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EEG Alpha Activity and Personality Traits

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WALL, T. L., M. A. SCHUCKIT, D. MUNGAS AND C. L. EHLERS. *EEG alpha activity and personality traits*. ALCOHOL 7(5) 461–464, 1990.—Comparisons between EEG spectral power in the fast alpha (9–12 Hz) range and scores obtained on the Millon Clinical Personality Inventory (MCMI) were made in two populations of subjects. The first was a group of 60 individuals who reported no personal or family history of alcoholism. The second was a subgroup of 13 sons of alcoholics and 13 matched control subjects. In the first population, 30% of the subjects were classified as "high" alpha based on the criteria that their EEG in the 9–12 Hz range was over 75 μV^2/octave in amplitude. Using this same criteria, 69% of the sons of alcoholics and 31% of their matched controls were also classified as "high" alpha. In both populations, subjects with high amplitude fast frequency EEG alpha activity in lead P4-O2 scored significantly higher on the Histrionic-Gregarious scale of the MCMI than subjects with low amplitude activity in this lead. These results are consistent with some previous studies showing a positive relationship between EEG alpha activity and extroverted personality traits. These results suggest that fast frequency alpha activity may be associated with some definable personality traits.

EEG Personality Alpha MCMI Alcoholism

EVALUATIONS of the relationship between EEG parameters and personality traits suggest a positive correlation between an increase in percentage of alpha activity and higher scores on scales measuring extroversion (10,11). Some studies have also reported that low EEG alpha levels, as seen in low voltage records, may be associated with higher scores on measures of anxiety and neuroticism (2, 12, 13). Unfortunately, not all studies agree, partly due to differences in subject populations, experimental situational factors, and in the specific analysis techniques used to quantify the EEG (5,6).

This investigation seeks to further explore the possible relationship between personality traits and spectrally analyzed EEG alpha energy using the Millon Clinical Personality Inventory (MCMI) in two groups of subjects who were participating in different ongoing studies. The first group were 60 normal individuals who reported no personal or family history of alcoholism or other psychiatric disorders. The second group were 13 sons of alcoholics and 13 matched control subjects from previous studies examining EEG variables in these men (4).

METHOD

The 60 subjects (33 females and 27 males, ages 30–81) from the first population consisted of staff at the Scripps Clinic who responded to an advertisement requesting subjects to participate in a larger study examining a variety of cognitive variables in normal controls. Potential subjects were screened by a questionnaire which assessed demographic variables, alcohol use patterns, and personal and family history of major psychiatric disorders. Individuals were excluded from the study if they had any medical disorders, were currently taking any medications, or reported a personal or family history of psychiatric disorders, alcoholism, or drug abuse.

The 26 subjects from the second population were 18- to 25-year-old, male students or nonacademic staff at the University of California, San Diego who were participating in a larger study investigating a probable genetic influence in the development of alcoholism (4). Subjects were initially identified through a mailed questionnaire which gathered information on demography, alcohol and drug use patterns and associated problems, and family history of major psychiatric disorders. Individuals were excluded from the study if they had any major medical disorders or fulfilled criteria outlined in the third edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-III) (1) for psychiatric disorders, or alcohol or drug abuse or dependence. From the remainder,

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TABLE 1

MCMI SCALE SCORES FOR 60 "NORMAL" SUBJECTS (MEAN ± S.D.)

Subtest	"Low" Alpha	"High" Alpha	F	p
Schizoid-Asocial	31.4 ± 16.9	26.1 ± 15.5	1.286	0.261
Avoidant	27.7 ± 18.3	22.4 ± 17.0	1.066	0.306
Dependent-Submissive	44.6 ± 22.4	40.2 ± 20.5	0.505	0.480
Histrionic-Gregarious	55.6 ± 21.4	74.6 ± 23.4	9.367	0.003*
Narcissistic	63.5 ± 14.7	71.9 ± 12.6	4.551	0.037*
Antisocial-Aggressive	56.8 ± 19.5	60.8 ± 13.8	0.623	0.433
Compulsive-Conforming	73.0 ± 14.5	68.1 ± 10.2	1.718	0.195
P. Aggressive-Negativistic	20.4 ± 12.7	27.1 ± 16.2	2.963	0.091
Schizotypal-Schizoid	43.3 ± 17.9	39.9 ± 14.8	0.488	0.487
Borderline-Cycloid	43.3 ± 17.8	43.3 ± 16.8	0.000	0.992
Paranoid	56.1 ± 17.7	54.2 ± 20.9	0.134	0.716
Anxiety	52.0 ± 18.9	56.9 ± 17.6	0.880	0.352
Somatoform	55.8 ± 16.34	59.8 ± 13.5	0.814	0.371
Hypomania	26.1 ± 23.6	44.0 ± 22.9	7.362	0.009*
Dysthymia	49.8 ± 22.5	50.4 ± 21.0	0.008	0.929
Alcohol abuse	29.4 ± 15.3	27.5 ± 18.2	0.174	0.678
Drug abuse	42.2 ± 20.9	50.9 ± 18.7	2.324	0.133
Psychotic thinking	42.3 ± 15.4	37.1 ± 22.5	1.090	0.301
Psychotic depression	29.2 ± 18.8	22.4 ± 20.6	1.576	0.214
Psychotic delusion	51.4 ± 21.7	42.7 ± 27.2	1.735	0.193

