

Short Communication

Electroencephalography (EEG) Frontal Alpha Asymmetry Index as an Indicator of Children's Emotions in the Three Quran Learning Methods: Visual, Auditory, and Memory

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Abstract

Objective: Quran memorization is familiar in Indonesia since early childhood (EC) education level and it is reported to have a positive effect on children's emotional state. This study investigates how Quran memorization influences children's emotions in a certain condition using Frontal Alpha Asymmetry (FAA) index.

Method: The participants were 4 children aged 5-7 years, studying at Islamic-based schools in Surakarta. The tasks included three methods of Quran learning: visual, by watching videos; auditory, by listening to murattal recitations of the Quran; and memory, by repeating rote. The FAA index measurement used absolute power data obtained from Electroencephalography (EEG) by calculating the natural logarithm (\ln [right alpha power] – \ln [left alpha power]) from channel F8 and channel F7 respectively.

Results: The majority of participants showed a positive FAA index in almost all tasks. The FAA index of various tasks were not significantly different from each other, with $P = 0.592$ based on Kruskal-Wallis nonparametric test. The post hoc Mann-Whitney U test does not find any intervention that stands out among the others.

Conclusion: Learning the Quran with methods that involve visual, auditory, and memory activities results in positive, happy, motivated and excited feelings in children's emotional state based on the FAA index assessment.

Key words: Brain Waves; Children; Electroencephalography; Learning

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Quran memorization has been reported to correlate with six aspects of early childhood development including moral and religious, psychomotor, social, emotional, cognitive, and arts (1). This article focuses on studying effects of memorizing the Quran on children's emotions. Emotional assessment was carried out objectively and quantitatively with Frontal Alpha Asymmetry (FAA) index parameters obtained from electroencephalography (EEG) recording (2). The FAA has been used by scientists to study various types of patterns of psychopathology, motivation, emotion, and cognitive control. FAA employs three basic abilities: visual, auditory, and memory, which develop along with the child's growth. Visual abilities affect all aspects of children's development including physical, intellectual and emotional aspects, as well as their habits, academic performance and social skills (3). Visual perception develops as children get older and this development occurs most rapidly at the age of 9. Children's auditory abilities develop in the womb and continue after birth. Implicit memory exists since the beginning of a child's life and does not change much until several years after birth (4). Language, emotion, and memory are controlled by the temporal lobe, and the development of the grey matter in this lobe does not reach its peak until late childhood.

Materials and Methods

Four children participated in this study with the following criteria: 1) being male or female aged 5-7 years; 2) taking formal education in Islamic-based schools; and 3) having normal growth and development. The tasks included three methods of Quran learning: visual, by watching videos; auditory, by listening to murattal recitations of the Quran; and memory, by repeating rote. The three methods were provided in the form of five tasks with varying levels: 1) watching a video of a surah in the medium category, 2) listening to the murattal recitation of a surah in the easy category, 3) listening to the murattal recitation of a surah in the difficult category, 4) repeating rote of a surah in the easy

category, and 5) repeating rote of a surah in the difficult category. The easy category surah was Surah Al-Fiil (5 verses), the medium category surah was Surah Al-Fajr (30 verses), the difficult category surah was Surah An-Nazi'at (46 verses). The video mentioned at task number 1 showed a child qari (Quran reciter), while tasks 2 and 3 used the sound recording. In tasks 4 and 5, the children were asked to recite the surah only. The five tasks were carried out sequentially, with a duration of 1-2 minutes for each task. The EEG recordings were done independently for each task. The participants were allowed to rest for a moment after each task. The difference in levels of difficulties was used to assess the stress level of subjects.

It used EEG Cadwell® Easy III with Easy III Record Data and NeuroGuide 3.0.0.1 softwares. The overall recording took 45-60 minutes with several trials. The data were mined from the best trial, whose artifacts had been eliminated by several methods (manual selection, artifact free template matching, and Z-score artifact free selection). The steps to process the EEG data using NeuroGuide 3.0.0.1 focused on the alpha band within a 6-12 Hz frequency range. The FA index was obtained by calculating the natural logarithm (\ln [right alpha power] – \ln [left alpha power]) from channel F8 and channel F7 respectively (2).

