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Review article

# A review of the holy Quran listening and its neural correlation for its potential as a psycho-spiritual therapy

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ABSTRACT

Since its revelation over 14 centuries ago, the Holy Quran is considered as scriptural divine words of Islam, and it is believed to promote psycho-spiritual therapeutic benefits to its reciter and/or listener. In this context, the listening of rhythmic Quranic verses among Muslims is often viewed as a form of unconventional melodic vocals, with accompanied anecdotal claims of the 'Quranic chills' pleasing effect. However, compared to music, rhythm, and meditation therapy, information on the neural basis of the anecdotal healing effects of the Quran remain largely unexplored. Current studies in this area took the leads from the low-frequency neuronal oscillations (i.e., alpha and theta) as the neural correlates, mainly using electroencephalography (EEG) and/or magnetoencephalography (MEG). In this narrative review, we present and discuss recent work related to these neural correlates and highlight several methodical issues and propose recommendations to progress this emerging transdisciplinary research. Collectively, evidence suggests that listening to rhythmic Quranic verses activates similar brain regions and elicits comparable therapeutic effects reported in music and rhythmic therapy. Notwithstanding, further research are warranted with more concise and standardized study designs to substantiate these findings, and opens avenue for the listening to Quranic verses as an effective complementary psycho-spiritual therapy.

## 1. Introduction

The overarching goal of cognitive neuroscience is to unravel the mental processes and behavioral mechanisms based on mapping the brain and nervous system architectures and the underlying neuronal processing. The brain is the most complex and powerful single organ that functions as the command center that controls all bodily activities [1]. Our emotions and perceptions - and what induces them, are also regulated and modulated by the brain [2]. Music, which has been practiced in many cultures and civilizations, is regarded as a powerful stimulus that elicits intense emotional responses [3]. Music and/or rhythm are known to evoke the feeling of pleasantness in most humans, if not all [4, 5]. Music and rhythm have been found to exist alongside humans in various cultures and civilizations, whereby both have been used as an alternative therapy and as one of the techniques in meditation to evoke calm and relaxation [6, 7, 8]. Solanki et al. [9] reported that music therapy might be an effective healing tool in neurologic and psychiatric conditions such as Alzheimer's and anxiety disorders. Meanwhile, in Muslim culture, Quran has always been the source of alternative treatment among Islamic practitioners through the use of certain Quranic verses [10, 11].

On the other hand, meditation encompasses an extensive variety of practices that range from approaches intended to encourage relaxation to the most comprehensive purpose, including increasing a sense of well-being and also for religious rituals. Music and rhythm also act as one of the techniques in meditation to increase relaxation and a sense of well-being. In mantra or prayer meditation, the chanting or reciting of a certain script or verse in Hinduism [12] or Christianity [13], respectively, produced a rhythmic effect, thus eliciting a consequent calming effect to its practitioners. Recently, the calming and relaxation response related to

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meditation practices had been reported to be a common tool to mitigate current chronic stress due to the worldwide COVID-19 crisis [14].

The various approaches in meditation not only refer to definite spiritual and religious practices but also involved numerous non-spiritual practices to instill a sense of tranquility and serenity, as well as to relieve depression and anxiety [15, 16]. Examples of meditation-like approaches that constitute music and rhythm in the practices are the Christian chorale and the Quranic recitation, known as the Tarannum style [17]. From a language perspective, Tarannum is defined as a song. In contrast, from the Quranic study terminology perspective, it refers to the rules to beautify voice according to pitch, rhythm, and cadence. Tarannum is a part of the Quranic study on making Quran recitation beautiful and melodious [18, 19]. Thus, it could be stated that music and rhythm can be applied to produce a calming effect in human daily life, as demonstrated by their utility in alternative treatment and meditative techniques.

