

Original Article **Attentional Process during Listening to Quantitative Quranic Verses (Fatihah Chapter) Associated with Memory, Speech and Emotion**

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Abstract

Attentional problem associated with negative emotions can prolong irritable episodes, and apparently related to inhibitory incapability and memorial dysfunction. Quantitative Verse, the first chapter with rhymed proses and beauty literary rhythms, found to be endowed with cognitive and psychoacoustical effects that eliminate negative emotions and improving emotional and speech fluency. Twenty-eight normal subjects' brainwaves were analyzed after given auditory stimulation of Quantitative Verse recited by Abdul Basit Abdul Samad. The alpha waveforms were analyzed by Fast Fourier Analysis (FFT) to get the power in frequency bands. Results were further analyzed by the Brain Electrical Stimulation Analysis (Besa 6.1) and XLSTAT for statistical analysis. Results showed areas modulate emotion and speech were strikingly significant decreased with $p < 0.05$. The right inferior frontal (F8) and middle temporal (T8) were significantly decreased their synchronization reflecting increase in inhibition of distractors may well give effects to focus to the goal; and in short term memory that pulling the positive thoughts whilst expelling negative rumination can increase short term memory. While the significant result in the left inferior frontal (F7) and middle temporal (T7) showed improvement in speech fluency and memory. Listening to Arabic news increased speech fluency as well.

Keywords: Attention, auditory stimulation, brainwaves, speech, memory

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Introduction

Persistent rumination and negative cognition are 'products' of attention control problems. It is a pattern of repetitive thought that linked to many attention deficits problem ^[1] such as major depression ^[2], borderline personal disorder, schizophrenia and ADHD. It is also apparent in depressed people which leads to suicidal attempts ^[3]. These behaviours have a strong link with attention where they feel difficult to focus and fail to discriminate distractors ^[2], yet Obsessive-Compulsive Disorder (OCD) patients who did learn to stop rumination showed better prognosis ^[4]. Moreover, deficits were found without any type of explicit provocation, suggesting that cognitive control mechanism is dysfunctional. Research also found the greater attentional problem in suicidal attempters compared to healthy control through Stroop task using suicide-related words as distractor ^[5]. The ability to selectively attend to a specific subset of one's sensory realm is at the root of human cognition and negotiation of one's environment.

Attentional training showed significant reduction in all depression and anxiety subjects. In addition, reduction in negative thoughts, rumination and attentional and metacognitive factors gained similar improvements. Listening to pleasant auditory stimulation linked to emotional exacerbates and coping with emotional stress. A reduction of anxiety and depression in patients with somatic illness has been shown as well as enhancement of recovery of cardiovascular and respiratory functions and decreased cortisol after stress ^[6]. These emotional effects and arousal are mostly related to enhanced attention which activates the brains's functionality through neural mechanism pathway ^[6].

It has been suggested that The Quantitative Verse serves as a potential sound therapy for sleep disorder among autistic children for its acoustical aesthetic stimulus in mental disorders ^[7]. Listen to its recitation giving such a relaxation effect for listeners even if the person understand the meaning or not, potentially grab through its meaning and through its sounds from verses promising reward and verses promising punishment ^[8]. This was achieved because of its richly varied rhythm employed by various phonetic features that generates synchronization with neuronal oscillation ^[9] to give an aesthetic and communicative effects. Research done by Zulkurnaini, Kadir, Murat, & Isa, (2012) mentioned that listening to this recitation yielding more alpha waves than to music which is due to release of some biochemical associated with relaxation ^[11], reduced anxiety and stress in dental surgery patients ^[12] and influence memory due to stimulation on auditory cortex by its harmonic rhythms ^[13].

