

Chapter 9

Effect of Slow and Fast Music on the Autonomic Nervous System and Cardiac Health: A Preliminary Investigation

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ABSTRACT

In this study, the effect of slow and fast music on the heart rate variability and conduction pathway of the heart was studied. The results indicated an increase in the parasympathetic dominance as the volunteers were made to listen to music. The magnitude of the parasympathetic activity was higher when the volunteers were made to listen to fast music. This indicates that slow and fast music affected the sympatho-vagal balance in different proportions. The analysis of the ECG signal and wavelet transformed ECG signal suggested an alteration in the conduction pathway of the heart.

DOI: 10.4018/978-1-5225-0140-4.ch009

INTRODUCTION

Music has been reported to alter the physiological and the psychological states of humans (Kemp & Quintana, 2013). This results in the alteration of the cardiovascular activity (Levenson, 2014). The main reason for the alteration in the physiological activity of the heart has been described due to the intervention of the autonomic nervous system. In the last decade, there has been an immense increase in the stress and the anxiety of the persons. This, in turn, has resulted in the increase in the number of the diseases associated with the psychosomatic disorder (Dey, Banerjee, Bhattacharya, & Tibarewala, 2015). To alleviate such conditions, music therapy has been proposed due to its ability to alter the activity of the autonomic nervous system. Even though the music therapy has been found to change the emotional states of the patients, the mechanism of music therapy is still a gray area for the researchers (Z. Yang, Su, Ji, Zhu, & Bai, 2014). Music has been found to evoke a particular type of emotional state.

Many researchers have studied the effect of different types of music on the emotional states of the volunteers. In most of the studies, the response of the volunteers regarding their emotional states was recorded. Unfortunately, no other physiological responses were taken into account. Due to this reason, conflicting results were obtained. In some of the recent literature, it was found that listening to music decreases the sympathetic activity with the corresponding increase in the parasympathetic activity (Lee et al., 2012). The sympathetic and the parasympathetic activities, which form an integrated part of the autonomic nervous system, can be analyzed non-invasively by studying the heart rate variability (HRV) (Thoma et al., 2013). The analysis of the HRV helps in understanding the dynamic interactions among the sympathetic and parasympathetic systems, which constantly changes due to the internal and the external stimuli. Till date, very few reports were found which analyzes the effect of music on the conduction pathway of the heart. It is important to study this parameter because the autonomic nervous system innervates the sino-atrial (SA) node, which is regarded as the pacemaker of the heart. It is quite possible that the physiological changes in the conduction pathway may also alter the cardiac physiology.

In the present study, we have tried to understand the effect of slow and fast music on the activity of the autonomic nervous system and the conduction pathway of the heart. The activity of the autonomic nervous system was analyzed by studying the heart rate variability. The physiological changes in the conduction pathway of the heart were studied by analyzing the ECG signal. The ECG signal was analyzed either as acquired or after processing in the joint time-frequency domain using wavelet decomposition. The features of HRV, ECG signals and wavelet transformed ECG signals were used to predict the important parameters using linear (Analysis of Variance (ANOVA)) or non-linear (Classification and Analysis Regression Tree (CART), Boosted Tree (BT), Random Forest (RF)) classifiers. The important parameters were used as input predictors for the classification using Automated Neural Network (ANN).

BACKGROUND

Music has been instrumental in reducing the anxiety and mental-stress of people since the ancient days (Skånland, 2013). However, understanding the influences of music on the physiological parameters of the human body received a major thrust just more than a century ago (Davis, Gfeller, & Thaut, 2008). Extensive research has been done to analyze the effect of music on human health. A number of studies have suggested that listening to the music not only influences the emotional and mood states of a person but also modulates the physiological parameters like galvanic skin response, pulse rate, blood pressure,

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