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Alpha Wave Activity on Think Hard and Dhikr Condition Using Electroencephalographic *(EEG)*

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ABSTRACT

Emotions are very important in thinking, making decisions, and a person's personality. This research was conducted to know the activity of alpha waves using an electroencephalographic (EEG) instrument, using an experimental method given the treatment of thinking hard and dhikr of istighfar. The brain waves analyzed in this study are alpha waves with a frequency between 8-12 Hz. The analysis shows that the alpha wave mean result is 11.89 Hz when thinking hard, and the mean result is 10.89 Hz during dhikr. The statistical test results show a significance of $p = 0.000323$ ($p < 0.05$), showing that dhikr can volunteer from a state of hard thinking to a relaxed state. The istighfar dhikr (astaghfirullah hal adzim) by the volunteer is a response to ask for forgiveness and reassure the heart.

Introduction

One of the most essential organs in humans is the brain, which regulates all the activities of the body's organs and daily activities and plays a role in determining emotions (Dewi et al., 2018). The brain is a small organ stored in the skull, which is the center of the nervous system and functions as the control center for coordinating all biological, physical, and social activities of the entire body (Amin, 2018). The human brain will receive messages and information according to the frequency of brain waves (Saminan, 2020).

According to Fatma (2017), the brain constantly generates electrical impulses. These electric currents, better known as brain waves, are amplitude and frequency (Sunardi, 2019). Brain waves and emotions are interconnected, and a person's emotions are described or generated by the amygdala zone of the brain. The function of the amygdala is to stimulate a feeling that is happening to a person (Anadea, 2021; Gilang et al., 2018).

Emotions are reactions to conditions that occur in the body (Anadea, 2021). They play a vital role in one's thinking, decision-making, and personality (Gilang et al., 2018). Emotions can be grouped into six groups: happiness, anger, fear, surprise, sadness, and disgust (Parkinson, 2019). Happiness is a psychological state that includes pride, relaxation, self-satisfaction, and joy (Parkinson, 2019).

Many people experience emotions of anger with conditions of stress, emotionality, hatred, and even rude and hostile behavior (Parkinson, 2019). When faced with a life-threatening situation, fearful emotions arise from individuals, so there are changes in heart rate, blood pressure, and cold sweat (Nordin & Alias, 2022). Emotions of surprise are an

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unexpected stimulus in the living environment that prompts a temporary response to stop it.

Emotions of sadness can be defined as a psychological reaction to failure and negative moods such as depression, self-pity, loneliness, depression, hopelessness, and unreasonably severe melancholy (Domínguez-Jiménez et al., 2020). Lastly, disgust is an emotion when exposed to unpleasant sensations in the surroundings (Nordin & Alias, 2022).

The human brain produces five main types of waves, which are classified according to their frequency: delta waves (1 – 3 Hz), theta waves (4 – 7 Hz), alpha waves (8 – 12 Hz), and beta waves (13 – 38 Hz) (Khakim, 2021; Sofiani, 2022). All brain waves are generated through the synchronized electrical vibrations of the mass of neurons communicating with each other (Alivian, 2018). Alpha waves occur when a person is in the relaxation phase or begins to rest, signaling that the eyes close or become sleepy (Galang et al., 2020; Sofiani, 2022).

Alpha waves appear during the transition period between conscious and unconscious (Galang et al., 2020). Alpha waves are controllers that connect the conscious and subconscious minds so that humans can remember dreams (Galang et al., 2020). Alpha waves are also active in times of relaxation and freedom. Alpha waves strongly associate the brain wave with the best learning and thinking conditions (Li et al., 2019). Brain waves were measured with the electroencephalograph (EEG), invented in 1929 by a German psychiatrist, Hans Berger (Fadilah, 2018).

An electroencephalograph (EEG) is a method used to record electrical activity in the brain on the scalp (Pamungkas, 2021). EEG measures voltage fluctuations generated in brain neurons in the presence of electronic signals (Pribadi, 2021). It can typically capture electrical activity in milliseconds. EEG measurements are relatively inexpensive and flexible compared to other brain imaging methods, thus enabling a more comprehensive practical application in the brain-computer interface (BCI) (Khakim, 2021).

EEG signal is a recording of the brain's electronic signals over a certain period originating from a device called the Brain Computer Interface (BCI) (Siuly et al., 2016). This tool will produce a wave-shaped recording that can be used to diagnose a disease in the clinical field or to study the function of the brain itself in the field of research (Deu, 2019). This device records the electrical activity of the cerebral cortex in microvolts. An electrical amplifier must produce a strong signal on the computer. (Deu, 2019).

