-0,20±0,06	-0,50±0,13
Fp1-β PSD, μV²/Hz	0,484	-0,06±0,28	-0,31±0,14	-0,53±0,21
C3-β PSD, μV²/Hz	0,506	-0,22±0,22	-0,62±0,08	-0,58±0,19
C3-δ PSD, μV²/Hz	0,859	+1,08±0,26	+0,74±0,20	-0,60±0,18
F3-δ PSD, μV²/Hz	0,989	+2,68±0,37	+2,19±0,33	-0,60±0,26
F3-β PSD, μV²/Hz	0,558	-0,09±0,23	-0,51±0,07	-0,64±0,17
T6-β PSD, μV²/Hz	0,839	+0,27±0,36	+0,01±0,29	-0,65±0,29
T3-β PSD, μV²/Hz	0,895	+0,05±0,23	-0,41±0,08	-0,72±0,15
F4-β PSD, μV²/Hz	0,443	-0,03±0,29	-0,48±0,19	-0,73±0,23
T4-β PSD, μV²/Hz	0,702	+0,26±0,37	-0,52±0,14	-1,16±0,24
Fp2-θ PSD, μV²/Hz	0,631	+1,99±0,51	+1,36±0,29	-1,24±0,40
F4-δ PSD, μV²/Hz	0,994	+2,65±0,56	+1,64±0,33	-1,42±0,36
Fp2-δ PSD, μV²/Hz	2,162	+3,33±1,18	+1,89±0,52	-2,40±1,08
F8-θ PSD, μV²/Hz	0,689	5,52±1,77	4,00±0,77	-2,81±1,19

Figure 3 shows that the significant inhibitory neurotropic effects of Prayer are more numerous than activating (30 parameters vs 26) and more pronounced (Mean±SE: -0,66±0,11 vs +0,27±0,03).

Therefore, further analysis will begin with inhibitory neurotropic effects. Based on the levels of parameters before and during Prayer and their changes, the inhibitory profile was divided into two patterns.

So, the first pattern reflects the inhibitory effect of Prayer on elevated and upper limit levels of PSD of **θ**-and **δ**-rhythm in frontal loci (Fig. 4).

The second pattern (Fig. 5) reflects a decrease in normal PSD levels of **β-rhythm** as well as **θ-rhythm** in the frontal, central, temporal and parietal loci. In addition, **β-rhythm** variability and **δ-rhythm** asymmetry decrease, and the initial slight left-side lateralization of **β**-and **θ**-rhythms further drifts to the left.

The activating neurotropic effect of Prayer is reflected in three patterns. The first pattern (Fig. 6) reflects a small but significant increase in initially normal levels of **β-rhythm** index and asymmetry and PSD entropy in locus C3, as well as a further increase in elevated **δ-rhythm** PSD levels in loci P3 and T3.

The second enhancing pattern (Fig. 7) reflects the same slight increase in normal PSD levels of **θ-rhythm** in loci T3, T5, T6, O2 and **α-rhythm** in locus T5, as well as their indices and **entropy** PSD in locus O2.

The third pattern (Fig. 8) reflects a slight increase in amplitude and PSD of **α-rhythm** in central, frontal, temporal and occipital loci as well as the **entropy** of PSD in locus T6.

