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CASE REPORT ON THE SUBJECTIVE EXPERIENCE OF YOUNG ADULT WOMEN LISTENING TO MUSIC WITH A QUANTITATIVE ELECTROENCEPHALOGRAPHY STUDY

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Abstract: Introduction: many studies have proven the positive effect of listening to music on health. So far there is still limited research evaluating how the brain plays a role in supporting cognitive activity listening to music and how it affects health. One method that can evaluate brain activity in listening to music and its effects on health is by measuring electroencephalography quantitatively associated with changes in heart rate. Objective: to subjectively measure mental activity in listening to music through quantitative EEG examination by looking at the size of event related de/re-synchronization (ERD) alpha wave power and its correlation to heart rate variations in real time, in young adult women. Methods: measuring the ERD power of the alpha of the 20 EEG electrodes with variations in heart rate when the subject listens to music. Results: when listening to music there is a decrease in left prefrontal cortex activity (F3 and F7). In general, there is a lateralized pattern of increasing right hemispheric alpha power, and there is a very dominant increase in the right auricular (A2), right temporal (T6) and right occipital (O2) areas. There is no difference in heart rate frequency during basal conditions with listening to music. Conclusion: the subjective experience of listening to music is followed by lateralization of the right hemisphere with a very dominant increase in the auricular, temporal and occipital areas.

Keywords: electroencephalography, music, electrode, cognitive activity

Introduction

Music of the current era has become an inseparable part of human daily activities. Almost every moment of everyday human life is exposed to music. There is a recent trend that music is used as a therapeutic modality that has an impact on physical and mental health. (1)(2) Music is believed to be able to make people stay healthy, have a clear mind and be active in social development. (3) Music therapy is also believed to reduce stress, improve athlete performance, improve mood, and make people feel comfortable. (4) The activity of listening to music, is a subjective perspective of the experience of listening to sound, giving a charge of happy, sad and other emotional positive emotions as well as providing an intuitive and mindful influence. (5) In conditions of severe mental disorders

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such as schizophrenia, some researchers have concluded that reducing negative symptoms, increasing the patient's conversational skills, reducing social isolation and increasing the level of interest of the patient in the outside world. (6) In the group of caregivers with dementia, singing and music interventions have a good effect on social and emotional well-being, increase the ability to perform adaptive coping, maintain care in care, and contribute to the enrichment of positive experiences. (7) Some of the other benefits of music intervention are that it helps patients with emotional control disorders which are closely related to social functioning, emotional status, cognitive level, and academic development. (8) Involvement in traditional music such as Tibetan folk music for students which is "related" to Tibetan culture, has a positive impact in reducing symptoms of depression, anxiety and stress, improving affection, ways of communicating and relationships between families. (9)

Music, like language, as understood by western academics, consists of discrete elements. Musical notation is grouped into phrases, broken down into discrete pitch and time intervals. In western music, this interval has a condition, often defined as a ratio integer between pitch and time. discrete symbolic mental representations of music are thought to be aided by categorical perception – perceptual mapping from a continuous signal space to discrete elements. (10) In English there are two terms hearing and listening in listening to music. Listening refers to conscious activity where this mental activity is more complex. Meanwhile, more superficial hearing focuses on the sound produced. (11) The activity of listening to music is a unique mental activity, because from it a person can display visual memory memories, even without any sensory stimulus from the sense of sight. (12) When listening to music live, it turns out that the mind can wander everywhere, or cognitively perform a mental activity called mind wandering which is generated by a brain network known as the default mode network. (13) In general, music is often studied as a cognitive domain parallel to language. Despite the fact that music has an emotional side. For example, certain special emotions can be aroused by certain types of music. Some experts propose the involvement of the amygdala and medial prefrontal cortex which are responsible for the emotional content of music (14). The activity of playing, creating, listening to music is a complex mental activity in various neuroscience studies activating brain areas which are the centers of multisensory integration, motor, cognitive function and Emotional includes frontal, parietal and temporal. Other brain areas that are activated when interacting with music include the insular cortex, anterior cingular cortex, ventromedial prefrontal cortex, parahippocampal cortex, striatum, amygdala and hippocampus. (15)(16)