Previous research conducted by Annisah (2018) with the treatment of listening to mural Al-Qur'an surah Al Insyiqaq showed that alpha brain wave activity after treatment had a higher average than brain EEG alpha wave activity after treatment. Other researchers, Ramli et al. (2018), regarding the concentration of memorizing the Qur'an, found that the alpha signal was slightly more dominant because when memorizing, the participants were asked to close their eyes, which affected the psychological condition of the participants who felt relaxed when memorizing.

Other researchers by Radyaputra (2018) with the K-Nearest Neighbor method, which is a method for classifying objects based on learning data from training data that is closest to the object by calculating the Euclidian Distance, found that a person's concentration when listening to music and smoking results in an alpha signal accuracy level of 77.78% and smoking with an accuracy rate of 88.89%.

Based on the research that has been done, no one has discussed the effect of remembering Allah SWT with istighfar dhikr as a response to decreasing anxiety for people who think hard. In this study, a comparative analysis of alpha was carried out in people who dhikr istighfar against thinking challenging conditions using EEG medical instrumentation.

Methods

This research was conducted using experimental methods at the Modern Physics Laboratory, Universitas Islam Negeri Walisongo Semarang, from March to May 2022. Nine students participated in the research. The volunteers were asked to think about everyday problems for 60 seconds, take a short break for 60 seconds, and then silently recite dhikr for 60 seconds. This study used the Contec KT 88 EEG device with 16 channels.

This study uses an alpha brain wave variable with an 8-12 Hz frequency. The analytical method used in this study was a paired t-test. Before the paired t-test, the data were tested using the normality test to determine their distribution. If the data is normally distributed, then the paired t-test can be performed. If the data is not normally distributed, it will be transformed first to be normally distributed before being tested using the paired t-test.

The normality test aims to test whether, in the regression model, the dependent variable, the independent variable, or both have a normal distribution or not. A good regression model has

normally distributed values (Suardi, 2019). If the value significance (p) > 0.05, then the data is declared customarily distributed; if the value significance (p) < 0.05, then the data is declared not customarily distributed (Widana & Muliani, 2020).

The paired t-test tests the hypothesis where one individual (object of research) gets two treatments (Montolalu, 2018). The significance (p) < 0.05 indicates that there is a significant difference between the initial variable (thinking hard) and the final variable (dhikr). This significantly influences the differences in treatment given to each variable. A significance (p) > 0.05 indicates that there is no significant difference between the initial variable (thinking hard) and the final variable (dhikr). This shows no significant influence on the actions given to each variable (Mulyaningsih & Palangngan, 2020).

Result and Discussions

Figure 1 shows the results of recording EEG waves from one of the volunteers while thinking hard and doing dhikr.

Figure 1
Alpha Waves in the Treatment of (a) Thinking Hard and (b) Dhikr

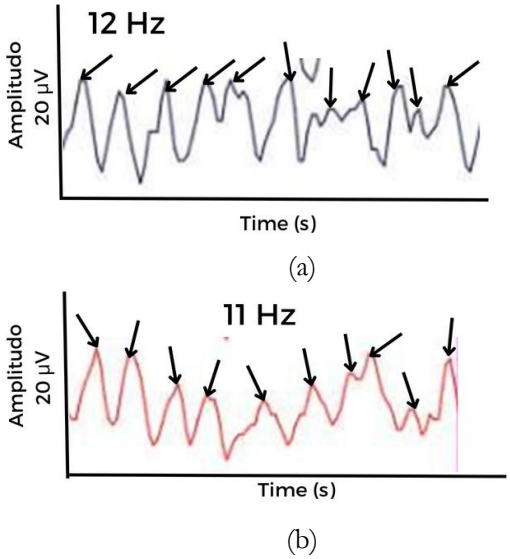

Figure 1 shows the activity of alpha waves when thinking hard with a frequency of 12 Hz and while dhikr appearing waves with a frequency of 11 Hz. The waves that appear are calculated based on peaks or troughs per second. Alpha waves are associated with states of relaxation. Alpha waves are generated by human brain activity (Mahendra et al., 2016).

Alpha Waves in 9 Research Volunteers

No.	Alpha Waves (Hz)	
	Thinking Hard	Dhikr
1.	12	11
2.	11	10
3.	12	11
4.	12	11
5.	12	11
6.	12	12
7.	12	10
8.	13	12
9.	11	10

Table 1 presents the results of alpha Waves in 9 volunteers in this study in conditions of thinking hard and dhikr. The EEG results show the presence of alpha waves with the emergence of a wave frequency of 10 Hz to 12 Hz. Alpha waves are taken from the average of three alpha waves per second. The alpha waves in the EEG results are averaged because the alpha signal appears clearly at a particular second.