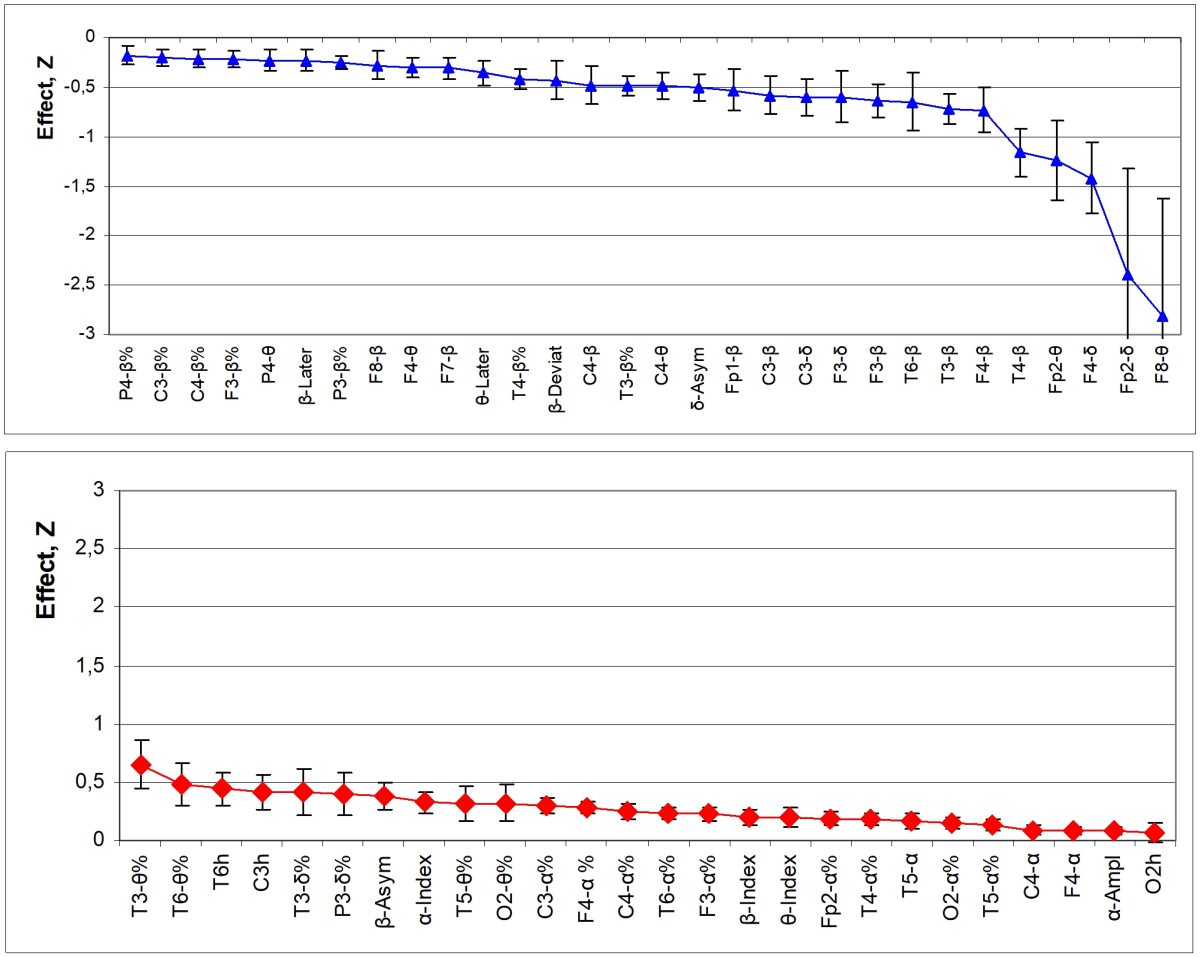

Fig. 3. Panoramic profiles of inhibitory (above) and activating (below) effects (Mean±SE) of Prayer on EEG parameters