*MANOVA followed by univariate F(1,58), p.

those men who had a biological father who met DSM-III criteria for alcohol abuse or dependence were designated as family history positive (FHP) for alcoholism and were then matched on demography (age, sex, religion, race, educational level) and drinking history with a control subject who had no family history for this disorder (FHN).

The present results were generated by obtaining baseline EEG data and responses on the MCMI from each subject. In the Scripps Clinic population, 20 minutes of EEG was collected from eight bipolar leads (F3-C3, C3-P3, P3-O1, F4-C4, C4-P4, P4-O2, T3-T5, and T4-T6) and was recorded on paper (Nihon Kohden) and magnetic tape (Vetter model D) for offline analysis. Paper records were edited for artifact and 15 minutes of artifact-free EEG was selected for spectral analysis. In the FHP/FHN population, six minutes of EEG was collected from four bipolar leads (F3-C3, P3-O1, F4-C4, and P4-O2) and was similarly recorded and edited using five minutes of artifact-free EEG which was selected for spectral analysis by computer as previously described (4).

Data analyses focussed on lead P4-O2 since alpha activity is most prominent in the posterior-occipital region, particularly over the right hemisphere. Subjects were sorted depending on the amount of energy in the 9–12 Hz range of their EEG, with greater than 75 μV^2/octave used as the cut-off criteria for designation of "high" alpha, a cut-off selected based on previous findings examining EEG alpha activity in FHP/FHN men (3).

Subjects were also assessed using the MCMI (9), a 175 item self-report inventory taking approximately 20 minutes to complete and generating 20 scales subdivided into three broad categories of personality styles, personality disorders, and transient clinical syndromes. The eight personality styles included Schizoid-Asocial, Avoidant, Dependent-Submissive, Histrionic-Gregarious, Narcissistic, Antisocial-Aggressive, Compulsive-Conforming, and Passive Aggressive-Negativistic and are considered to reflect relatively enduring and pervasive character traits. The three pathological personality disorders, indicating more severe impairments, include Schizotypal-Schizoid, Borderline-Cycloid, and Paranoid. Finally, the nine clinical syndromes (Anxiety, Somatoform, Hypomania, Dysthymia, Alcohol Abuse, Drug Abuse, Psychotic Thinking, Psychotic Depression, and Psychotic Delusions) are seen as extensions or distortions of the individual's basic personality style. These syndromes appear to be more dependent on the impact of stressful situations and thus are considered to be transient states.

The MCMI was chosen for this study since it appears to estimate several features of personality that have previously been described to be associated with EEG alpha activity. Although none of the MCMI scales directly measures extroversion, three have face validity for measuring traits such as sociability, impulsiveness, and hyperactivity and have been shown to have high negative correlations with the Social Introversion scale of the Minnesota Multiphasic Personality Inventory (MMPI): Histrionic-Gregarious (−0.61), Narcissistic (−0.72) and Hypomanic (−0.59) (9). The MCMI also has an Anxiety scale and has measures for what have traditionally been considered to be neurotic personality styles, i.e., DSM-III Axis II personality disorders.

Norms for the MCMI reported in the literature were based on several groups of clinical and nonclinical populations (9). Raw scores have been transformed into "base rate scores," a conversion determined by clinically diagnosed personality and syndrome prevalence data and by using cutting lines designed to maximize correct diagnostic classification. A base rate score of 60 represents the raw median score for the clinical patients who participated in the test construction studies, while a score of 35 represents the raw median score for the nonclinical subjects. Accordingly, the greater the base rate score, the greater the probability the subject has the characteristics measured by the scale. All MCMI protocols were computer scored and all were found to be valid. Statistical comparisons of subtest scores on the MCMI between the low and high alpha groups were made using multivariate analysis of variance (MANOVA) followed by post hoc univariate analysis of variance (ANOVA).

TABLE 2

MCMI SCALE SCORES FOR 13 MATCHED PAIRS OF SUBJECTS (MEAN ± S.D.)

