Implications of Religious Thinking in Therapeutic Compliance

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Presenting specialty literature background in: organic chemistry, neurology, theology and clinical psychology, in order to conceptualize and bring to the forefront the interdependency between organic chemistry, neurology, psychology and religion in describing the implications of religious thinking in therapeutic compliance is a first objective of the present paper. As such, we addressed the importance of neurotransmitters in the neurophysiology of spiritual interventions. Another specific objective was defined as measuring psychological reactions, components of the moral and religious structure of human personality, with the help of psychophysiological involved factors, in rapport with therapeutic compliance. According to the descriptive statistic of data, we found that those who do not adhere to any religious cult have greater chances of being diagnosed with a disease that necessitates daily treatment and monitoring (the percentage found was 20%), in comparison with those who are part of a religious cult (6.67 %). The estimated non-linear regression model to confirm the interdependency between the medial psychophysiological reactivity to religious stimulus and the medial score obtained in the compliance questionnaire was validated by the values of R = 0.99 and p-value=$0.00 \approx 10^{-10} < 0.05$). As such, we can accept the hypothesis that "there is a statistically significant association between religious thinking and compliance". On the other hand, the hypothesis "there is a statistically significant association between religious thinking and compliance" was validated, using the t test, only at 40%, as the results of the t test were only considered on significant components of the applied MARS questionnaire. The results given by approaching the two hypotheses through the mixture of psychophysiological and application of the MARS questionnaire consistently highlighted an image of importance of religious thinking in therapeutic compliance. The current study is useful in motivating adherents of any religion, in our study, the Christian belief, to improve their compliance.

Keywords:oxcytocin, vassopressin, MARS scale, therapeutic compliance, religious experience

Neurotheology[1], according to Smith, is the science that studies neurobiological processes present in the human brain during an individual's religious experience. According to Newberg's ideology, Smith[1] mentions that neurotheology implies understanding the human brain and its associated capacity to respond to religious belief and to have spiritual experiences.

Sayadmansour brings to the forefront the used functions of the brain [2] in leveraging different neural processes when conceptualizing religious experiences: the binary function, the quantitative function, the causality function, the holistic function.

Newberg highlights the four neuroscientific paradigms [3] that allow for the analysis of spiritual experiences: drug-induced spiritual experiences, neuropathological and psychopathological spiritual experiences, physical and psychological therapeutic interventions, and the neurophysiology of spiritual interventions.

In the paper "*The neuroscientific study of spiritual practices*"[3] Newberg mentions, regarding the neurophysiology of spiritual interventions, that the latter implies comparing psycho-spiritual measurements with neurobiological parameters, such as: activity of neurotransmitters [4], cerebral metabolism, electrical activity of the cerebral cortex and cerebral blood flow. Physiological parameters, such as: cardiac rhythm, blood pressure, galvanic skin response and body temperature are subject to a correlation analysis in rapport with neuroimaging in order to reveal the consequences of spiritual/religious practice.

Regarding the role of neurotransmitters in the neurophysiology of spiritual interventions[5], according to Yaden et al. there is an association between oxytocin [6] and religious experiences, and also, ADH neuropeptide (vasopressin) given by the molecular formula: $C_{46}H_{65}N_{15}O_{12}S_2$ [7b], combined with oxytocin, given by the molecular formula: $C_{43}H_{66}N_{12}O_{12}S_2$ [7a], (both oxytocin and ADH, whose chemical structures are presented in figure 1[8] and figure 2[9], respectively, are secreted in the posterior lobe of the pituitary gland) and the epiphysis play a role in achieving social connections, an important part in experiencing spiritual and religious experiences.

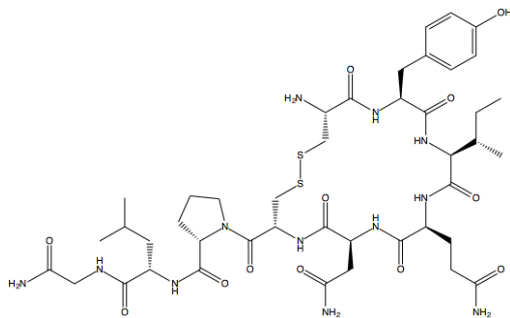**email: nicolae,cristea@drd.umfcd.ro, Phone: 0735623686*
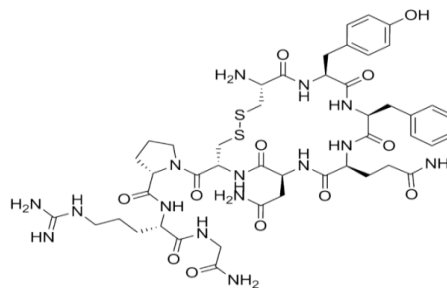
Fig. 1. Chemical structure of oxytocin

Fig. 2. Chemical structure of vasopressin (ADH)

Compliance is the process through which the patient follows the prescribed regiment and distributed as intended by the attending physician.

There are three important methods of measuring compliance [10] in psychiatric research. The first includes clinical patient self-reporting, the second is counting of the pills and the third is biological measurement. In the model of Health Belief, conformity is determined by the patient's knowledge and attitudes. The new model of Health Belief [11], described by McArthur et al., includes two variables: auto-efficacy and cues to action.