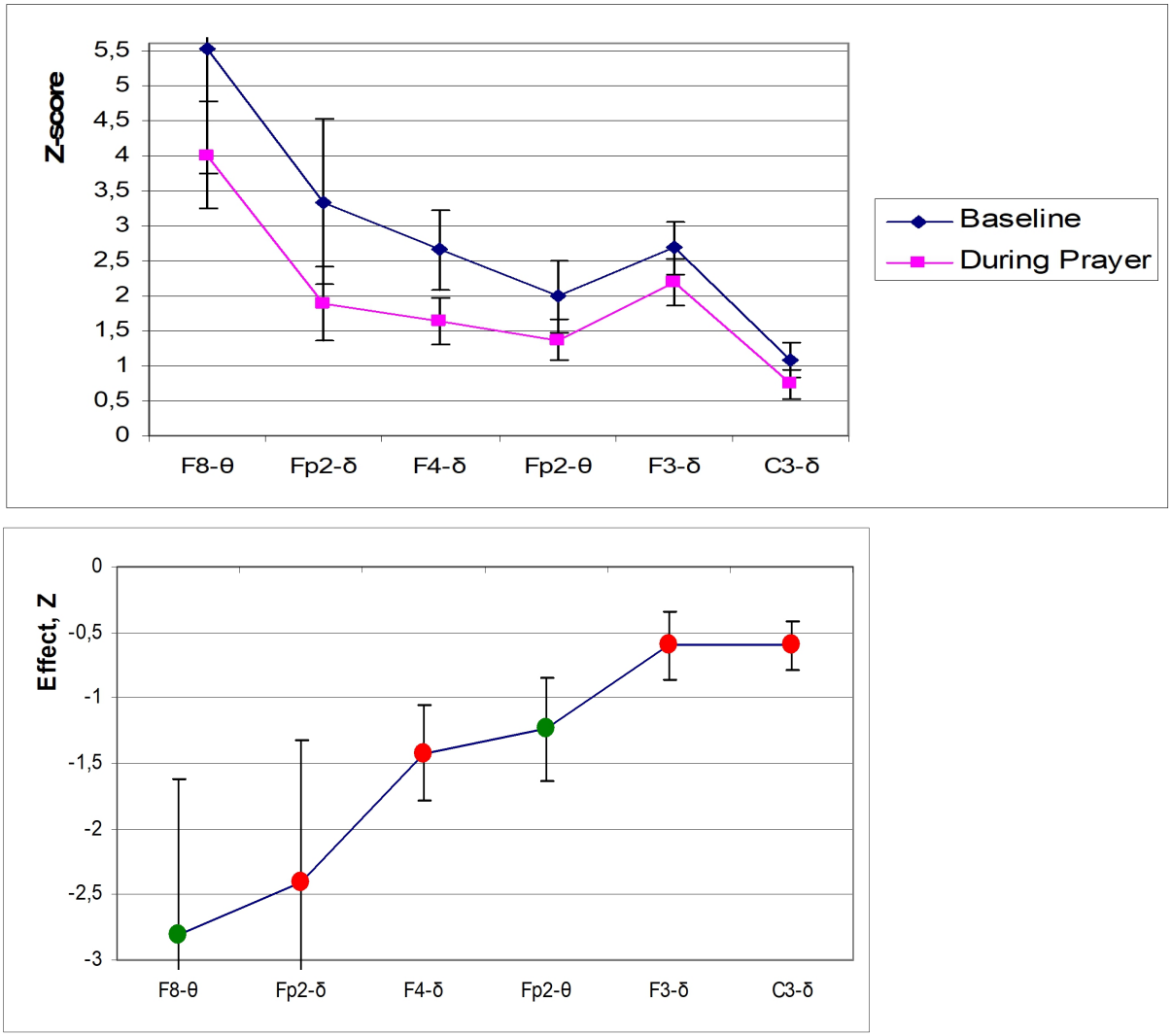

Fig. 4. Inhibitory immediate effect of Prayer on elevated and upper limit EEG parameters