Alpha brainwave has been used as a tool in treating emotion related to illness and cognitive problem because of its importance that predominantly dominating brain behaviour. It has been linked to relaxed mental states, thus its

training is used in most biofeedback training. Our study is to examine the alpha brainwave distribution and persistence under three stimulation; listening to Quantitative Verse, Arabic news and rest by using a non-invasive medical imaging technique, electroencephalography (EEG) that measures the electrical current of pyramidal neurons in cerebral cortex ^[14]. The recording electrodes were placed over the frontal, parietal, occipital and temporal lobes according to conventional scheme called the International 10-20 system ^[15].

Methodology

A. Participants

Twenty-eight normal volunteers (male = 14 & female = 14) with inclusion criteria of habitual daily listeners to Quantitative Verse were recruited as participants. Written informed consent form was signed up upon agreement to participate in this study. This study has been approved by the Human Ethical Committee at HUSM (Human Ethical Committee of University Sains Malaysia (USM/KK/PP/JEPeM[234.3.(09)]). Subjects were excluded from study if they had vision or hearing impairment, neurological disorder, history of significant psychiatric condition, drug history and other major diseases.

B. EEG procedure

This study was performed at Event Related Potential / Magnetoencephalography (ERP/MEG) laboratory in Hospital Universiti Sains Malaysia (HUSM) in a sound treated quiet room with dimmed light. EEG recording were done using 128-electrode sensor net (Electrical Geodesics, Inc.) with impedance of $\leq 50k\Omega$. They were listened to Quantitative Verse recited by Abdul Basit bin Abdul Samad, Arabic news and sham with closed eyes.

C. Waveform Analysis

The analysis was carried out to observe the spatial pattern of alpha band signal increment or decrement between listening to Quantitative Verse Recitation and resting. Upon EEG recording, pre-analysis process (filtering, artefact detection, bad channel replacement, montage operation) was done. The waveform then analyzed by Fast Fourier Transform (FFT) to yield spectrum in power (amplitude squared, μV^2) in alpha frequency band by using BESA Research 6.1 Software, Germany. The data were transferred to XLSTAT to run statistical analysis.

D. Statistical Analysis

Descriptive statistics

Boxplot and whisker plot ^[16] is an excellent tool for conveying variation information in data sets that can show the distribution of dataset at a glance. Boxplot condense, summarize and obscure information, incorporate statistical notions such as median, upper and lower quartiles and minimum and maximum data values that are conceptually demanding for students ^[17]

Discriminant analysis

Discriminant analysis was used in this study to determine which electrode discriminate between the occurring electrodes in the expressing the electroencephalography data. This produces discriminant factors calculated by using equation:

$$f(G_i) = k_i \sum_{j=1}^n w_{ij} P_{ij}$$

where i is the number of groups, k_i is the constant inherent to each group, n is the number of parameters used to classify a set of data into a given group, and w_j is the weight coefficient assigned by DF analysis to a given parameter (p_j).

Result

Results showed that listening to Quantitative Verse decreased the spectral power of alpha brainwaves which indicates the relaxed mental state and attention emanated by this activity. This results presented in statistical analysis together with brain imaging as below.

Descriptive results

The descriptive statistics of the observed parameters obtained from descriptive statistics and discriminant analysis XLSTAT summarizes the entire data sets for a better in order to simplify the observations. Table 1 below comprises of the total number of observations in the data set, the minimum and maximum values, media, mean, variance and standard deviation.

Descriptive statistics along with discriminant analysis XLSTAT were conducted and the observed results summarized in Table 1. Results indicated that the mean score of Quantitative Verse recitation was significantly different compared to rest. There are four electrodes which are significantly difference which are the right inferior frontal gyrus F7 ($P=0.002$), the left inferior frontal gyrus F8 ($P=0.034$), the right middle temporal gyrus T7 ($P=0.022$) and the right medial temporal gyrus T8 ($P=0.035$). From the table, P-value is less than 0.05. Thus we have sufficient evident to reject null hypothesis and accept the alternative hypothesis, meaning that there are significantly different changes in the alpha power of Quantitative Verse stimulation.

