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Assessment of relationship between asymmetries EEG waves at baseline with Eysenck Personality traits

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ABSTRACT

Aim: asymmetry of brain hemispheres activities, one of the wonderful features is the organization of human brain activity. aim of this study is Assessment of relationship between asymmetries EEG waves at baseline with Eysenck Personality traits.

Materials and Methods: The study design was cross-sectional study that was conducted in Sabzevar. The target population was all students of Payam Noor University of Sabzevar in the school year (93-92). 33 students (17 male and 16 female) were selected using available sampling method. Research instrument included electroencephalography, Eysenck Personality Questionnaire, General Health Questionnaire and Positive-Negative Affect Questionnaire. Data were analyzed using descriptive statistics and Pearson correlation.

 Results: The results of the EEG waves at rest revealed asymmetric temporal and parietal lobes activity in the extroverts and asymmetric temporal lobe activity in introverts. Other findings of the research were that in baseline, there was a significant relationship between asymmetry temporal lobe activity in the neurotic-stable personality trait.

Conclusion: Overall, the findings of this study suggest that the type of personality affects the activity of certain brain areas.

Introduction:

In personality psychology, Personality dimensions considered as reliable and stable behavioral tendencies at the time and in different situations [1]. Although there is no consensus among researchers on the number of characters necessary to describe a personality, But in general it can be alleged that extraversion and neuroticism are two basic dimensions of personality [2]. Eysenck (1967) raised the idea that personality is described best by combining upper and lower surfaces of two prominent traits, Which has been the foundation nervous, in the name of introversion-extroversion and neuroticism - emotional stability [3]. Extraversion is typically described in terms of positive emotions such as motivation, commitment and passion and in contrast, introverts described as the people quiet, conservative and insensitive to environment [4]. In addition, Eysenck believed Neuroticism is associated with negative affect [5].

There is a general principle which is not possible to completely understand the individuals personality without understanding the brain activity [6]. So, the basic question that arises is the most psychological research, this is how it will appear asymmetric hemisphere brain activity in people with different personalities [7]. Many studies have examined brain activity in the alpha character and most of them have used two basic dimensions of extraversion and neuroticism [8]. Today, many techniques are available, including anatomical imaging such as MRI and EEG for Cognitive Neuroscience personality [9].

Among the studies that have been conducted in the field of EEG showed at rest, increased

activity in the left frontal lobe is associated with feelings such as happiness and anger trend while the increase in EEG activity in the right frontal lobe is associated with the expression of feelings such as sadness, fear and anxiety [10]. Furthermore, Exner and Gross findings indicated that bilateral EEG activity was more related to the ability to regulate feelings of sadness [11]. Also, it is assumed cortical arousal is associated with the amplitude and frequency of alpha rhythm So that high amplitude low-frequency activity correlated with low cortical arousal & low amplitude high-frequency activity is associated with high cortical arousal. In addition, there are at least three times more likely In the extroverts that have domains with larger peak areas in the frontal alpha wave activity [12]. Also people with different levels of trait anxiety, during enjoyable visual stimuli and threatening show changes in the theta wave [13].

Therefore, the present study with regard to Eysenck's theory focuses on the study of the central nervous system associated with personality traits.

Materials and Methods:

The study design was cross-sectional study that was conducted in Sabzevar. The target population was all students of Payam Noor University of Sabzevar in the school year (93-92). 33 students (17 male and 16 female) were selected using available sampling method. Inclusion criteria included

age range between 19 and 29 years and receiving general health score over 23 in the questionnaire 28-GHQ, Absence of psychiatric disease or under drug treatment for behavioral disorders. After a short briefing for all participants on the objectives and essential research and how to do EEG and take informed concept, Tips presented on EEG preparations (Including non-use of stimulant and sedative drugs, avoiding heavy exercise the night before the test). In addition, schedule was prepared according to empty time participants to refer them to obtain EEG. After entering the room EEG, the subjects were asked to sit on the armchair, be in a state of relaxed and keep their eyes open. Meanwhile, before the start of the experiment, people were asked to determine their current emotional status according to the scale of PANAS. In every day, 4-5 participant was tested for 45 minutes. Brain waves were recorded at baseline (in 12 steps, each 30 seconds). Waves collected from databases [O1-O2, T5-T6, F7-F8, C3-C4 Fp1-Fp2, F3-F4, P3-P4, T3- T4] Which together form the anterior, frontal, parietal, temporal and posterior regions .Finally, after quantitative EEG data, data were analyzed using descriptive statistics and Pearson correlation.