The alpha waves that appeared in 9 volunteers in a deep thinking condition showed the same results in the 12 Hz range, while in the dhikr condition, the alpha waves decreased in the 11 Hz range. The results of the normality test are in Table 2.

Table 2
Normality Test Data Analysis

One Sample Kolmogorov-Smirnov Test	Thinking Hard	Dhikr
Number of data (N)	9	9
Mean	11.89 Hz	10.89 Hz
Significane (P)	0.206	0.761

The data obtained from the normality test is the Kolmogorov-Smirnov test with a mean result of 11.89 Hz in the thinking hard treatment and 10.89 Hz in the dhikr treatment. The analysis results have shown that there is beta wave activity, characterized by a wave frequency of 11 – 13 Hz when volunteers think hard, and when doing dhikr, an alpha wave appears with a frequency of 10 – 12 Hz. Normality test results in thinking hard treatment got p value = 0.206 and dhikr p value = 0.761. The Kolmogorov-Smirnov test results obtained a value > 0.05, which means the data is normally distributed (Widana, 2020).

Table 3.
Paired T-Test Data Analysis

Paired Samples Test	Thinking Hard-Dhikr
Significance (P)	0.000323

Table 1

The data obtained from the paired t-test is in Table 3. In the paired t-test statistical test, the value of p = 0.000323 means the paired t-test in this study obtained a significance value ($p < 0.05$). This result shows a significant effect of dhikr, so volunteers from a state of hard thinking become relaxed. The results were significant because the thinking-hard treatment group had been given an intervention called dhikr.

Alpha waves indicate a person's condition is relaxed, calm, and happy; in this case, dhikr provides calm (Iskandar, 2019). When endorphins are produced, the amygdala stimulates the activity and control of autonomic nerves, including sympathetic and parasympathetic nerves (Riyadh et al., 2021). In this study, the voluntary hypothalamus is stimulated so that endorphins appear, which function as sedatives. The proof in the Shari'a is istighfar in the Qur'an, which reads:

فَسَبِّحْ بِحَمْدِ رَبِّكَ وَٱسْتَغْفِرْهُ إِنَّهُ كَانَ تَوَّابًا

Meaning: "So glorify by praising your Lord and asking forgiveness of him. Verily, he is the recipient of repentance." (Surat an-Nasr: 3)

Reading istighfar means that a servant has admitted his mistakes, intentionally or not. Humans often forget and are too busy with the world to forget that we also have obligations as servants. The dhikr of istighfar has the virtue of calming the heart, as conveyed by the scholar Ibn Al-Qayyim Al-Jauziyah, who said: "Whoever always istighfar, Allah will provide a solution to all his difficulties, and a way out of every difficulty and sustenance from a direction that is not in the conjecture" (Mahmudah, 2021).

In this study, volunteers understood the meaning of the phrase dhikr istighfar (astaghfirullah hal adzim), which was uttered as a sign of asking for forgiveness and peace of mind. Zikrullah relates to human feelings towards the amygdala (Samsudin et al., 2019). Zikrullah will also produce harmonious brain waves because the mental signal is stable (Iskandar, 2019). This study shows that istighfar dhikr can reduce alpha wave activity in people who think hard. This shows that the dhikr of istighfar can give peace to people who think hard.

Conclusions

The results of the analysis show that there is alpha wave activity when thinking hard with a frequency of 11 – 13 Hz with a mean result of 11.89 Hz, and during dhikr, an alpha wave appears with a frequency of 10 – 12 Hz with a mean result of 10.89 Hz. Comparison of alpha waves after the intervention showed significant results between the thinking hard group and the dhikr group, with the test results showing p = 0.000323 ($p < 0.05$), showing that dhikr can volunteer from a state of hard thinking become a relaxed state. Dhikr can reduce the alpha wave activity of the human brain, which is characterized by a state of pleasure and a decrease in anxiety.

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References

Alivian, G. N. (2018). Pengaruh Light Massage Dan Murottal Terhadap Perubahan Hemodinamik Pada Pasien Dengan Gagal Jantung Di Rsud Prof.Dr. Margono Soekardjo Purwokerto. In *Repository Universitas Airlangga*.