The aesthetic merits of music and rhythm have been well-studied over the past decades from the empirical neuroscience perspective [20, 21, 22, 23, 24]. Similarly, the neural correlates of meditation have also garnered much interest and continued to expand [15, 25, 26]. However, unlike the studies on music, rhythm and/or meditation, research on the neural correlates for the calming effects of Al-Quran as potential psycho-spiritual therapy to its listener is largely unexplored. To date, such studies had attempted to validate this assertion by the leads from the low-frequency neuronal oscillations (i.e., theta and alpha). These neuronal oscillations act as the neural correlates established in music and meditation research, using techniques such as electroencephalography (EEG) and magnetoencephalography (MEG).

This narrative review describes current literature exploring neuronal modulation, particularly the low-frequency neuronal oscillations, i.e., theta and alpha oscillations associated with listening to rhythmic Quranic verses. The review also summarizes current neuroimaging techniques commonly used in the study and analysis of brain signals often investigated in music and meditation research, including in Quranic studies, and current knowledge on the potential brain regions correlate to Holy Quran listening. Finally, the review highlights the limitations and challenges often encountered and makes recommendations for further method refinement in future Holy Quran research involving neuroimaging modalities.

## 2. Overview of the rhythmic Quranic verse and its aesthetic

The Quran was sent over 1400 years ago and is a unique holy book that encompasses all aspects of life [27]. During daily prayers, it is obligatory for Muslims to recite certain chapters or verses of the Quran; thus, the act of reciting and listening to the Quran has always been ingrained in Muslims' daily life. Aside from being recited during prayers, Quranic verses are also used as a therapeutic and healing tool. Muslims believe that listening and reciting the Quranic verses can evoke a sense of pleasantness and relaxation to the listeners and reciters. Listening to the Quranic verses produced a meditation-like quality and may be a beneficial healing therapy, regardless of religious beliefs.

The Quran is considered a rhythmic text when being recited due to the rhyming system, which comes from the arrangement and combination of words and alphabets that are distinctive and unique, which cannot be found in any other Arabic literature [27, 28]. The Quran is revealed in Arabic, which is regarded as an expressive language [29]. The rhyming system and rules applied when reciting the Quran contribute to its audible beauty, which elicits a subsequent calming effect on the listeners, as compared to other Arabic literature, such as poetry [27].

The Arabic letters, words and verses in Quran are considered by the Muslims as the most extraordinary miracle as it is impossible to change, imitate or refabricate the word of the Quran [30]. The literary consistency within each Quranic verse differentiates it from any other Arabic text and poetry [31]. Besides the Quran's historical, scientific and Islamic rules and regulations, there are verses emphasizing relaxation and the way to attain calmness and overcome stress.

There are many approaches to reading and reciting the Quran, depending on the purpose of the reader, whether for spiritual growth or for developing further understanding of the religion itself. The Quran must be read according to proper styles and rules despite the various approaches. The rhythmic Quranic recitation is pleasing to the listeners, even to persons unfamiliar with the sound of the Quran. There are ten recitation styles called *qiraat* [32]. *Qiraat* refers to various types of Quran recitation narrated by the source (different schools of thought), also known as *Qurra'* [33].

Meanwhile, *tajweed* refers to the system of rules regulating the correct oral reciting of the Quran. The significance of *tajweed* is to systemise and prevent any changes in the nature of revelation and accent of Quranic recitation in terms of rhythm, resonance, and phonetics. These Quranic recitation rules form a standard guideline that must be followed by the reciter, thereby distinguishing it from any other Arabic text or literary. Reciting Quran without *tajweed* could change the meaning of words and/or verses, which may eventually distort the Quranic message by mistake. The Quranic recitations are generally performed in three tempos or recitation speeds, namely *Tahqiq*, *Hadr*, and *Tadwir* (i.e., slow, moderate, and fast tempos, respectively) [32].