Bahrini et al. describe the advantages of the MARS scale [12], an abbreviation of "Medication Adherence Rating Scale", which includes characteristics both of the DAI and the MAQ tests [11] developed by Morisky et al, with a significant validity that can be clinically utilized with greater efficiency in identifying the tested individual's attitude towards his/her medication.

Experimental part

Methods

Through the current research we aim to measure psychological reactions, components of the moral and religious structure of human personality, with the help of the following parameters [14]: Line length of chest breathing (logo:LLRT; measurement unit:pixeli), Amplitude of blood pressure in brachial pulse (logo:ATAB; measurement unit: Figures), Amplitude of electrodermal reaction (logo:ARED; measurement unit: Figures), Breathing rhythm (logo:RR; measurement unit:cycles/minute), Heart rate (logo:RC; measurement unit: heartbeat/min), Average value of electrodermal reaction in ohms (logo:RED;measurement unit: ohms), in bank with self-defining compliance through application of the MARS questionnaire.

The experiment took place between the 19th of February and the 28th of May, and included subjects that were hospitalized at least once or were subjected at least once to treatment, for a duration of at least 7 consecutive days, in Bucharest. Subject participation was ensured based on informed consent. In psychophysiological testing, the Lafayette polygraph machine was used model LX 4000 [15], and the obtained data could be viewed through the afferent software, LXSoftware, version 11.7.2 (Lafayette, Co.2018). For testing of compliance, an online questionnaire was used based on the structure of the MARS scale.

The participant lot included 60 individuals from two categories: practicing religious and non-practicing religious. From a gender perspective, there were 32 female participants and 28 male participants, with ages ranging between 19 and 47 years old.

Sampling was performed once, with no recurrence, randomly. A 95% degree of confidence in the dataset and a representation margin of error of 3% were ensured.

Regarding this research's hypotheses, the following two hypothesis were tested: 1. There is a statistically significant association between religious thinking and compliance; 2. There are statistically significant differences regarding compliance between practicing Christians and non-practicing Christians.

The utilized experimental design [16] is presented in Table 1, and the study's variables are, on the one hand, independent variables: parameters obtained on the polygraph based on religious stimulus and, on the other hand dependent variables: scores obtained after applying the compliance questionnaire.

Table 1
EXPERIMENT DESIGN

Group	Religious stimulus	Calipers Results	Compliance questionnaire	MARS Score
N1	X1	O1	X2	O2
N2	X1	O1	X2	O2

The constituting elements of the design presented in table 1 are: N1 is the set of practicing religious Christians; N2 is the set of non-practicing religious Christians; X1 are religious stimulus; X2 is the self-assessment of compliance; O1 are the results of psychophysiological measurements; O2 are the scores obtained on the MARS questionnaire.

Statistical analysis

Collection and classification of data was performed with the help of the tabular calculus software "Excel". This data was later consolidated into an SAV database and processed with the statistical software IBM SPSS Statistics (version 23). Data

processing aimed at verifying and validating or invalidating the two aforementioned hypotheses, by utilizing inferential statistics.

Results and discussions

Based on the results obtained in the descriptive statistics of the dataset, it can be said that those who are not active participants of a religious cult have greater chances of being diagnosed with a disease that requires daily treatment and monitoring (20%), compared with people who are participants of a religious cult (the percentage of these being 6.67%).

By continuing the structural analysis to a subset level, we found that of those that do not participate in any religious cult, 60% of subjects were female and 40% of subjects were male, while in the subset of those that do participate in a religious cult, males represented 53.33%, while females the rest of 46.67%.

In order to validate or invalidate the hypothesis "There is a statistically significant association between religious thinking and compliance" with the help of the R test, or, better said, to "measure" psychophysiological reactivity to religious stimulus in rapport with compliance in the subjects of this study, the latter were separated in two categories: those who do not participate in a religious cult, and those who do participate in a religious cult, we chose as specific parameters: RR (respiratory rate) and RC (heart rate). Inclusion of these two parameters was based on selection criteria based on found correlations.
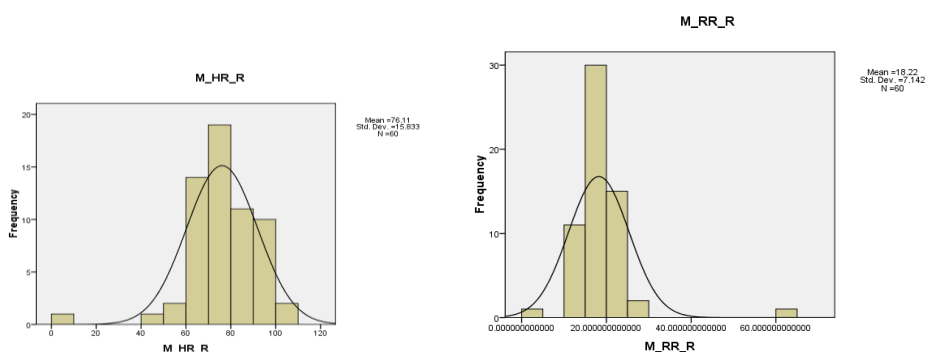

