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Research Paper

Brainwaves as markers of intelligence quotient and spiritual intelligence

Sharma Priya[1]*, Singh Abha[2]

ABSTRACT

Objective: The present study attempts to explore the role of brain waves in the expression of intelligence and spiritual intelligence. ***Methods and Materials:*** Thirty participants were assessed on different scales of intelligence and spiritual intelligence and their brainwaves were recorded via an electroencephalogram (EEG). The relative power of each electrode was then correlated with the individual raw scores on the scales. ***Results and Conclusions:*** Scores of intelligence and spiritual intelligence had significant positive correlation with relative alpha, beta, and theta waves power and significant negative correlation with relative delta waves power. Stepwise multiple regression analysis demonstrated that alpha waves are the best predictor of intelligence and spiritual intelligence, followed by theta waves. The results have been discussed in the light of available empirical researches. This study helps in broadening the applicability and significance of brainwaves in assessment and interventions related to Intelligence.

Keywords: *EEG Neuro-feedback, Alpha relative power, Life quality, Insomnia, Meaning*

Nerve cells in the brain transmit electrical impulses through the dendrites and down the axon. Electroencephalogram (EEG) detects this electrical activity at the site of dendrites. The signals received by them in concert, creates a magnetic field[1] which is recorded with electrodes placed on the scalp in the form of brainwaves[2].

There are four brainwaves. Beta brain waves (13 Hz to 30 Hz) have been correlated with attention, concentration, solving of complex mental problems[3] and increased task difficulty[4]. Alpha waves (8 to 14 hertz) aid in gating irrelevant and distracting information from interfering with task processing[5, 6] and creative thinking[7, 8]. Theta waves (3-8 Hz) are related to encoding and retrieval of memory[9] and mental concentration[4]. Delta waves (1.5 Hz to 3 Hz) are characterized by deep dreamless sleep, meditation and are usually evident in a coma patient[10].

Spirituality may include aspects like meaning of life, being a part of something grander, transcendental states, feeling of oneness, and an omnipresence of infinite power[11]. Here, it

[1]M.A Clinical Psychology, Amity University, Noida, India
[2]Ex - Director (Research), Amity University, Noida, India
*Responding Author

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has been defined as 'ability to access, express and process spiritual information'[12]. One of the most holistic definition of intelligence is, "the ability to solve problems, or to create products, that are valued within one or more cultural settings"[13].

A study[14] established that participants scoring high in the religion/spirituality domain demonstrated greater posterior alpha activity. Deep spiritual connection is associated with theta brainwaves and alpha waves during meditative states[15]. Another study[16] reported a rapid shift in theta activity in long-term meditators. Additionally, participants with high IQ showed reduced asymmetry value of beta and alpha waves[17].

From the preceding reviews it is evident that the cognitive performances are related to the different brain waves[18]. It is crucial to understand how brain waves contribute to different states of mind as well as different psychological attributes. Our brain waves may play a key role in our quest for being spiritual and intelligent. In this study, we will be observing our brainwaves and their association with intelligence and spiritual intelligence.

Objectives

1. To observe the relationship between brain waves, intelligence and spiritual intelligence.
2. To explore the relative significance of brain waves in predicting intelligence and spiritual intelligence.

METHODOLOGY

Sample

The present study was conducted on a sample of thirty participants belonging to middle class from Noida and Delhi NCR (India) via randomized sample technique (age range 18- 45 years, mean age 32.4 yrs). With the help of an electroencephalogram (EEG), four waves were taken for the study. None had reported any history of chronic illness (hearing ability, mental and physical health conditions of all participants were normal). Furthermore, the participants had not undergone any EEG-related training. This study was designed under a controlled environment.