The other way to beautify the recitation of the Quran is through *tarannum*. *Tarannum* can be translated into English as 'cantillation', 'simple humming or singing'. *Tarannum* can be diversified according to the tone, rhythm, and rhyme. For example, *Tarannum,* which applies the Tahqiq method, is a slower, longer and precisely enunciated form of recitation, rendering absolute clarity in pronunciation and recitation. Besides, *tarannum* seems to be a technique of heightened speech related to the verse it supports and is different from the vocal elaborations of singing [32]. These sets of disciplined and specific recitation rules of the Holy Quran contribute to its melodious and rhythmic recitations, hence can act as one of the unconventional types of music.

Listening to the Quranic verses is a complementary coping strategy for Muslim behavior and mental health challenges. A growing number of research have been conducted on the effect of listening to the Quran on human mental and physical well-being. Some Quranic verses are believed to have healing impacts and are used in alternative therapy known as *syifa'* [34, 35]. Moreover, listening to the Quranic verses has been shown to be effective in reducing stress and anxiety during pregnancy [36], and in managing depression [37] and pain [38]. Based on the available research, listening to the Quranic verses have a potential therapeutic value and may be used as a non-pharmacological or alternative therapy. However, methodologically strong randomized controlled trials and further research are still needed to support this notion.

## 3. Literature search strategy

The literature search strategy employed included utilizing online databases and search engines for a specific keyword combination. Science Direct, PubMed, Medline, and Google Scholar were the internet resources used. The following keywords were used in the literature search, which developed from single to combination keywords: Quran, EEG, MEG, Brainwaves, Alpha, Theta, and psycho-spiritual. This approach included thirteen articles, seven of which were full papers, and the rest were conference proceedings. A manual search among the cited references was then used to find additional references for a discursive analysis of each topic discussed in this review.

## 4. Neuronal basis of the relaxing and pleasing response to listening to the Quranic verses

Several studies in the Quran have focused on the effects of listening to and/or reciting the Quranic verses on brain signals, particularly in terms of promoting relaxation or meditation (Table 1 summarizes the studies' design and findings). Most of these studies focused on alpha and theta neuronal oscillations as the targeted brainwaves due to the functions and characteristics of these brainwaves found during relaxation and