The finding of this study would improve the knowledge for auditory stimulation that listening to Quantitative Verse recitation is associated with improvement in psycho-emotional regulation which helped people reduce their stress. On the other hand, listeners also benefitted with speech fluency that improves the communication quality. By the way, listening to Arabic news would improve speech fluency as noted above of F3 ($P=0.046$) and F7 ($P=0.016$).

Figure 1 shows the box and whisker plots of four significant electrodes of these three stimulations; Quantitative Verse, Arabic News and Rest in 28 normal respondents. The red crossed correspond to the means. The central horizontal bars show the median while the lower and upper limits of the box are the first and third quartiles, respectively. Shown clearly that means of F7 (1.205), F8 (1.210), T7 (1.192) and T8 (1.200) of Quantitative Verse profoundly lowered compared to Rest, but only F7 (1.247) is significant in Arabic News with $p<0.05$, and F3 (1.355) which is not shown here. From either end of the box, there is a straight line called whisker running to the highest value and the lowest. Noted here, although this stimulation performed on the same respondents, the Quantitative Verse data distributed distinctly from the Rest showing the different responses perceived accordingly. All the Quantitative Verse quartiles are also lowered.

Discussion

In terms of psycho-acoustical effect of Quantitative Verse, one of the electrodes that were significantly decreased was the right inferior frontal gyrus (F8 electrode). Shown here the electroencephalographic data that apparently decreased as was tabulated in Table 1. This data was visualized by Box and Whiskers plot in Figure 1. In regard to Quantitative Verse richly varied rhythms and tones those having arrangement of precise and accurate language, listening to this scripture activates selected ensemble of neurons and synchronized them and their connected regions in decreased amplitude in respect to cognition-emotion processing. The box and whisker plots showed the mean of alpha spectral power was decreased from rest to during listening to Quantitative Verse as mentioned earlier. Look into the circuitry of emotion, emotion regulating system involves amygdala, anterior cingulate and prefrontal cortex, and it overlapped with attention system. Over activation in rostral cingulate and dorsolateral prefrontal cortex found in depressed subjects suggested that deficit in attentional task is a characteristic of conditions where emotional dysregulation is prominent ^[3]. So, decreased alpha power of this electrode site produced by listening to Quantitative Verse recitation indicates the internalized attention that counterfactual to rumination and negative thoughts.

Table 1. Summarized statistics of the results from 10-20 system

Electrode sites	Sample size	Stimulus						<i>p-value</i> Quantitative Verse	<i>p-value</i> Arabic News
		Quantitative Verse		Arabic News		Rest			
		<i>Mean</i>	<i>Std. dev</i>	<i>Mean</i>	<i>Std. dev</i>	<i>Mean</i>	<i>Std. dev</i>		
Fp1	28	1.427	0.393	1.410	0.355	1.459	0.408	0.448	0.209
F3	28	1.350	0.450	1.355	0.393	1.439	0.445	0.069	**0.046
F7	28	1.205	0.386	1.247	0.401	1.352	0.455	**0.002	**0.016
Fp2	28	1.410	0.399	1.405	0.366	1.448	0.380	0.467	0.249
F4	28	1.406	0.419	1.377	0.344	1.436	0.378	0.315	0.109
F8	28	1.210	0.407	1.249	0.363	1.311	0.387	**0.034	0.106
C3	28	1.219	0.440	1.250	0.357	1.292	0.396	0.193	0.266
C4	28	1.300	0.444	1.304	0.386	1.354	0.394	0.344	0.201
T7	28	1.192	0.381	1.253	0.337	1.295	0.389	**0.022	0.254
T8	28	1.200	0.432	1.242	0.369	1.304	0.393	**0.035	0.109
P3	28	1.349	0.464	1.335	0.394	1.336	0.418	0.939	0.977
P7	28	1.671	0.542	1.644	0.443	1.641	0.457	0.794	0.932
P4	28	1.363	0.423	1.368	0.387	1.382	0.400	0.889	0.726
P8	28	1.633	0.607	1.596	0.514	1.603	0.539	0.776	0.893
EO1	28	1.738	0.535	1.780	0.464	1.702	0.478	0.290	0.100
EO2	28	1.694	0.532	1.699	0.513	1.666	0.498	0.796	0.525
Fz	28	1.469	0.447	1.435	0.384	1.488	0.426	0.455	0.200
Pz	28	1.468	0.480	1.492	0.463	1.465	0.520	0.833	0.580
Cz	28	1.414	0.455	1.448	0.405	1.455	0.419	0.599	0.879