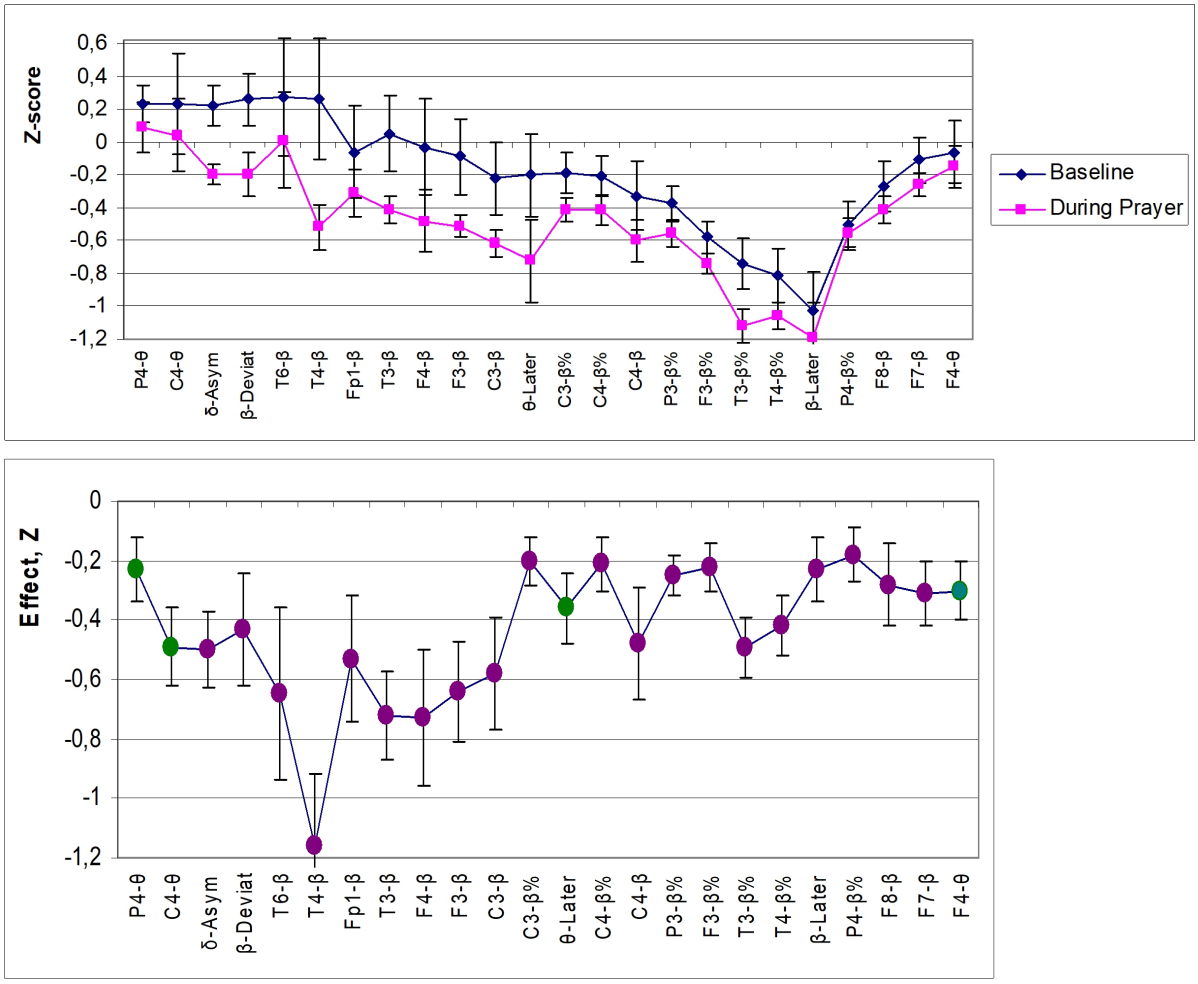

Fig. 5. Inhibitory immediate effect of Prayer on normal EEG parameters