**Table 1.** Summary of neural changes as a result of listening to and/or reciting the Holy Quran.

| Author | Brainwaves | Brain Areas | Neuroimaging Methods | Quranic Stimuli | Non-Quranic Stimuli | Analysis | Main Findings | Author conclusions |
|---|---|---|---|---|---|---|---|---|
| Abdullah and Omar (2011) [42] | Alpha and beta | Frontal, Parietal, Temporal and Occipital | EEG (20 electrodes) | Not stated which chapter and verse | Hard music | Analysis was done using Compumedics nexus software | During listening to Quranic verses, alpha wave magnitude value is increasing compared to beta value. | Listening to Quranic verses generates the alpha wave and helps a person to be in a relaxed condition |
| Zulkurnaini et al. (2012) [10] | Alpha | Not stated | EEG (not stated how many electrodes) | Quran (36:1–83) | Pachelbel's Canon D major (classical music) | Waveware program was used to show the brainwaves response. | Alpha band power during listening to Quranic verses is greater compared to classical music | Listening to Quranic verses can result in a more relaxing and alert condition compared to classical music |
| Kamal et al. (2013) [39] | Alpha | Parietal | EEG (20 electrodes) | Quran (39:20–31) | Excerpt from a novel called *Jendela Hati* pages 45-46 | EEG data were analyzed by using FFT algorithm | PSD of alpha band is higher during reciting Quran than reading a book | Reciting the Quran leads to a state of resting and calming mind.<br>The Quran can become a tool for meditation, reduces stress and induce the calming mind |
| Taha Alshaikhli et al. (2014) [43] | Alpha, beta, gamma | Frontal | EEG (4 electrodes) and ECG | Quran (25:1–77) | Wintersun entitled 'Death and the Healing' (hard music) | EEG data were analyzed using KDE and MLP. | Alpha waves elicit higher for most subjects when listening to Quranic verses and all subjects had higher gamma wave activity while listening to Quranic verses as opposed to music | Listening to Quranic verses causes the subjects to be more relaxed. The ECG signal is smoother while listening to Quranic verses, reflecting the calmness of the subjects |
| Vaghefi et al. (2015) [28] | Alpha and theta | Frontal, parietal and occipital | EEG (13 electrodes) | Quran (49:1–29) & Quran (25:1–57) | Positive semantic Arabic text | EEG data were analyzed by using FFT algorithm | Listening to Quran stimuli consciously increased alpha and theta power | Listening to Quranic verses consciously causes the subjects to be more relaxed, which can be related to their religious beliefs |
| Mohd Nasir and Wan Mahmud (2015) [44] | Alpha and beta | Not stated | Not stated | Not stated which chapter and verse | Light, Rock, Mozart and Jazz | EEG data were analyzed using Powerlab software | Alpha and beta waves increased when listening to Rock, Mozart and Quranic verses | Listening to Quranic verses increased attention as shown by the increase of alpha and beta waves |
| Ab Rani et al. (2015) [57] | Theta | Frontal, midline, temporal, parietal and occipital | Simultaneous EEG (61 channels) and MEG (306 sensors) | Quran (2:255) with various styles of recitation | Hare Krishna chanting, Monochord, Arabic poem, Arabic news | Only EEG data were analyzed by using FFT algorithm, SPM8 software | Theta band appear highest in the right frontal cortex when listening to Quran stimuli compared to others | Listening to Quranic verses increases the theta responses more readily compared with non-Quranic rhythms. It also elicits calming effect to the listeners hence paving the way to be one of the methods in music therapy |
| Al-Galal and Alshaikhli (2017) [63] | Alpha and Beta | Frontal and parietal | 19-channel EEG signal | Verses from the Quran chapters; 36, 94, 112-114 | Mozart Music K448 | Data were analyzed using BrainMarker software | Alpha magnitude is higher than the beta magnitude when listening to the Quranic verses. While the alpha and beta magnitudes are almost equal for music. | Listening to Quranic verses increases the alpha magnitude reflecting the calmness and relaxation of the subjects |
| Shab et al. (2017) [64] | Theta | Frontal, midline, temporal, parietal and occipital | Simultaneous EEG (61 channels) and MEG (306 sensors) | Quran (2:255) with various styles of recitation | Not applicable | Only EEG data were analyzed by using FFT algorithm | Highest theta power was dominant at the left frontal region | Listening to Quranic verses increase positive emotions |
| Samhani et al. (2018) [65] | Alpha | Frontal, midline, temporal, parietal and occipital | EEG (128 channels electrode – 19 electrodes were chosen) | Quran (1: 1–7) | Arabic news | EEG data were analyzed using FFT in BESA software | Listening to Quranic verses decreased the alpha power at the right inferior frontal and middle temporal | Listening to Quranic verses filter the intrusive memory, giving more positive emotion and cognition |
| Irfan et al. (2019) [66] | Alpha & beta | Frontal & occipital | EEG (2 electrodes, frontal & occipital) | Quran (55: 25–40) | Morning light by Serenity Studio (soft music) | EEG was analyzed using Power-Lab | EEG showed that Quran generates comparatively higher amplitudes of alpha than beta waves. | Listening to Quranic verses elicits the calmness and relaxation effect shown |

(*continued on next page*)

**Table 1** (*continued*)

| Author | Brainwaves | Brain Areas | Neuroimaging Methods | Quranic Stimuli | Non-Quranic Stimuli | Analysis | Main Findings | Author conclusions |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | by an increased in alpha power and mild reduction in diastolic blood pressure in older subjects |
| Jalaudin and Mohammed Amin (2019) [67] | Alpha | Parietal | EEG (256 channels electrode – 14 electrodes were chosen) | Not stated which verse and chapter | Not stated what kind of music | Spectral analysis was done using MATLAB software | Higher alpha power was observed during listening to Quranic verses | Listening to Quranic verses influences the relaxation of the mind |
| Samhani et al. (2022) [68] | Beta | Occipital | EEG (128 channels electrode – 19 electrodes were chosen) | Quran (1: 1–7) | Arabic news | Power spectrum was extracted by FFT using the EGI system | Left occipital area showed a significant decrease in beta power when listening to the Quranic verses | Listening to Quranic verses activates the oscillatory neural network associated with visual-mental imagery |