Subtest	"Low" Alpha	"High" Alpha	F	p
Schizoid-Asocial	33.5 ± 19.8	26.2 ± 17.0	1.018	0.323
Avoidant	27.9 ± 23.0	18.9 ± 19.3	1.168	0.291
Dependent-Submissive	40.9 ± 26.0	40.5 ± 22.7	0.002	0.962
Histrionic-Gregarious	66.6 ± 11.6	76.9 ± 13.0	4.465	0.045*
Narcissistic	63.5 ± 19.5	77.6 ± 16.6	3.975	0.058
Antisocial-Aggressive	62.6 ± 17.7	64.2 ± 19.0	0.05	0.825
Compulsive-Conforming	66.1 ± 5.4	66.5 ± 3.6	0.045	0.833
P. Aggressive-Negativistic	31.7 ± 22.6	26.0 ± 11.5	0.655	0.426
Schizotypal-Schizoid	32.5 ± 18.2	27.0 ± 18.2	0.602	0.445
Borderline-Cycloid	33.2 ± 20.8	30.7 ± 18.9	0.106	0.747
Paranoid	52.2 ± 14.2	56.6 ± 14.8	0.617	0.440
Anxiety	43.0 ± 23.2	42.0 ± 20.6	0.014	0.908
Somatoform	45.9 ± 16.5	53.8 ± 16.6	1.793	0.234
Hypomania	34.6 ± 26.4	52.0 ± 19.5	3.639	0.068
Dysthymia	46.9 ± 28.6	40.4 ± 17.4	0.496	0.488
Alcohol abuse	35.9 ± 19.3	39.1 ± 13.9	0.229	0.636
Drug abuse	51.0 ± 17.8	59.9 ± 15.7	1.81	0.191
Psychotic thinking	31.8 ± 18.2	39.4 ± 14.7	1.379	0.252
Psychotic depression	17.9 ± 23.6	19.5 ± 21.8	0.033	0.858
Psychotic delusion	45.7 ± 21.1	46.4 ± 19.1	0.008	0.931

*MANOVA followed by univariate F(1,24), p.

RESULTS

Of the 60 subjects from the Scripps Clinic population of normal subjects between the ages of 30 and 81, 18 (30 percent) met criteria for having high alpha because their EEG in the high alpha frequencies (9–12 Hz) was over 75 μV^2/octave in amplitude. Table 1 presents mean scores ± standard deviations for these 60 subjects (42 low alpha and 18 high alpha) on the 20 MCMI scales revealing that high alpha subjects scored significantly higher on three of the 20 MCMI scales: Histrionic-Gregarious, $F(1,58) = 9.37$, $p<0.003$, Narcissistic, $F(1,58) = 4.55$, $p<0.04$, and Hypomanic, $F(1,58) = 7.36$, $p<0.009$.

Thirteen of the 26 subjects from the FHP/FHN population had high alpha, including 9 of the 13 FHP men (69 percent) and 4 of the 13 FHN men (31 percent). Table 2 presents mean scores ± standard deviations for these 26 subjects revealing a significant difference between the high and low alpha men only on the Histrionic-Gregarious scale of the MCMI, $F(1,24) = 4.47$, $p<0.05$, and a trend for higher scores for high alpha men on the Narcissistic, $F(1,24) = 4.00$, $p<0.06$, and Hypomanic, $F(1,24) = 3.64$, $p<0.07$, scales.

DISCUSSION

Using two separate populations, the results indicate that subjects with high amounts of energy in the 9–12 Hz range of their EEG scored significantly higher on the Histrionic-Gregarious scale of the MCMI. Levels on the Narcissistic and Hypomanic scales were also found to be significantly higher in the population of normals gathered at Scripps Clinic and a similar trend was seen in the population of FHP/FHN subjects. The lack of statistical significance for the latter two scales in the FHP/FHN population probably reflects low power associated with a relatively small number of subjects.

The present findings are consistent with some, but not all, prior studies showing a positive correlation between alpha activity and characteristics that are generally considered to reflect extroverted personality traits (10,12). Furthermore, the present results do not support reports that low alpha activity may be related to anxiety and/or neuroticism in these populations, however our low alpha population did not include an excess of subjects with low voltage records.

There is evidence suggesting that both EEG rhythms as well as some personality traits are genetically influenced. For instance, results from twin studies have revealed that there is a much greater similarity in the frequency of alpha activity in monozygotic as compared to dizygotic twins (8,14). Similar investigations have reported a correlation between monozygotic twins on extroversion that is twice as high as that for dizygotic pairs (7). Thus, the present correlations between gregariousness and predominant high alpha frequency raises some interesting questions. However, future studies will be required to determine whether EEG rhythms and personality traits might be coinherited or if certain personality styles may develop in response to specific types of brain activity patterns.

The FHP/FHN population presented in Table 2 raises an additional hypothesis. Previous studies from our laboratory have demonstrated that sons of alcoholics have significantly more fast alpha activity in the 9–12 Hz range than carefully matched controls (4). This was also true in the present subset of that population where 69 percent of the FHP men displayed high fast alpha whereas only 31 percent of the FHN men had high alpha activity. Further studies will be needed to determine whether these EEG and personality variables might represent risk factors for development of alcoholism.

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