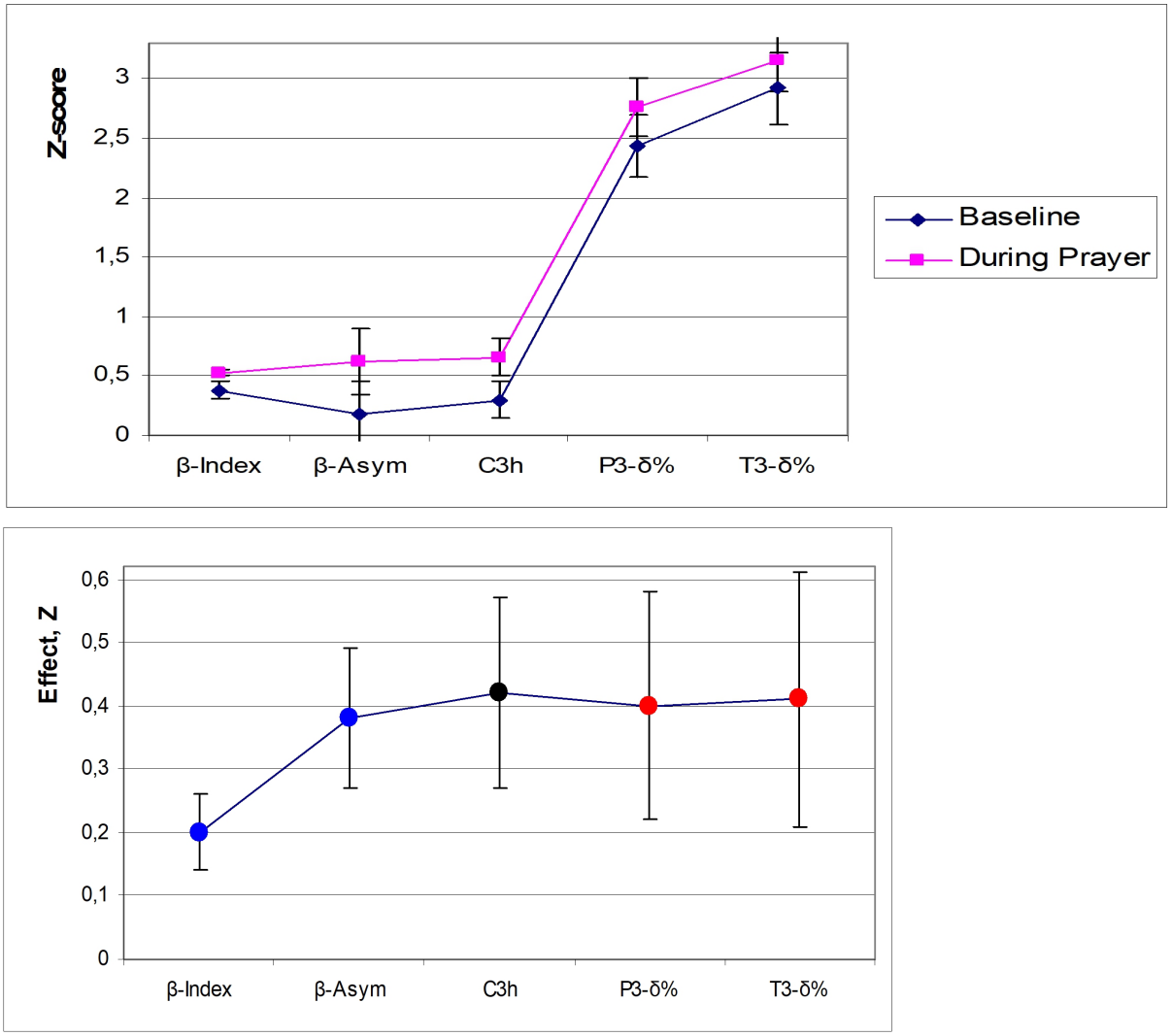

Fig. 6. Enhancing immediate effect of Prayer on normal and elevated EEG parameters