Note:
ECG = Electrocardiography, FFT = Fast Fourier Transform, PSD = Power Spectral Density, KDE = Kernel Smoothing Density Estimate, MLP = Multi-layer Perceptron.

meditation states. We also included one study by Kamal et al. [39], comparing reciting the Quran to reading a novel. This was because the participants would also listen to their recitation as they recited the Quran out loud. Hence, we interpreted that this would also trigger similar effects compared to receptive listening to the Quranic verses.

## 5. Alpha and theta neuronal oscillation as the targeted brainwaves

### 5.1. Alpha oscillation as the indicator for relaxation state

The specific signal often investigated for Quran recitation is usually the alpha brainwaves which are often related to relaxation and mental inactivity [40, 41]. It has been reported that listening to the Quranic verses can increase alpha power compared to listening to various types of music [10, 42, 43, 44]. Compared to reading an excerpt of a novel, reciting the Quranic verses out loud can also increase the alpha power [39]. Alpha brainwaves can best be seen when the subjects close their eyes and put their brain "at rest" or in a relaxation state [45].

It is often speculated that the production of alpha waves is associated with a pleasant and relaxing effect [46]. Additionally, an increase in alpha activity often is regarded as 'cortical idling' since it is the highest when the brain is at rest [47]. High alpha power is correlated to alpha synchrony which reflects the deactivation of cortical areas, thus the term 'cortical idling' [13, 48]. That is why alpha power is inversely related to brain activity. Hence a decrease in alpha power specifies an increase in brain activity and vice versa [49, 50, 51].

However, the increase of alpha waves and the subsequent decrease in brain activity following Quranic recitation does not signify that the brain is deactivated. Instead, a certain part of the brain is functionally disengaged from doing specific tasks, allowing another part of the brain to concentrate on completing the task [52, 53]. Therefore, these findings indicated that listening to and/or reciting Quran have the ability to promote relaxation and pleasant effects.

### 5.2. Theta oscillations in a meditative state

Theta brainwaves (4–8 Hz) are often correlated with deep relaxation felt by meditators and implicated in an emotionally positive state [54, 55, 56]. Compared to alpha waves, theta waves are not being widely studied in investigating the effect of listening to the Quranic verses on the human brain. However, a few studies demonstrated an increment of theta spectral power when listening to the Quranic verses.

Vaghefi et al. [28] found that listening to Quranic verses yielded higher spectral power of both theta and alpha waves as compared to listening to non-Quranic Arabic text. In addition, listening to Quran showed an increase in theta waves when compared to other established music therapy like transcendental meditation (TM) techniques, such as chanting of Hare Krishna mantra [12] and monochord sound [57, 58]. These findings suggest that listening to Quranic verses is comparable to established music therapy in terms of the neuropsychological effect and/or mindfulness.

The increase in theta activity, particularly the frontal-mental (FM) theta, which originates from the medial prefrontal cortex (MPFC) and may be localized at ACC [13], has been considered to be one of the significant signatures of meditation [59]. An increased theta power has been shown with various meditation practices, including focused attention meditation and TM [60]. Many studies have shown that theta power correlates with an attentive state in meditation or mental tasks [55, 61, 62]. Hence, the presence of theta alongside alpha waves is often described as an indicator of executive functioning [13].

The listed studies indicate that there has been positive progress in Quran research in recent years. Nevertheless, the reliability, reproducibility and comprehensiveness of these studies' findings still need further validation. Thus, in this review, we aim to critically evaluate the study design of previous studies and provide our insights so that more comprehensive research on listening to and/or reciting the Quranic verses can be performed in the future, as well as to encourage the use of the Holy Quran in all aspects of life.