Tools

1. **Electroencephalogram machine:** Clarity Brain tech System – Software Version 4.48, hardware version 3.2 was used. It is a 24 Channel EEG, USB powered. (Copyright © Clarity Medical Private Limited, C-84, Industrial Area, Phase-7, Mohali, Punjab (INDIA) – 160055)
2. **Raven's Standard Progressive Matrices (RSPM) by J.C. Raven (1998):** Raven's Standard Progressive Matrices (RSPM), is a nonverbal group test typically used in educational settings. It is the most common and popular test administered to groups ranging from 11-year-olds to the elderly. It is made of 60 multiple choice questions, listed in order of difficulty. This format is designed to measure the test-takers reasoning ability or, ('meaning-making') component of Spearman's g which is often referred to as general intelligence. The test is extremely robust, and measures intelligence effectively across various cultural and socio-economical and ethnic groups. Furthermore, the majority of split-half internal consistency co-efficient reported in literature reviews exceed 0.90.
3. **Spiritual Intelligence Scale by Dr. K.S. Mishra**, **(2005):** The scale is five-point Likert scales with the responses ranging from strongly agree to strongly disagree, containing forty-two items. The scale explores the seven broad domains of spiritual

intelligence (Amran, 2009) – (a) Consciousness (b) Grace (c) Meaning (d) Transcendence (e) Truth (f) Inner directedness (g) Freedom. The split half reliability co-efficient is 0.864 for the under and post graduate sample (N=180). The values of cronbach alpha are 0.890 and 0.874 respectively.

Procedure

The participants signed the consent and the confidentiality sheet to ensure that they are participating in the research study willingly. The procedure was followed as per the institutional ethics which was closely monitored at all steps. The participants were administered Standard Progressive Matrices test, Spiritual Intelligence scale with proper instructions. Their responses were recorded in an answer booklet. The participants were asked to solve the problems at their own preferred pace, without interruption. After the conduction of tests, their brainwaves were recorded. The EEG recording was carried out by experienced technicians to ensure minimal artifacts of the data collected. Next, the scores of the scales were calculated. The average of the relative power of the brain waves present in all the lobes was then calculated and then later correlated with the scores in the scales. Relative power can be understood as the over-all amount of power at each electrode. It is the percentage of power of any wave compared with the total power in the participant's EEG. For example, relative alpha power would be the percentage of alpha wave compared to the sum of beta, alpha, theta and delta waves.

Electroencephalography procedure: All the participants were instructed to wash their hair a day before the EEG recording since, an oily scalp is contraindicated during EEG recording. The electrodes, made up of small metal discs, were placed on the scalp as per the international 10-20 system [19] with the aid of EEG paste. It was ensured that the electrical impedance was kept below 10 kΩ. The brainwaves were recorded during the resting phase for five minutes after which, the EEG recording was stopped and the electrodes were gently removed.

RESULTS

To examine the relationship of brain waves with intelligence and spiritual intelligence, bivariate correlations were computed using of IBM SPSS Statistics (version 20). The obtained results have been displayed below.

Table 1: Bivariate Correlation between the relative frequency of brain waves and scores of IQ and Spiritual Intelligence

Measures/Brain Waves	Spiritual Intelligence	Standard Progressive Matrix
Total Alpha	0.513**	0.685**
Total Beta	0.395*	0.389*
Total Theta	0.379*	0.457*
Total Delta	-0.555*	-0.721**

**p<0.05, **p<0.01*

Table - 1 demonstrates that the alpha, beta, and theta brainwaves significantly correlated positively with scores of spiritual intelligence scale and standard progressive matrices whereas, the delta waves are correlated significantly negatively with the same. Additionally, a series of stepwise regression analysis was conducted using different brain waves as predictors and spiritual intelligence and standard progressive matrices as criterion variable. the relative significance of different brain waves in predicting spiritual intelligence and

intelligence quotient cannot be determined by simple bivariate correlation. The results have been shown in Table-2 and Table-3.