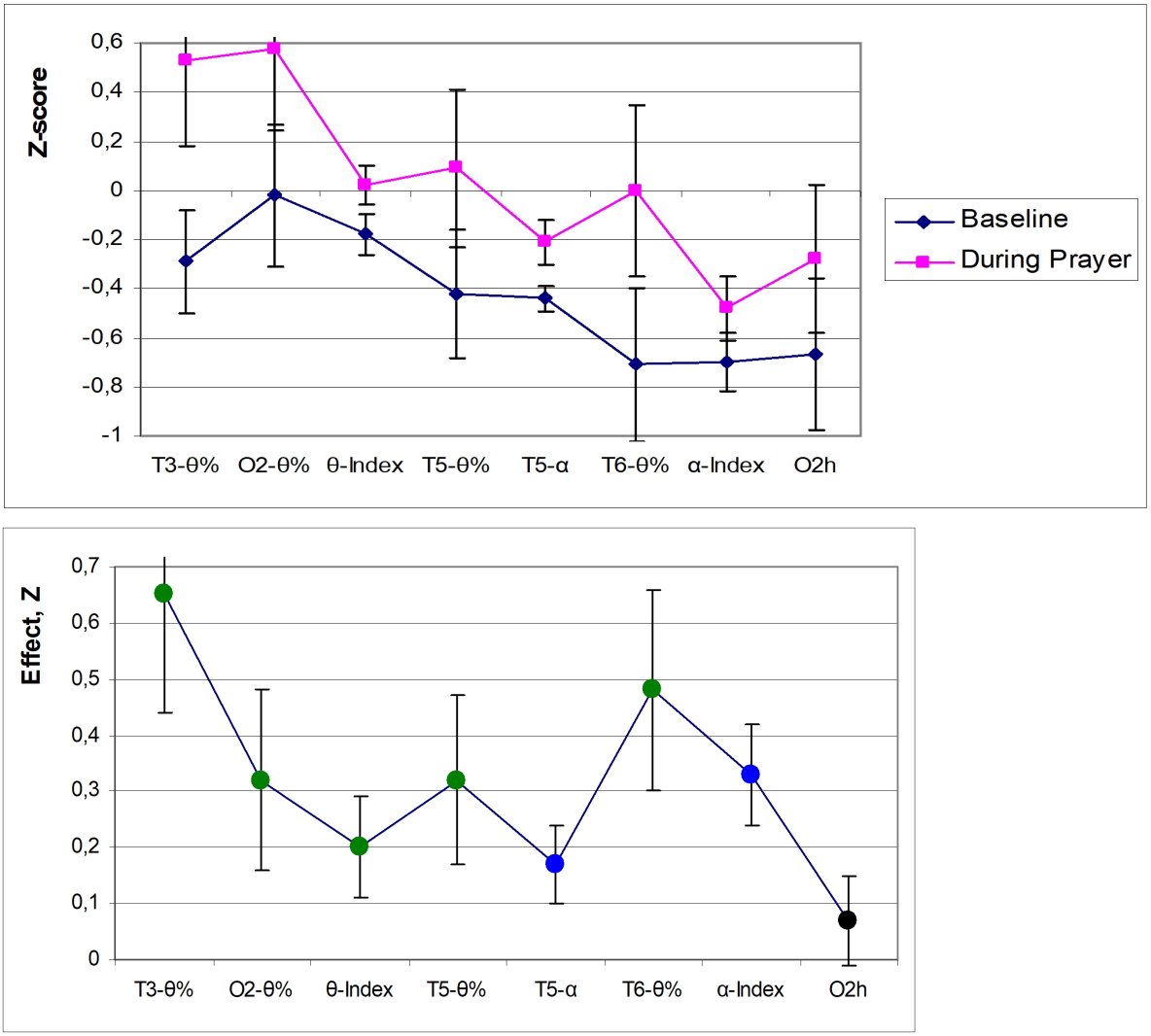

Fig. 7. Enhancing immediate effect of Prayer on normal and lower border EEG parameters