## 6. Current study designs and techniques employed in Quranic research

### 6.1. Neuroimaging modalities used in the Quranic studies

Most studies have primarily utilized EEG recordings to investigate the effects of the Quran on brainwaves. Over the years, most researchers have used EEG to analyze brain waves produced during meditation or meditation-like approaches. Unlike functional Magnetic Resonance Imaging (fMRI) and Positron Emission Tomography (PET) scans, EEG data provide a direct measurement of neural activity [69]. In terms of real-time resolution, the EEG has an advantage over other equipment because of its higher temporal resolution [70, 71]. Nevertheless, EEG, fMRI, PET, and Magnetoencephalography (MEG) are promising neuroimaging techniques that researchers in Quran research would use to investigate how reciting the Quran impacts the brain, body, and general health.

### 6.2. High-density EEG the way forward

High spatial resolution is required, which necessitates the use of high-density EEG [72, 73, 74]. Using a large number of electrodes improves

the specificity and sensitivity of source localization. As a result, the 10/10 and 10/5 systems were designed to support the greater density electrode settings. These two systems are capable of providing scalp locations effectively while avoiding overlapping with a large number of electrodes (>256) [75]. This remark is supported by a study conducted by Brodbeck et al. [73], who reported that a low number of electrodes (less than 32 electrodes) reduces the sensitivity and specificity of EEG by 50–60%. This shows that the high number of electrodes in EEG (high--density EEG) utilized in a study might affect how sensitive and accurate the data gathered in localizing the brainwave sources is [76]. Nonetheless, the EEG electrodes used in Quran studies are low-density, typically using ≤20 electrodes. In the previous literature, six studies used EEG ≤20 electrodes for brain waves acquisition [28, 39, 42, 43, 63, 66] and five studies used high-density EEG (≥32 electrodes) [57, 64, 65, 67, 68]. Meanwhile, two studies did not state how many electrodes were used in their study [10, 44].

### 6.3. Concurrent EEG-MEG/fMRI studies

Combining high-density EEG with additional neuroimaging devices such as MEG and fMRI will enhance spatial resolution and, consequently, the accuracy of localizing the source [77, 78]. Similarly, Brodbeck et al. [73] reported that when paired with an image from an individual MRI, high-density EEG exhibited greater sensitivity and specificity of data localization when compared to images obtained from MRI, PET, and SPECT alone. In addition, Gavaret et al. [79] stated that combining MEG with high-density EEG can improve the sensitivity and accuracy of source detection since EEG and MEG have distinct sensitivities in various intra-cerebral sources. As a result, EEG and MEG are complementary modalities. From the previous literature (see Table 1), two studies incorporated a simultaneous recording of EEG/MEG [57, 64]. However, both studies only reported the analysis of the EEG data. To support current findings, more research was needed to combine neuroimaging methods to elucidate the neuronal basis of listening to and/or reciting the Quranic verses.

### 6.4. The auditory stimuli: Quranic and non-Quranic stimuli

Some studies failed to mention the chapters or verses of the Quran used in their investigations, making it hard to replicate the study design [42, 44, 67]. Certain verses in Quran had always been used in Islamic medicine due to their purported healing effect, such as *Ayatul Kursi*. Hence, it is important to state the verse and the implication in choosing the verse. Quranic recitations might have different effects depending on the meanings, method of recitations, and variations among reciters [27, 80]. This information is crucial to be stated in detail in the methodology section.

The primary comparisons to the listening of the Quranic verses were based on limited experimental conditions, such as reading books [39], listening to classical music [10, 81], and hard rock music [42, 43]. Only one study compares listening to the Quranic verses against mantra [57]. Nevertheless, it is important to identify whether the stimuli used as comparisons to Quranic verses are suitable for probing the intended research questions. Listening to the Quranic verses can also be compared to various spiritual practices, such as yoga [82, 83], Taiichi [84], and Zen meditation [85], which also promote relaxation, in addition to healthy mind and body fitness. These practices are established therapeutic techniques and meditation approaches that can give a relaxation effect. Thus, comparing listening to the Quranic verses with these practices might help identify the influence of the Quranic verses on the brainwaves and relaxing effect towards the listeners or reciters, thus providing more plausible evidence of neural correlate for rhythmic Quranic verses. However, to date, there is still a lack of information for this type of comparison.