Table 2: Step wise multiple regression analysis using Spiritual Intelligence as a criterion and total Alpha Brain waves as a predictor

Criterion Variable (Spiritual Intelligence)							
Predictor	**R**	**R square**	**R square change**	**B**	**β**	**t value**	**F value**
Total Alpha	.513	.263	.263	.065	.513	3.165*	10.016*

*p<0.05

Table 3: Step wise multiple regression analysis using standard progressive matrix as criterion and total Alpha, total Theta Brain waves as predictor variable

Criterion variable (Standard Progressive metrics)							
Predictors	**R**	**R square**	**R square change**	**B**	**β**	**t value**	**F value**
Total Alpha	.685	.469	.469	.033	.606	4.532*	24.752**
Total Theta	.742	.551	.082	.027	.296	2.215*	4.908*

The results revealed that total alpha waves emerged as the best predictors of spiritual intelligence, contributing to 26% of the total variance. Beta value shows the positive direction of alpha waves with spiritual intelligence (β = 0.513). It is evident from table-3 that the alpha waves emerged as the best predictors of standard progressive matrices, contributing to 46.9% of total variance followed by theta wave that contributed to 8.2% of total variance. Beta also revealed the positive direction of alpha and theta waves with standard progressive matrices (β=0.60, β=0.29) respectively.

DISCUSSION

In the present investigation an attempt was made to find out how brain waves are related to intelligence and spiritual intelligence and moreover, which brain waves serve as the best predictor for the same. The data was acquired through thirty participants within the age range of eighteen and forty-five years via electroencephalogram, Standard Progressive Matrices and Spiritual Intelligence Scale.

A significant relationship between spiritual intelligence, intelligent quotient and brain waves was observed (Table 1). The result revealed an association between relative power frequency of brain waves and the scores of spiritual intelligence and intelligence. Spiritual Intelligence positively and significantly correlated with alpha [14-15, 20-22], beta [23-24] and theta [21, 25 -26] waves and negatively with Delta waves [27].

Intelligence quotient (Table no. 1) is also correlated positively with alpha [28-29], beta [30-31], and theta [32-33] waves and negatively with delta waves.

Furthermore, as compared to the other brainwaves, alpha waves turned out to be the best predictor of spiritual intelligence (as demonstrated in Table no. 2). Alpha waves are associated with flow of thoughts, when a person is relaxed [34] and thus perhaps is positively associated with spiritual intelligence. Furthermore, a study [20] amongst others, established that participants who scored high in the religion/spirituality domain seemed to demonstrate greater posterior alpha activity after ten years.

As for intelligence, alpha waves and theta waves were deemed to be good predictors of standard progressive matrix (IQ). However, the best predictor of intelligence quotient (IQ)

was also alpha waves as per Table no. 3. A study [35] observed that the alpha power was higher in the high IQ group.

CONCLUSION

The present study aids in exploring the importance and broad application of brainwaves. The results demonstrate that alpha, beta, and theta waves are positively correlated whereas, delta waves are negatively correlated with intelligence and spiritual intelligence. Moreover, Alpha waves appear to be the best predictor for intelligence and spiritual intelligence.

Future directions

This study gives insight into the intricacies associated with brainwaves and behavior. It gives an understanding into the potential use of brainwaves to assess various psychological domains such as different types of intelligence, creativity, and spirituality. Additionally, it explores the possibility of utilizing EEG alpha neurofeedback for providing intervention to individuals with below average intelligence and spiritual intelligence. Since low spiritual intelligence has been linked to depression due of lack of meaning, loss of belief in higher power, a sense of purpose in life and resilience [36] as well as insomnia [37]; There is a possibility that enhancement of alpha waves in an individual can also lead to increased quality of life and psychological well-being [38]. Moreover, enhanced alpha activity is associated with increased concentration and mindfulness [39], visual working memory [40], associative memory [41], emotional expression and musical ability [42]. And thus, alpha neurofeedback would help in enhancing all the aforementioned psychological domains. This study encourages research in the correlation of brainwaves with different aspects of intelligence, spirituality, emotions, depression, music, sleep and thus urges the curious mind to ponder over the malleability of brainwaves and their optimal level associated with such psychological domains.

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Conflict of Interest
The author declared no conflict of interest.

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