Different complex cognitive activities will generate different regional neural network activities depending on what cognitive tasks are carried out. (17) Areas of the brain that are activated due to certain complex cognitive tasks will generate neurophysiological changes, where these neurophysiological changes can be intercepted by various neurological imaging examination techniques such as functional magnetic resonance imaging (fMRI), positron emission tomography (PET) or by quantitative techniques electroencephalography (q-EEG). (18) The electroencephalogram is a method of recording the oscillations of the brain's electrical potentials, sometimes referred to as the "mind window". The EEG is widely used to evaluate the action of synapses in the cerebral cortex, both moderately and strongly correlated with the functional status of the brain. (19)

Material and Methods

Before carrying out the electroencephalography examination, the subjects were asked to wash their hair and not use wax or hair oil at all. Recording music equipment from cell phones and headsets has been prepared before laying down and finishing installing the electrodes. Subjects were in a lying position, relaxed, did not think about anything and closed their eyes for two minutes to serve as a basal condition. Music familiar to the subject is played, and the subject listens to the music through a headset. The familiar song chosen was "1975 - about you". The range of the number of beats per minute for this song is 95-97 beats per minute. The sound volume is 50 db. Cadwell Easy III (USA) electroencephalography recording device, using 20 electrodes (10 – 20 system), made of Ag / AgCl with an impedance of 5 kΩ. Easy ambulatory III recording software and brain map, filtered 1 – 70 Hz, sensitivity 7 v/mm, and power range 0 – 196 v. The results of the recording being analyzed were artefact-free 10-second sampling. The focus of the analysis is on alpha waves with a frequency of 8 – 12 Hz, the analysis uses the centrum as a reference on average. Quantitative analysis uses the event related de-/re-synchronization ERD-/ERS method by calculating the alpha power while listening to music minus the alpha power during basal conditions divided by the alpha power during basal at all electrodes. The heart rate is also evaluated for one minute by counting one QRS wave which is displayed as one beat multiplied by 6.

Result and Discussion

Subjective experience expressed when listening to music.

During the examination, the first thing I felt was a feeling of tension. Because it was my first experience doing it and seeing the process firsthand.

During the examination, I try to relax, I try not to think about anything so as not to strain.

Then when listening to murottal, at first I felt tense, because the murottal being played was not what I usually listen to. However, over time I felt relaxed

When listening to the song, what comes to my mind is the situation on trains and stations, where people separate to go overseas, where they start their journey, as well as a place to travel to their hometown. At that time, I actually didn't have a favorite song, I just thought at the time, I happened to be traveling by train a lot

Table 1. Quantitative Electroencephalography Results Left Side Electrode

Cognitive activity	FP1	F7	F3	A1	T3	C3	T5	P3	O1
baseline	3.67	2.47	1.70	3.36	3.10	5.67	4.38	3.75	4.09
music	4.19	2.26	1.38	3.94	3.16	7.32	5.65	4.14	6.86
Music ERD	14.17	-8.50	-18.82	17.26	1.94	29.10	29.00	10.40	67.73

Table 2. Quantitative Electroencephalography Results Right Side Electrode

Cognitive activity	FP2	F8	F4	A2	T4	C4	T6	P4	O2
baseline	4.26	4.55	4.98	4.86	5.02	6.03	5.26	5.89	6.26
music	5.14	5.68	6.11	8.07	7.14	7.96	9.60	8.80	15.56
Music ERD	20.66	24.84	22.69	66.05	42.23	32.01	82.51	49.41	148.56

Table 3. Middle side electrode

Cognitive activity	FZ	PZ
baseline	4.96	7.23
music	6.92	8.08
Music ERD	39.52	11.76

Heart rate frequency at baseline and when listening to music 60 times per minute.