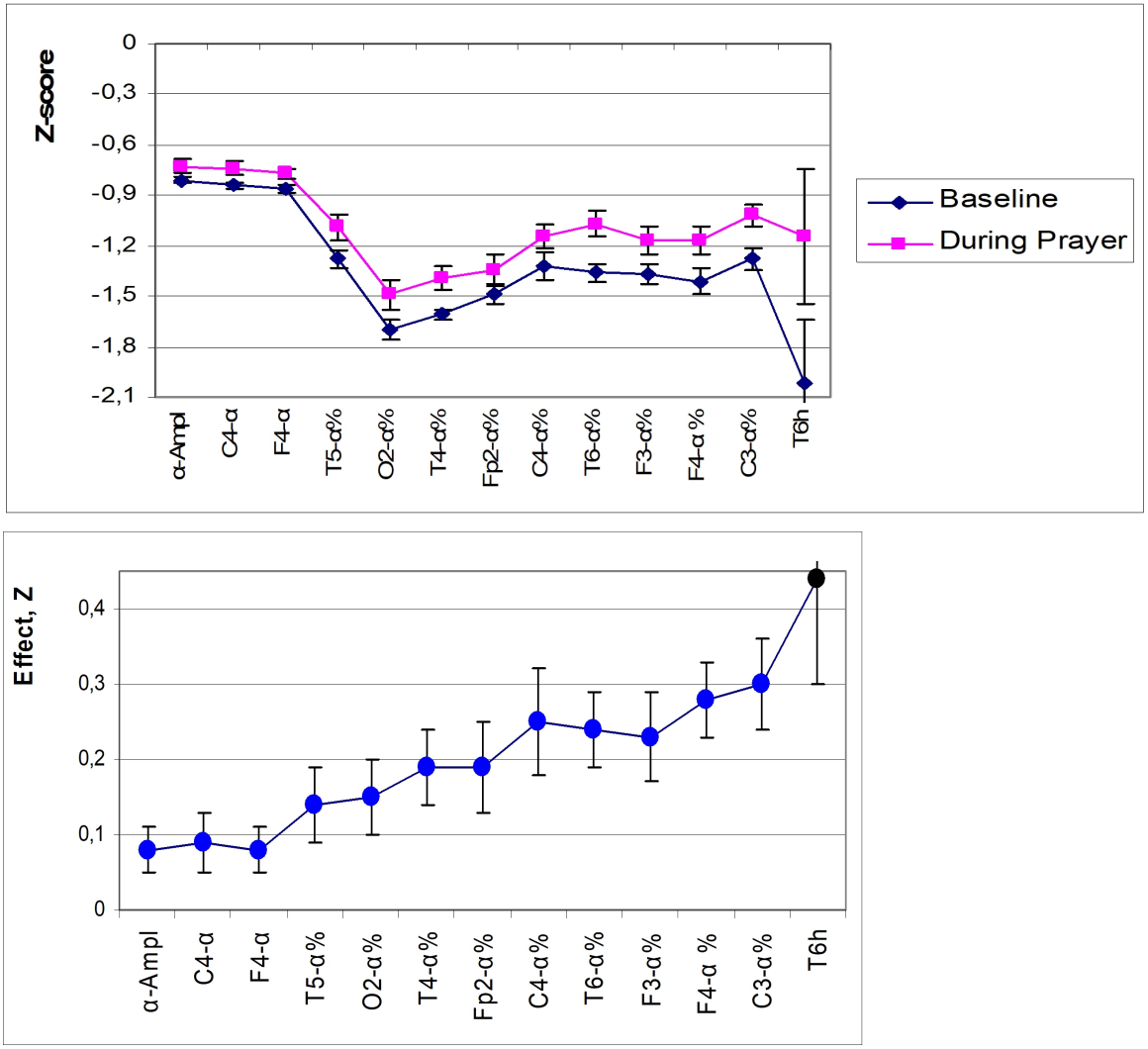

Fig. 8. Enhancing immediate effect of Prayer on normal and lower border EEG parameters

DISCUSSION

We consider it appropriate to hold a thorough discussion in the next article, which will present the results of synchronous with the EEG heart rate variability and gas discharge visualization. And now let's limit ourselves to only some aspects.

We found that the brain responds to Prayer almost immediately: the response recorded during the first 25-second session remains the same for the next 4-7 recordings over a period of 7 minutes. Significantly, the stimuli of the brain's response to Prayer are neither sound nor lip movements, because Prayer is specially performed **mentally**. Therefore, it remains to accept the **informational** nature of the neurogenic stimulus.

In a similar study involving one Catholic and three Orthodox priests and two Orthodox lay people, Slyozin VB et al [26] found a “significant (one and a half to two orders of magnitude) decrease in spectral power at alpha- and beta-rhythms; although the absolute level of spectral density in the range of theta- and delta- rhythms did not change, the relative content of slow oscillations in the dynamics of EEG signals increased, and they began to dominate against the background of the reduced high-frequency part of the EEG; the return of

study participants to a normal state of consciousness was accompanied by a rapid restoration of the initial background picture of the bioelectrical activity of the brain". Unfortunately, the authors do not provide data from statistical processing of the results, limiting themselves to two illustrations of the EEG and the power spectrum. However, they declared the "discovery of the **fourth** physiologically normal functional state of the brain, nominated as **slow wakefulness**". We also found a **decrease** in PSD beta-rhythm, but moderate (see Fig. 5), while PSD alpha-rhythm increased moderately (see Fig. 8). Regarding the changes in PSD of theta- and delta-rhythm, our data are ambiguous: it **increased** in the temporal, parietal and occipital loci (see Fig. 7), while decreased in the frontal (see Fig. 4).