In addition, the variability of the brain signals is likely affected by the backgrounds of the subjects. It is advisable to initially screen the subjects through a questionnaire (e.g., to substantiate their comprehension level, religious/spiritual activity, etc.) [10, 86] to decrease subject bias. Subjects with extensive experience in spiritual practices had been reported to have elevated medial posterior alpha power and higher resting alpha power [87]. These variances in the production of the brainwave signals also are suggestive of analysis of the production of the brainwave individually [88]. The environment for when the brain signals are being taken should be soundproof and comfortable to reduce the artifacts and noise as much as possible.

## 7. Brainwaves analyses methods in Quranic research

The analysis of brainwaves resulting from exposure to Quranic stimuli seems to rest on changes in the power spectral density of each brainwave compared to resting or exposure to other stimuli. The analysis methods that are being used include FFT and Power Spectrum Distribution (PSD), where the signals are filtered depending on the research's settings to get the power of the brainwaves.

Researchers can also analyze the source localization using methods such as LORETA [89]. This is to deduce the origin of the sources and correlate them with a specific role in cognitive functioning. The usage of high-density EEG is essential in acquiring brainwaves data to ensure adequate spatial sampling, hence enabling fast sampling of the brain activity and more accurate source localization [76]. Therefore, it is extremely important to use EEG with a denser/high number of electrodes (at least more than 32 electrodes).

Nonlinear analyses such as approximate and sample entropy can also be used to further understand brain behavior when listening to Quranic verses [31]. Besides that, the functional connectivity measures could be employed for future work as they could benefit in terms of the relationship between brain locations and the Quranic recitations [90].

## 8. Potential brain regions correlate to the holy Quran listening

Both relaxation music and rhythmic Quran can be classified as positive valence as both can change negative emotions into positive ones [91]. Notably, that pleasant emotion is subjective and differs between each individual. However, there are specific brain regions governing pleasant emotion in response to pleasing stimuli, namely the nucleus accumbens (NAcc), ventral tegmental area (VTA), hypothalamus, forebrain, limbic-cortical and deep brainstem regions [20, 92].

Even passive listening to pleasant music without explicit reward (such as drugs and food) can invoke the mesolimbic reward network (NAcc and VTA), in addition to the activation of bilateral cortical regions that consist of the left and right inferior frontal cortex, left orbitofrontal cortex and ACC [20]. The involvement of the hypothalamus, well known for its role in regulating autonomic responses such as heart rate and respiration during listening to music, generates the subjective feeling of “musical chill” [20, 93]. The activation of the NAcc and VTA generates the release of dopamine which is responsible for the pleasure emotion that the subjects feel when listening to music [94]. Hence, it showed that music, just as any other pleasant stimuli such as psychoactive drugs, food and sex that modulate dopaminergic activity, can also cause pleasant and pleasurable effects, although it does not consider biological reinforcement [94]. Similar to music, it was hypothesized that listening to Quranic verses can also activate the same brain region such as the ACC, NAcc, and hypothalamus, thus producing the peak emotional response, or “Quranic chill” [95].