/ Significance ($p < 0.05$)

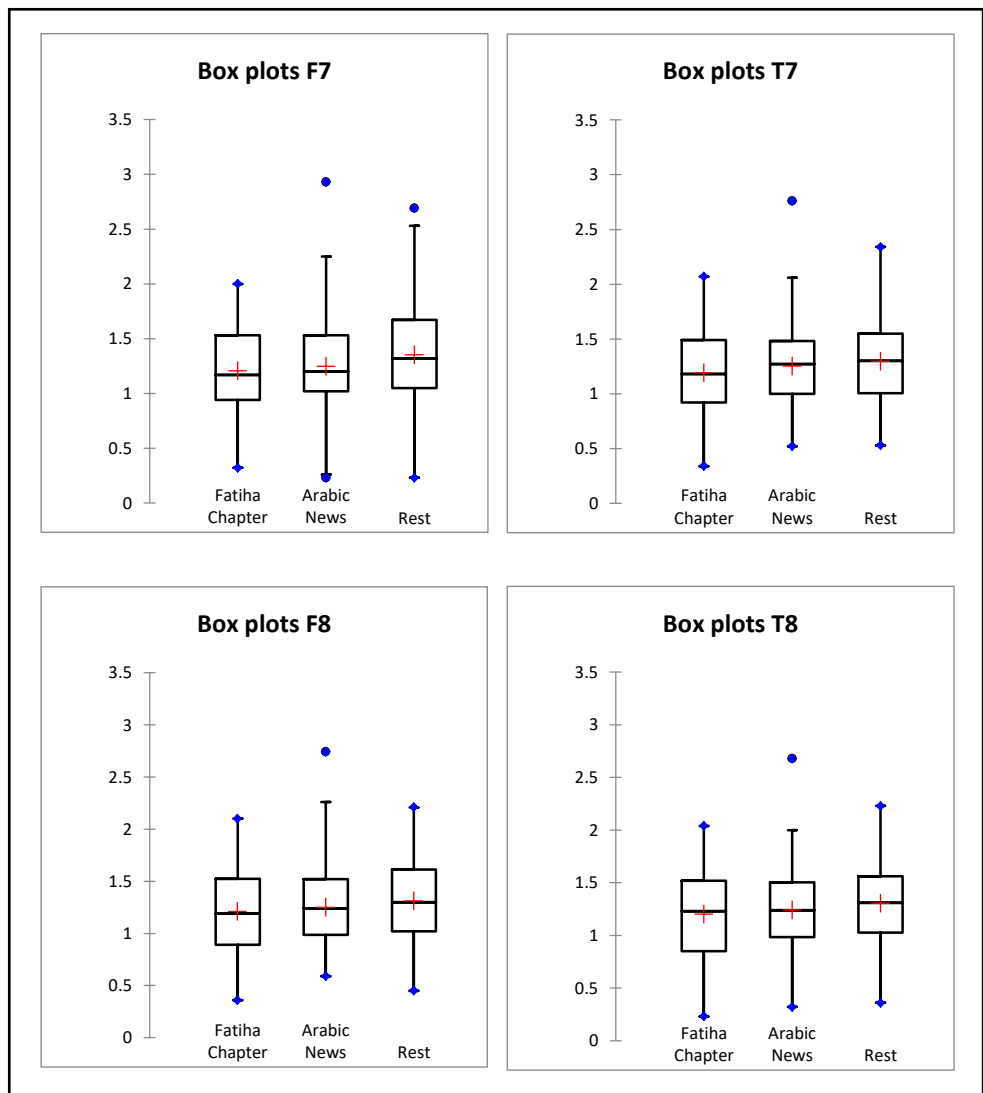


Figure.1 Boxplot and whisker plots of F7, F8, T7 and T8 generated to visualize the dataset of significantly decreased alpha power for listening to Quantitative Verse compared to Rest.