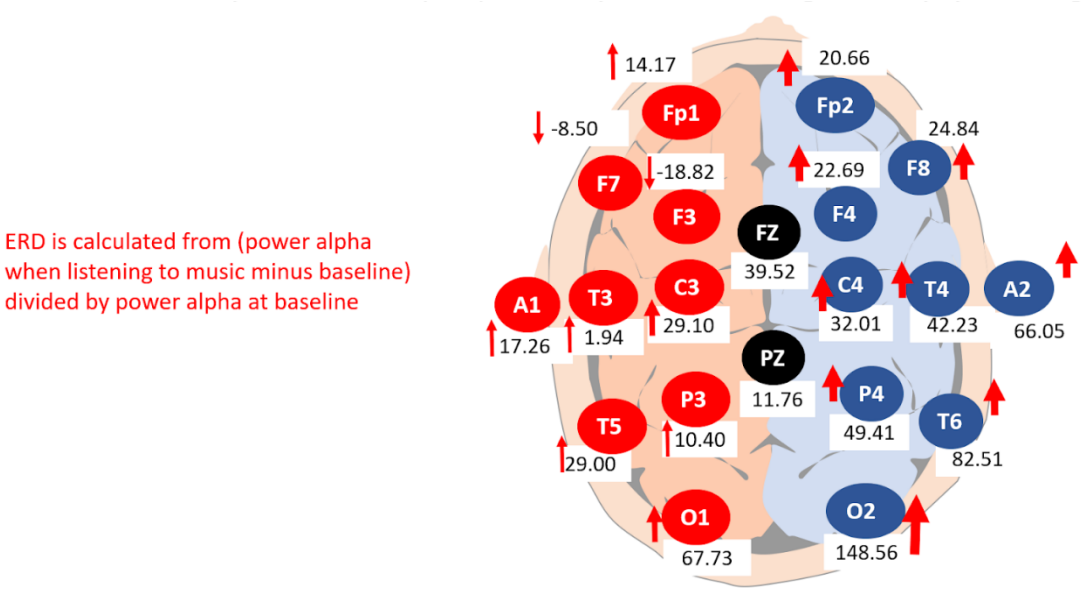

Figure 1. Map of Event-Related Desynchronization/ERD (increase) and Event-Related ERS Resynchronization (decrease/negative) on the Right and Left Electrodes when Listening a Popular Familiar song.

In general, from the elevation picture (ERD) there is a lateralization pattern to the right, the strength of desynchronization activity is higher in the right hemisphere. The increase was very significant in the right auricular (A2), right temporal (T6) and right occipital (O2) electrodes. There is decreased activity at the left-hand electrode at F3 and F7 which is probably the area of the medial and ventral prefrontal cortex.

The main finding from the results of the quantitative electroencephalogram of the subjects while listening to music was the lateralization of an increase in the right hemispheric alpha power and the dominance of the main increase in the auricular, temporal and occipital areas. The auricular and temporal areas represent the activity of the lobes which have a supporting role for auditory mental activity as sensory centers and auditory memory. While the occipital is the center of support for visual memory storage. The increasing dominance of this activity is in line with what was subjectively expressed by the respondents when listening to this music.

Listening to music is a form of choice behavior, so our brains selectively receive music information and filter other information. Brain oscillator activity in alpha waves (8-14 Hz) in certain areas plays an important role for engagement and disengagement depending on the demands of the mental task. (20) Music and sound processing by the brain is a cortical nerve network that is spread over the superior temporal lobe, dorsolateral frontal, and also the parietal brain region. (21) A qualitative study

provides the view that there are six main categories of conscious mental experiences interacting with music. Mental awareness interacting with music is given the term as expectancy defined as the default brain function in which an individual can create affective and cognitive sensations from their experiences (when listening to music) by comparing actual events that unfold with their predictions. The six categories include: 1) personal background (memory, personality traits, and expectations), namely self-relevance assessment of the stimuli (music) generated, 2) cultural acceptance of music (sonoristic enculturation), 3) musical structure, 4) action listening to music, 5) mental mechanisms, 6) affective and cognitive listening experience. (22) Generating autobiographical memories and emotions related to listening to music and involving memory systems that support memory, which arise such as memories related to lyrics, melodies, harmony progressions, rhythms and tones. (23)

Lateralization of the brain is generally recognized in motor activity, where most of the population, almost all of their motor activities, such as texting, cutting vegetables, and playing football, use the right side dominantly. (24) Cortical lateralization is defined as how functions are dominantly carried out by the right or left side of the brain. (25) Functional lateralization is a main characteristic of the human brain, especially in brain networks that play a role in language, sensorimotor, and facial processing which begins in infancy. (26) In a study that compared musicians and non-musicians when given stimuli that stimulated the perception of speech, it was found that older musicians were relatively more lateralized to the left compared to young musicians or non-musicians. (27) Working memory is mental activity which is the core of the cognitive function needed to integrate information over time, supported by the dorsal and ventral prefrontal cortex, basal ganglia, and limbic areas. In the mental activity of listening to music, in one study, it activated the function of this working memory and found a pattern of lateralization to the right. (28)

Conclusion

The subjective experience of listening to music by tapping the quantitative electroencephalogram found that there was lateralized activity of the right cortex hemisphere with very dominant activity in the auricular, temporal and occipital areas.

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