Fig.3. Distribution of data of RR (respiratory rate) and RC (heart rate)

Based on figure 3, we may say that RR (respiratory rate) and RC (heart rate) respect the Gaussian distribution (normal), which confirms their consistency.
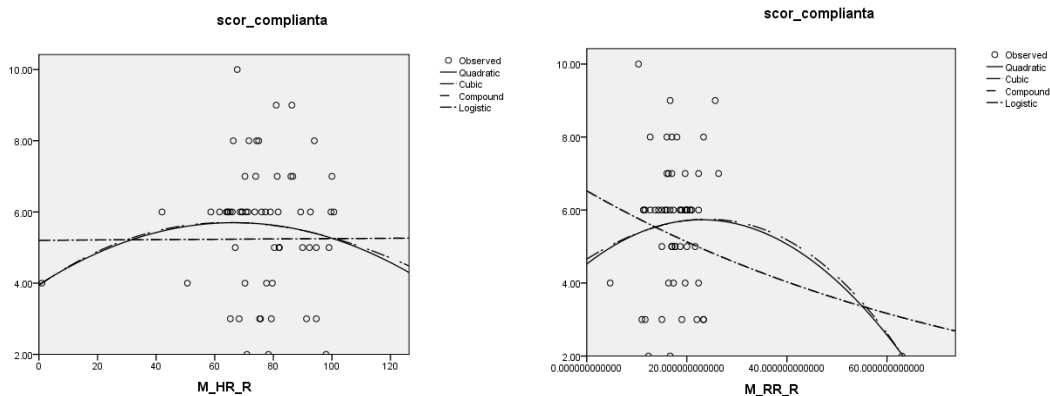

Fig.4. Representation of logistical, compound, quadratic and cubic functions of RR (respiratory rate), and RC (heart rate)

In figure 4, the evolution of respiratory rate and heart rate in rapport with medial compliance score, together with possible descriptive functions (logistical, compound, quadratic, cubic) of interdependencies between the medial psychophysiological reactivity to religious stimulus and the medial score obtained in the compliance questionnaire. We can observe that, from a mathematical trend perspective, RC (heart rate) could follow an exponential equation [17] ($f{:}R{\rightarrow}(0,+\infty), f(x){=}e^x$, where x is heart rate), and RR (respiratory rate) could follow a logarithmic Gamma function [18] :

$$\ln \Gamma(z) = -\eta \cdot z - \ln z + \sum_{\lambda=1}^{\infty}\left[\frac{z}{\lambda} - \ln\left(1 + \frac{z}{\lambda}\right)\right]$$ where: z is respiratory rate, η is a positive constant. We could then estimate a non-linear regression equation, including the aforementioned elements.

The estimated model is as follows: $Y_{score} = e^{0.504*RC} + \ln\Gamma(0.5RR)$, where: Y_{score} is the dependent variable (in this case, score on the applied MARS questionnaire); $e^{0.504*RC}$ is the exponential function [17] associated with RC; $\ln\Gamma(RR)$ is the logarithmic gamma function associated with RR [18].

As the calculated R (R=0,99, that tends to 1) and the estimated p-value (parametric p-value equals 0.00<0.05) for the estimated non-linear regression model, we find that this model confirms the interdependency between the medial

psychophysiological reactivity to religious stimulus and the score obtained on the compliance questionnaire, thus accepting the hypothesis "There is a statistically significant association between religious thinking and compliance".

On the other hand, to verify and validate or invalidate the hypothesis "There are statistically significant differences regarding compliance between practicing Christians and non-practicing Christians" the t test was used. It is worth mentioning that to validate this hypothesis, we have applied and validated the t test for all components of therapeutic compliance. By summarizing the results of the t test just to significant components (the selection criteria being that calculated value of the t test is greater than the critical value of the t test (0.8477)).

Element of the MARS questionnaire	P-value	t
CP01 Do you ever forget to take your medication?	.034	2.212
CP03 Do you ever stop taking your medication when you feel well?	.001	1.795
CP05 Do you take your medication only when you feel unwell?	.000	2.555
CP09 Do you feel strange, like a "zombie", when you take your medication?	.033	|-1.072|

Table 2
RESULTS OF THE T TEST, ON THE LEVEL OF MOST SIGNIFICANT ELEMENTS FROM THE THERAPEUTIC

As the t test only fulfills the validation criteria for four components of therapeutic compliance, we can only validate the hypothesis "There are statistically significant differences regarding compliance between practicing Christians and non-practicing Christians" in a 40% proportion.

Conclusions

The novelty of this study is represented by approaching the two hypotheses through a mixture of psychophysiological measurements and application of the MARS questionnaire. Performing this study by using the non-linear regression model and parametric tests to validate the hypotheses confirms its consistency with a high degree of statistical significance.

Through the obtained results, we were able to paint a clearer picture of the importance of religious thinking in therapeutic compliance and, as such, the presented study is useful in motivating practicing religious individuals, in our case, Christians, to improve compliance.

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