All procedures in this study have received ethical approval from the Health Research Ethics Committee of Universitas Sebelas Maret No.091/UN27.06.6.1/KEPK/EC/2020. The statistical tests used to analyze the differences in the FAA index were the Kruskal-Wallis nonparametric test followed by the Mann-Whitney U post hoc test.

Results

The four participants had started memorizing the Quran since the ages of 2.5-5 years and had memorized 1-3 juzs at the time of the study. Table 1 and Table 2 show the absolute power data. These will be used in the calculation of the FAA index.

The results of these calculations are presented in the Table 2.

Table 1. Absolute Power of Alpha Channel F7 and F8 Denoting Brain Wave Quantification for each Task

Participant (sex, age [years old])	Channel	Absolute power (μV^2)				
		V-b	A-a	A-c	M-a	M-c
A (F, 7)	F7	10,11	10,50	12,35	10,90	11,50
	F8	10,87	12,69	11,54	12,42	12,31
B (F, 7)	F7	5,99	6,71	6,91	6,83	7,13
	F8	6,67	7,37	7,92	8,04	7,45
C (M, 7)	F7	7,02	8,33	8,28	7,80	7,25
	F8	7,83	9,77	9,27	8,15	7,56
D (M, 5)	F7	6,64	10,11	13,89	18,07	12,02
	F8	6,26	9,29	12,27	17,46	10,88

M: male; F: female; V: visual method by watching videos; A: auditory method with listening to murattal recitations; M: memory method by rote repetition; -a: easy category surah; -b: moderate category surah; -c, difficult category surah.

Table 2. Frontal Alpha Asymmetry Index Indicating Emotional State for each Task

Participant (sex, age [years old])	V-b	A-a	A-c	M-a	M-c
A (F, 7)	0,072482	0,189439	-0,06784	0,130545	0,068065
B (F, 7)	0,107528	0,093819	0,136422	0,163104	0,043903
C (M, 7)	0,109199	0,159453	0,11294	0,043894	0,04187
D (M, 5)	-0,05893	-0,08459	-0,12401	-0,03434	-0,09965

M: male; F: female; V: visual method by watching videos; A: auditory method with murattal listening; M: memory method by rote repetition; -a: easy category surah; -b: moderate category surah; -c: difficult category surah.

Discussion

The results indicate that age does have a correlation with brain wave patterns. The relative power of alpha waves increases with age until the age of 9 (5). The peak frequency of alpha waves increases with age, while the power does not change significantly (6). Seen from the memorization method perspective, the activities of watching happy videos and watching Quran recitation videos, as well as listening to Quran recitation (8), had a similar effect in forming positive emotions (7). Meanwhile, negative emotions occurred when it came to difficult surah.

In the memory learning method by repeating rote, we found similar findings both with easy and difficult surah categories in Participants A, B, and C. So far, we have found no studies that examine the effect of memory recall activity on FAA. Thus, these data can be initial findings, indicating that conditions in which children are encouraged to repeat rote will put them in an approach-oriented emotional state with increased motivation, which is indicated by a positive FAA index. However, this still needs further study for sure, given that the activity of repeating rote is certainly more 'stressing' than just watching or listening to murattal videos.

Based on the results of the Kruskal-Wallis nonparametric comparative test, the FAA index of the five tasks is not significantly different ($p > 0.05$). This shows that learning the Quran with visual, auditory, and memory methods has no meaningful effect on emotions. The only implication is that the three methods put the majority of participants in an approach-oriented emotional state. Also, the post hoc Mann-Whitney U test, which compared the FAA index between the 2 tasks, finds no task that stands out among the others.

Limitation

These findings, taken from four participants, require further investigation involving more participants. In this study, all participants received the same task, so there was no control group to compare the results with. We also did not collect EEG data at the resting state that could be compared with EEG data during the task to see the significance of changes in the FAA index.

Conclusion

Learning the Quran with methods which involve visual, auditory, and memory skills puts the majority of EC participants in an approach-oriented emotional state that appears in the form of positive, happy, motivated and excited feelings based on the FAA index assessment. This suggests that Quran learning has not been shown to interfere with the emotional aspects of EC development. Factors other than the learning methods that might affect the development of EC in the Quran learning process in the 6 aspects need to be studied further. One of these factors is the age at which one starts memorizing the Quran.

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Conflict of Interest

None.

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