Amin, M. S. (2018). Perbedaan Struktur Otak dan Perilaku Belajar Antara Pria dan Wanita; Eksplanasi dalam Sudut Pandang Neuro Sains dan Filsafat. *Jurnal Filsafat Indonesia*, *1*(1), 38. https://doi.org/10.23887/jfi.v1i1.13973

Anadea, Y. (2021). Manajemen Emosi Pada Anak Remaja. *OSF Preprints*, 1–10. https://doi.org/https://doi.org/10.31219/osf.io/v4x3n

Annisah. (2018). *Perbandingan Aktivitas Gelombang Alfa Elektroensefalografi (EEG) Otak Sebelum Dan Setelah Perlakuan Saat Diperdengarkan Murottal Al-Quran Surah Al-Insyiqaq Pada Mahasiswa Kedokteran UIN Syarif Hidayatullah Jakarta*.

Deu, A. (2019). Aktivitas Gelombang Alfa Otak Saat Diperdengarkan Surah Al-Fatihah Dengan Mengetahui Maknanya. In *repository.uinjkt.ac.id*. http://repository.uinjkt.ac.id/dspace/handle/123456789/53694%0Ahttp://repository.uinjkt.ac.id/dspace/bitstream/123456789/53694/1/ALHAYANDI DEU - FK.pdf

Dewi, C. T., Fitri, N. W., & Soviya, O. (2018). Neurosains dalam Pembelajaran Agama Islam. *Ta'allum: Jurnal Pendidikan Islam*, *6*(2), 259–280. https://doi.org/10.21274/taalum.2018.6.2.259-280

Domínguez-Jiménez, J. A., Campo-Landines, K. C., Martínez-Santos, J. C., Delahoz, E. J., & Contreras-Ortiz, S. H. (2020). A machine

learning model for emotion recognition from physiological signals. *Biomedical Signal Processing and Control*, *55*, 101646. https://doi.org/10.1016/j.bspc.2019.101646

Fadilah, M. (2018). Ekplanasi Ilmiah Metode Hipnotis terhadap Otak Manusia. *Jurnal Filsafat Indonesia*, *1*(1), 8. https://doi.org/10.23887/jfi.v1i1.13969

Fatma, A. N. (2017). Pengaruh Pengkondisian Gelombang Otak Zona Alfa pada Apersepsi Pembelajaran Terhadap Motivasi Belajar Biologi Siswa Kelas XI IPA MAN 3 Makassar [UIN Alaudin Makassar]. In *Repositori UIN Alaudin Makassar*. http://repositori.uin-alauddin.ac.id/

Galang, A. P., Jangkung, R., & Nur, I. (2020). Analisis Sinyal Alpha Dan Beta EEG Brainwave Terhadap Konsentrasi Diri Pada Kondisi Mengerjakan TESWARTEGG Analysis. *E-Proceeding of Engineering*, *7*(1), 512–520.

Gilang, R., Wijayanto, I., & Nur, Y. (2018). Analisis kondisi rileks saat mendengarkan Alquran berdasarkan sinyal delta theta eeg analysis of relaxed conditions while listening Quran based on delta theta eeg signal. *E-Proceeding of Engineering*, *5*(2), 1931–1938.

Iskandar, I., & Dirhamsyah, M. (2019). The Effect of Dhikrullah on Brain Health According to Neuroscience. *Asian Social Work Journal*, *4*(2), 71–77. https://doi.org/10.47405/aswj.v4i2.92

Khakim, Z., & Kusrohmaniah, S. (2021). Dasar - Dasar Electroencephalography (EEG) bagi Riset Psikologi. *Buletin Psikologi*, *29*(1), 92. https://doi.org/10.22146/buletinpsikologi.52328

Li, T. M., Chao, H. C., & Zhang, J. (2019). Emotion classification based on brain wave: a survey. *Human-Centric Computing and Information Sciences*, *9*(1), 1–17. https://doi.org/10.1186/s13673-019-0201-x

Mahendra, Y. H., Tjandrasa, H., & Fatichah, C. (2016). Klasifikasi Data Eeg Untuk Mendeteksi Keadaan Tidur Dan Bangun Menggunakan Autoregressive Model Dan Support Vector Machine. In *JUTI: Jurnal Ilmiah Teknologi Informasi*. https://doi.org/10.12962/j24068535.v15i1.a633

Mahmudah, A. D. (2021). *Penerapan cognitive behavior therapy dengan istighfar untuk mengurangi fobia koran pada remaja di lamongan*.