In addition, Wilkins et al. [22] reported an increase in default mode network (DMN) connectivity, which is the interconnected region in the brain when listening to various types of music genres. DMN is the brain network that includes the medial prefrontal cortex (MPFC), precuneus, anterior cingulate cortex (ACC) and posterior cingulate cortex (PCC). These areas become active when an individual is not engaged in the cognitive process, during self-referential thoughts and resting [96, 97]. It will become less active when people become more engaged with the

**Table 2.** Summary of the identified challenges/issues and future recommendations.

| Challenges/Issues identified | Recommendations |
|---|---|
| EEG recording is the primary method used by the majority of studies to investigate the effects of the Quran on the brain. | Other promising neuroimaging techniques, such as fMRI, PET, and MEG, can be utilized. |
| The 10/20 system is often used in most studies. | The use of 10/10 and 10/5 systems is proposed for future research to improve the specificity of EEG. |
| The EEG electrodes applied in Quran studies are low density, with studies typically employing 10–20 electrodes. | To improve source localization, it is preferred that a large number of electrodes be used to ensure optimal sensitivity of the inverse problem in the data processing. |
| Previous research has not explained why the brain area/regions were selected. | Researchers need to clarify why certain brain regions are chosen for data acquisition and analysis. |
| The majority of previous research focused on changes in the activity of alpha and theta brainwaves. | The influence of the Quran on other brainwaves such as beta and gamma needs to be investigated. |
| The spectral power method was primarily used in the analysis of brain signals. | It is encouraged to employ advanced source modeling techniques, such as LORETA, to help estimate the exact brain regions involved, which can be correlated with previously established research findings. |
| Some studies did not provide Quran chapters or verses, making it difficult to replicate the study design. | We recommend providing the chapters or verses used in the Quran research. |
| The prior comparisons to listening to and/or reciting the Quranic verses were constructed under limited experimental conditions. | Further research might compare the Quran to other forms of Arabic speech, such as poetry and chants. |
| **Opportunities for future research** | |
| • An evaluation of connectivity analysis while listening to the Quran is proposed, which may provide further insights into the brain networks involved.<br>• It is necessary to explore the effect of listening to various verses, styles, tempos, and reciters.<br>• More research is needed to investigate the people who comprehend the meaning of the Quranic verses.<br>• It is advised that the long-term impact of listening to the Quran on cognitive functions be studied. | |

outside world and doing tasks. There is also the possibility of encoding new information with the activation of the hippocampus when listening to preferred music [22]. DMN regions were also dominant in alpha brainwaves when subjects were at rest [98]. Interestingly, there was an increase in alpha power during various acts of meditation had been reported [15]. This indirectly reflects the function of alpha power to inhibit and disengage the brain from outside activity, causing the meditators or subjects to feel calm and relaxed.

## 9. Recommendations and opportunities for future neural correlate studies in Quran research

The interest in the neural basis and correlate for the rhythmic, melodic Holy Quran is an emerging neuroscience empirical research with a particular focus on establishing the neuronal mechanisms that underlie the anecdotal pleasing and calming effects as a psycho-spiritual form of therapy. Considering the fast-evolving neurotechnological tools and the prospect for research in this area, this review identifies the following aspects that are largely methodical to facilitate future research, as summarized in Table 2.

## 10. Conclusion

The neural foundation of the effect of listening to the Quranic verses is still in infancy as not much research had been done using current neurotechnological devices to investigate the melodic Quran as compared to the other meditation-like approaches. Only recently, studies had been done to investigate the neural mechanism on the effect of listening to the Holy Quran verses being recited particularly using EEG and the associated brainwaves produced. However, current evidence indicates that listening to Holy Quran verses activates similar brain regions and elicits comparable therapeutic effects (i.e., induction of a relaxed cognitive and spiritual state) comparable to music rhythmic therapy. Yet, due to the limited number of studies in this area, further investigations are required with more concise and standardized study designs to ensure the validity and reliability of the findings. Findings from this review, and the current advent of neuroimaging studies, pave the way in acknowledging listening to Quranic verses as an alternative tool in rhythmic therapy. Further neuroimaging and clinical studies to assess the possible effects of listening to Quranic verses are warranted (including in the post-operative, rehabilitation, pre- and post-partum care, pain, psychological parameters, etc.). It is of much interest that, in the near future, listening to rhythmic Quranic verses will be accepted and established as one of the mind-body alternative therapeutic tools to substitute and/or supplement conventional therapies.

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