In a first study conducted by Doufesh H et al [6], nine Muslim subjects were asked to perform the four required cycles of movements of Dhuha prayer, and the EEG were subsequently recorded with open eyes under three conditions, namely, resting, performing four cycles of prayer while reciting the specific verses and supplications, and performing four cycles of acted salat condition (prayer movements without any recitations). Analysis revealed that there were no significant difference in the mean alpha relative power between the alpha amplitude in the Dhuha prayer and the acted conditions in all eight electrode positions. However, the mean alpha relative power showed higher alpha amplitude during the prostration position of the Dhuha prayer and acted condition at the parietal and occipital regions in comparison to the resting condition. Thirty healthy Muslim men participated in the next Doufesh's H et al study [7]. Their EEGs were continuously recorded before, during, and after salat practice. During salat, a significant increase was observed in the mean alpha relative power in the occipital and parietal regions. This is consistent with our data (see Fig. 8).

Vaghefi M et al [33] investigated the effect of Quran on a Persian-speaking Muslim. Volunteers listened to three different audio files (Verses from Sura 'Forqan' unconsciously; Arabic text unconsciously; Verses from Sura 'Fath' consciously). EEG signals were recorded and the changes in the relative power of theta and alpha band are considered an indicators of relaxation. The findings indicate that conscious listening to Holy Quran increases the relative theta power in most areas of the head, compared to the rest condition, and listening to Quran unconsciously increased relative theta power in the frontal and central lobes of the head significantly, compared to the rest condition. Also, listening to Quran consciously increases the relative alpha power in the frontal lobe, compared to the rest condition.

Next study by Vaghefi M et al [34] has been designed and implemented with the aim of determining the effects of religious beliefs and the effect of listening to Holy Quran on electrical activity of the brain of the Iranian Persian-speaking Muslim volunteers. The brain signals of 47 volunteers while listening to the Holy Quran consciously, and while listening to the Holy Quran and the Arabic text unconsciously were used. Therefore, due to the nonlinear nature of EEG signals, these signals are studied using approximate entropy, sample entropy, Hurst exponent, and Detrended Fluctuation Analysis. Statistical analysis of the results has shown that listening to the Holy Quran consciously increases approximate entropy and sample entropy, and decreases Hurst Exponent and Detrended Fluctuation Analysis compared to other cases. So, consciously listening to the Holy Quran decreases self-similarity and correlation of brain signal and instead increases complexity and dynamicity in the brain. We also found an **increase** in Shannon's entropy at the loci C3 (see Fig. 6) and T6 (see Fig. 8).

Three women and two men participated in Yousefzadeh's F et al [36] pilot study. Linear (absolute and relative power of θ, α1, α2, β1, β2, β3, γ1, γ2) and non-linear features (approximate entropy, Katz fractal dimension, Petrosian fractal dimension, spectral entropy, and sample entropy) from Fps channel were calculated. The relative β to γ band, approximate and sample entropy, Petrosian fractal dimension and mean of amplitude decreased in open eye state in women. While θ to γ bands in the closed eye state decreased after Sajdah in women.

The absolute γ bands in closed eye state and relative β band in open eye state increased after Sajdah in men. So, 10 seconds of Sajdah has effects on brain activity and sometimes showed the opposite effect on genders.

Taken together, our data and the data of the cited authors testify to the similarity of the immediate influence on the EEG of Prayers of different confessions.

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ACCORDANCE TO ETHICS STANDARDS

Tests in patients are conducted in accordance with positions of Helsinki Declaration 1975, revised and complemented in 2002, and directive of National Committee on ethics of scientific researches. During realization of tests from all participants the informed consent is got. All participants (Father Volodymyr, Brather Ivan and Viktor) agreed to publish their names.

For all authors any conflict of interests is absent.

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