Research instrument:

EGG recording

In order to record EEG, 16-channel *v-Amp* device under windows XP-2000 operating system was used. In EEG method the electrical brain activity is recorded by placing electrodes on the scalp. These caps can be wired or wireless. A standard naming and electrode positioning design called 10-20 International system is available. In this design, "10" and "20" means that the distance between the contiguous electrodes placed on the skull is either 10% or 20% of the front-to-back
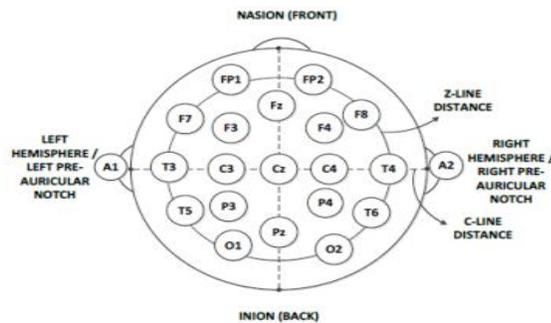or right-to-left total distance of the skull [14] which is as shown in Figure 1.

Figure 1. 10-20 International System [14]

In figure 1, The letters 'F', 'T', 'C', 'P' and 'O' representes Frontal, Temporal, Central, Parietal and Occipital lobes. FP is Prefrontal point on the skull. Next, *actiCAP* control software was employed for checking the right location of electrode and the resistance of each electrode. After this phase, we started using Brain Recorder device to record the waves: by FFT option, brain waves are converted from time scope to frequency scope, and hence, EEG absolute power with alpha for each region is computed. *BrainVision video Recorder* was used for recording data. Next, for preparing numerical data for statistical tests, *Analyzer Test* software was employed. This software is Excel-based application designed for averaging numerical data based on alpha, beta, delta and infradelta waves. According to the settings, the resolution frequency is equal to 0.004Hz. In addition, frequency range of waves is shown in table 1.

Wave name	infradelta	Delta	Theta	Alpha	Beta	Out of range
Frequency range (Hz)	0 - 0.5	0.5 - 3.5	3.5 - 7.5	7.5 - 12.5	112.5 - 30	30 - 524.288
Total	0.5	3	4	5	17.5	494.288

Table 1. Frequency range of waves.

Calculated mean values for electrodes Fp1, Fp2. F3, and … , and each EEG waves are based on 131072 samples taken from each channel. After this phase, calculated mean values for alpha wave were entered to SPSS software, and finally, the average of alpha waves in each channels in two normal and induced states were obtained. Overall, the time spent for EGG recording for each participant was 45 minutes. After that the mean of obtained averages in both states were calculated in SPSS. Other instrument included Eysenck Personality Questionnaire. The questionnaire contains 57 questions that are answered in the form of Yes – No. In total, the questionnaire measures three dimensions of personality (extraversion, neuroticism and psychoticism). The questionnaire also include a scale polygraph L. Makvan Hosseini[15] This questionnaire has been validated on Iranian students, the credibility is reported on a scale of extraversion 0/76 and neuroticism 0/84. In addition, some research has been reported test-retest reliability of the questionnaire between 0/84 to 0/94 and reliability of Split-half method between 0/74 to 0/91 [16]. General Health Questionnaire is a questionnaire with 28 questions which has been developed by Goldberg and Hiller to identify non-psychotic mental disorders (Quoting ehteshami tabar) [17]. The questionnaire has four subscales, namely, physical symptoms, symptoms of anxiety and sleep disorders, social functioning, symptoms of depression. The research is reported reliability coefficient 7 (by way of test-retest) and the correlation coefficient between the subtests of the questionnaire with total score 0/72 to 0/87 [18]. Taghavi

[18] has introduced to as the best cutoff score of 23 with simple Likert scoring method. In this study, the cutoff point of 23 was used as screening criteria of eligible and non-eligible for the test.

In order to measure emotional states, subjects responded the questionnaire items (PANAS) on the basis of their general state and at baseline when entering the room EEG. (PANAS) is a self-evaluation tool which is designed to measure two aspects of mood, a negative affect (PANAS -N) and positive affect (PANAS -P) [19]. There is a whole range of scores for each subscale between 10-50. Each subscale has 10 items. Items are ranked on a scale of 5 points (1 =

very low, 5 = very high). In this range, number (1) indicates lack of experience excitement and the number (5) is an expression of enormous experience. Therefore if getting a score of 10 in each subgroup, no one is excited and is at baseline. And the scores are closer to 50 increased emotional. Abolqasemi [20] calculated the correlation of internal components and the overall scale between 0/74 to 0/94 which is indicative of the high reliability of this scale. In addition, studies have been reported test-retest reliability of the questionnaire (with an interval of 8 weeks) for PANAS-P 0/68 and for PANAS-N 0/71

Results:

This study investigated the relationship between extraversion and neuroticism personality trait with different areas of the brain. The results in Table 3 show that the basic mode, there is a significant inverse relationship between asymmetric activity of

brain regions (Frontal, temporal and posterior) and asymmetries bases such as (fronto-lateral asyF7-8) and (Temporo-lateral asyt7-8) with extraversion personality trait.