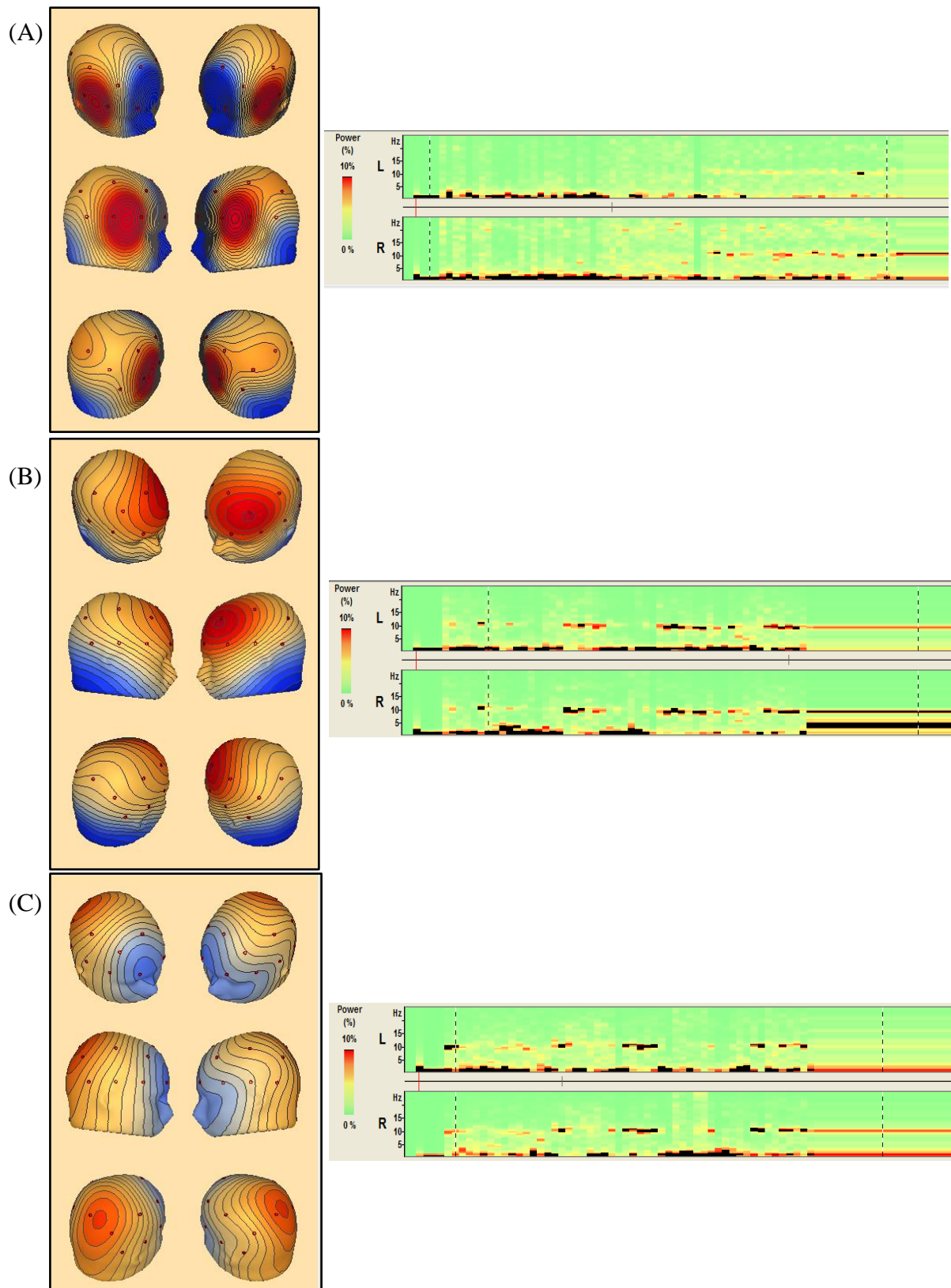


Figure 2 Alpha brainwave recording performed with 128 channels HydroCel EEG net (Electrical Geodesics Inc.). Auditory stimulations were delivered through speakers. The brainwaves were analysed using BESA 6.1. Shown above the alpha power distribution over the scalp showing stimulation related density changes during listening to (A) Fatiha Chapter (B) Arabic news and (C) sham (Rest) in the middle of stimulation, i.e the 4th verse. The Density Spectral Analysis (rights) also revealed the reduction of alpha spectral (10Hz) both in right and left side in Fatiha Chapter auditory stimulation compared to rest.

As been reported by many researchers, negative mood can reduce the access control to the negative cognitions and memories that leads to difficulties in attending to and processing new information that resulted in rumination, implicating the likelihood of a depressive episode^[18]. Listening to Quantitative Verse also activates the T8 electrode which associated with memory. Short term memory is a limited capacity system that provides a temporary access to current cognitive processes^[19]. It reflects the focus of attention and the temporary activation that are content of awareness^[20]. Our results suggested an activation occurred in the right medial temporal (P=0.035) which are supposed to indicate an improvement in controlling short term memory as well as increase the ability to regulate negative emotion. This means that their ability to expel negative congruent was increased leading to increasing space to new information to be installed. Significantly decreased alpha power spectrum in this area precisely filter the intrusive memory for encoding and recall, giving more positive emotion and cognition to Quantitative Verse's listeners.