Montolalu, C., & Langi, Y. (2018). Pengaruh Pelatihan Dasar Komputer dan Teknologi Informasi bagi Guru-Guru dengan Uji-T Berpasangan (Paired Sample T-Test). *D'CARTESIAN*, *7*(1), 44. https://doi.org/10.35799/dc.7.1.2018.20113

Mulyaningsih, E., & Palangngan, S. T. (2020). *Pengaruh Permainan Puzzle Taerhadap Kemampuan Mengenal Lambang Bilangan Pada Anak Usia Dini*. *1*(1), 29–40.

Nordin, N. F., & Alias, N. (2022). The Classification of Human Emotions Based on The Electroencephalogram (EEG) of Brain Waves. *Proc. Sci. Math*, *9*, 286–297.

Pamungkas, M. R., & Indratno, I. (2021). Persepsi Masyarakat Berbasis Neurosains di Desa Wisata Rawabogo. *Jurnal Riset Perencanaan Wilayah Dan Kota*, *1*(1), 38–46. https://doi.org/10.29313/jrpwk.v1i1.148

Parkinson, B. (2019). Emotion. In *Companion Encyclopedia Of Psychology*.

Pribadi, M. A., (2021). Classification of Enchepalo Graph (EEG) Signals For Epilepsy Using Discreate Wavelet Transform and K-Nearest Neighbor Methods. *Procedia of Engineering and Life Science*, *1*(1), 1–7.

Radyaputra, Y., Wijayanto, I., Hadiyoso, S., Elektro, F. T., Telkom, U., Analysis, P. C., Neighbor, K., & Alpha, G. (2018). Analisis Sinyal Alpha Dan Beta Eeg Brainwave Terhadap Perbandingan Konsentrasi Seseorang Pada Kondisi Mendengarkan Musik Dan Merokok. *E-Proceeding of Engineering*, *5*(3), 4583–4588.

Ramli, Z. F. M., Inung Wijayanto, S.T., M. ., & Sugondo Hadiyoso, S.T., M. . (2018). Deteksi Kondisi Konsentrasi Berdasarkan Sinyal Eeg Dengan Stimulasi Menghafal Al-Quran. *E-Proceeding of Engineering*, *5*(3), 4683–4690.

Riyadh, Lakadimu, A., & Fathurrahman, M. (2021). Metode Terapi Murrotal Al-Quran Dalam Penanganan Stres Studi Kasus Pada Mahasiswa PENS Teknologi Rekayasa Internet 2021. *Al Yasini: : Jurnal Keislaman, Sosial, Hukum Dan Pendidikan*, *06*(2), 301–321.

Saminan, N. F. (2020). Frekuensi Gelombang Otak dalam Menangkap Ilmu Imajinasi dan Realita (Berdasarkan Ontologi). *Jurnal Filsafat Indonesia*, *3*(2), 40–47. https://ejournal.undiksha.ac.id/index.php/JFI/article/download/22299/15477

Samsudin, A., Yahya, N., Wan, M. W. R., Masdar, A., Liu, C. Y., & Izaham, A. (2019). Listening to Islamic Praises (Dzikr) is More Effective in Reducing Perioperative Anxiety Levels when Compared to Nature-Based Sounds in Muslim Patients Undergoing Surgery Under Regional Anaesthesia. *IIUM Medical Journal Malaysia*, *18*(3), 31–39. https://doi.org/10.31436/IMJM.V18I3.191

Siuly, S., Li, Y., & Zhang, Y. (2016). EEG Signal Analysis and Classification Techniques and Applications. In *Springer*. http://www.springer.com/series/11944

Sofiani, R. N. (2022). Klasifikasi Jenis Emosi Berdasarkan Gelombang Otak Menggunakan Dimensi Higuchi Dengan K-Nearest Neighbor. *Math Unesa (Jurnal Ilmiah Matematika)*, *10*(01), 150–160.

Suardi. (2019). Pengaruh Kepuasan Kerja Terhadap Kinerja Pegawai Pada Pt Bank Mandiri, Tbk Kantor Cabang Pontianak. *Business, Economics and Entrepreneurship*, *1*(2), 9–19. https://doi.org/10.46229/b.e.e..v1i2.124

Sunardi, S., & Sujito, S. (2019). Eksplanasi Pengobatan Alternatif Supranatural Berdasarkan Tinjauan Teori Gelombang Otak Dan Hipnosis. *Jurnal Filsafat Indonesia*, *2*(1), 1. https://doi.org/10.23887/jfi.v2i1.17545

Widana, I. W., & Muliani, P. L. (2020). Uji Persyaratan Analisis. In *Klik Media*.