Region		Left frontal		Right frontal		Left parietal		Right parietal		Left temporal		Right temporal	
Personality traits	State	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Extraversion	Normal	0.0600	0.5248	0.0578	0.06198	0.0192	0.01336	0.0249	0.0216	0.01110	0.09806	0.0866	0.07267
Introversion	Normal	0.0803	0.8653	0.1202	0.11176	0.0294	0.03212	0.0381	0.4176	0.1101	0.8507	0.1574	0.16169
Neuroticism	Normal	0.0736	0.8571	0.0967	0.10148	0.0256	0.03382	0.0302	0.03055	0.1046	0.8129	0.986	0.9716
Stability	Normal	0.0630	0.5599	0.0724	0.08067	0.0215	0.1406	0.0295	0.03097	0.1137	0.09886	0.1192	00.12610

Table 2:average and standard deviation of the activity of brain regions associated with personality traits at baseline.

Extraversion	Number	correlation coefficient	significance
Right frontal asymmetries	33	-*0/414	0/021
Right Temporal asymmetries	33	-*0/410	0/026
Right occipital asymmetries	33	*-0/438	0/010
fronto- lateral asymmetries	33	-*0/408	0/032
Temporo- lateral asymmetries	33	-*0/463	0/008

Table 3: Pearson correlation test between the extraversion personality trait with asymmetries cortical activity at baseline

Discussion:

The results of the EEG waves at rest revealed asymmetric temporal and parietal lobes activity in the extroverts and asymmetric temporal lobe activity in introverts. So at baseline, due to the positive difference between the average of the two hemispheres in all these areas, left hemisphere is more activity in the right hemisphere. Other findings of the research were that in baseline, there was a significant relationship between asymmetry temporal lobe activity in the neurotic-stable personality trait. So at baseline, Due to the positive sign of the difference in mean absolute alpha power in both groups, there is more activity in the left hemisphere in this lobe in both groups. In this regard, Azami and colleagues conducted a study in the field of Brain Cortical activity change patterns with consideration of extraversion and neuroticism and the results showed

Significant inverse relationship between extraversion and activity of posterior, frontal and temporal right's areas in basic status. The brain activities of anterior, temporal and posterior right's areas in men at the basic status were more than those of women[21]. Which is similar to the results of this study. Also Pascalis and et al conducted a study in the field of EEG-alpha asymmetry, BIS/BAS, and dispositional optimism, the analysis showed significant associations between resting posterior versus frontal delta and theta activity personality traits. Higher BAS was uniquely related to greater left-sided activation in the middle frontal gyrus (BA11). Optimism was associated with higher activations in the left-superior frontal gyrus (BA10) and in the right-posterior cingulate cortex (BA31) [22]. at baseline, in the field of increased activity of the brain posterior obtained the same results of this study.

In addition, Alessandri and et al in their study in the field of EEG-alpha asymmetry and positivity personality trait, generally, evidenced a significant and unique association of POS scores with the posterior right hemisphere activation in the BA23 and BA31 Broadmann areas [23]. Which is consistent with the study. In this context, Fakhari and colleagues concluded in their study about the induction of mood and brain activity that individuals with high BAS sensitivity in response to neutral stimuli showed increased activity in the frontal area and left posterior but no significant difference was found in the BIS group in this position [24]. Tolegenova & et al in their study in the field of gender and EEG response showed that gender differences included elevated theta in females in the reappraisal condition, but effects of gender and Trait Meta-Mood appeared to be dissociable [25].

Makvand Hosseini and colleagues in their study in the field of Anterior-Posterior Asymmetry and Emotion achieved similar results and showed that right and left frontal area activity are the same and no significant asymmetries in the region; While appears in temporal lobe a significant asymmetries in the right and in the parietal area a significant asymmetries in the left [26]. MikolajczaK & et al in their study in the field of frontal EEG asymmetries and emotional intelligence showed that individuals with higher trait EI evidence greater resting left frontal activation [27].

Also Aftanas & et al showed that viewing aversive movie clip by the HA group led to significant lateralized decrease of the right parieto-temporal beta-1 power, which was initially higher in the emotionally neutral conditions. The EEG data suggests that asymmetrical parieto-temporal theta-1 and beta-1 EEG activity might be better interpreted in terms of Gray's BAS and BIS theory [28]. Sarlo & et al in their study showed that at rest, neuroticism correlated with increased activity in the right temporo-parietal area [29]. Moghadas Tabrizi & et al in their study found that left frontal alpha asymmetry (superiority right hemisphere) is associated with depressive symptoms at rest [30]. That are inconsistent the results of this study. That can be mentioned reasons such as the use of different tools, different research environment and different sample sizes.

The most important limitation is the generalizability of the findings of the present study because of the availability of sampling and small sample size should be cautious in generalizing results. Therefore, it is suggested that future research used a sample with a higher volume as well as a random sampling method. Recommendations that can be raised about the methodology that current research projects carried out in groups with equal number extroverted introverted and neurotic stable between men and women, Using other personality questionnaires such as NEO, Using the methods of emotional induction and the effect of emotional induction on brain function, Or implementation of the study on healthy people and unhealthy (eg, depression).

Conclusion:

Overall, the findings of this study suggest that the type of personality affects the activity of certain brain areas and gender can

be considered as a factor affecting the activity some of the brain bases.

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