Activation of left inferior frontal (F7) cortice also provides an essential functional architecture for empathy processing^[21] through inner imitation that was playing a crucial role in generating empathy. This is because the inferior frontal area is critical for action representation and connected to the limbic system via the insula^[22]. Activation in the bilateral inferior frontal support the enhancement of empathy since this sense involves both the emotion and cognition system that support our ability to empathize and understand other's perspectives. This was shown by converging evidence from neuroimaging and lesion studies where inferior frontal gyrus is necessary for emotion recognition and emotion contagions^[23] and further supported by neurochemistry and social research as well^[24]. This finding explain the historic inspiring man Umar Al-Khattab who accepted Islam after listening the prosodic beauty from a part of The Holy Quran recitation because this region, especially the right hemisphere can well recognize the emotion through prosody^[25].

Activation of left inferior frontal (F7) cortex stimulated by listening to Quantitative Verse and also Arabic news appears to be devoted to the processing of the rhythmical, temporal and sequential components of music^[26]. It is supposed to improve verbal performance in listeners. While activation in the left middle temporal (T7) gyrus area as shown in our study revealed that listening to Quantitative Verse recitation increased speech perception ability in listeners, a process by which enable humans to interpret and understand the sounds used in language. The middle temporal gyrus is a structure that involves in language processing and neighbouring with Wernicke's area, thus enhancement in this region help to improve the pitch and phonetic comprehension.

Conclusion

As a conclusion, listening to Quantitative Verse relates both the emotion expression and emotion memory enhancement, and also speech expression and memory for its listeners. Future study is suggested to delve further relation between Quantitative Verse recitation listening and neuronal oscillation those give impacts to other cognitive elements such as judgment, perception and decision making.

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