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Sensation of Rhythm and Related Synchronization with Physical Movements during Listening to Music

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Abstract

Authors have continued the activity of Integrative Medicine Japan (IMJ) for managing art therapy, music therapy and physical therapy. When people listen to music, certain phenomenon would be observed where the sense of rhythm and physical movements are synchronized to the same rhythmic stimuli as auditory-motor synchronization (AMS). For these mechanism, mirror neurons in the brain are deeply involved, and causes movements and reactions in sync with the rhythm. Synchronizing the body movement is also called as Auditory-Motor Entrainment that showed research development in biology and psychology. Physical movements improve "motor economy" by matching them to a certain tempo.

Keywords: Auditory-motor synchronization (AMS); Mirror neurons; Auditory-Motor Entrainment; Motor economy; Vibration coupling

Introduction

Music contributes much not only for art and culture, but also greatly for mental and physical health, which is deeply related to psychosomatic medicine [1]. The authors have been involved in the management of Integrative Medicine Japan (IMJ), Shikoku Island division [2]. Furthermore, we have continued various research for Integrative Medicine (IM) involving art therapy, music therapy and physical therapy [3]. Among them, the power of music has been known from various points of view. Listening to music activates the mechanism of rhythm and synchronization with physical movements [4]. Especially, vibration coupling has been a fundamental mechanism of communication, and it has been suggested that cardiac rhythm plays a causal role in regulating neural vibrations. Various activities of dance, music, hiking and yoga were investigated in the light of empirical aspects. From generalized perspectives, they include plural bio-psycho-social studies, and several research of relationship among music, rhythm sensation, and related physical movements [5]).

When people listen to music, certain phenomenon would be observed where the sense of rhythm and physical movements are synchronized to the same rhythmic stimuli as Auditory-Motor Synchronization (AMS) [6]. This mechanism is closely related to the brain, nervous system, and motor system. Lots of interdisciplinary studies are found from the perspectives of neuroscience, psychology, and musicology. Several impressive topics will be introduced in this article.

Rhythm and the brain can be synchronized. For human being, hearing and movement usually interact. The rhythm of music activates not only the auditory cortex (the area of the brain that processes sound) but also areas involved in movement (the motor cortex and cerebellum) [7]. This allows the beat of the music to affect human motor system, making it easier for the body to move in time with the rhythm. Furthermore, brainwaves also have rhythm. The constant rhythm of music stimulates certain frequency bands of the brainwaves, such as alpha and gamma waves. These changes in brainwaves increase attention and concentration while also promoting synchronization with physical movements.

Rhythm is an essential element of music. The rhythm that people perceive has the power to affect their emotions and evoke certain feelings. For example, fast-tempo music increases energy of the person, while slow music promotes relaxation. In this way, the emotional reactions that arise in people's minds unconsciously affect their physical movements. Simultaneously, they tend to have their movements in synchronization with the rhythm. The "mirror neurons" in the brain are deeply involved in the reason why people can respond to rhythm and movement [8]. These neurons have the ability to enter a state of readiness to imitate the actions or sounds of others just by seeing or hearing them. In fact, the rhythm of music stimulates this system, causing movements and reactions in sync with the rhythm.

This sense of rhythm not only influences emotional responses and the responsiveness of mirror neurons in the cerebrum, but also has a close influence on physical movements. It brings the smooth movements of the upper/lower limbs and trunk. In other words, physical movements improve "motor economy" by matching them to a certain tempo [9]. For example, if a person listens to music and move to the beat of the music while walking or running, one can move more efficiently. Dance and rhythm training are further continuous programming using this principle. In recent years, music videos have become a popular form of video. In this way, music plus dance can improve the sense of rhythm and strengthens the sense of unity between the body and music. Continuing this practice promotes brain plasticity or adaptability, creating a cycle that further strengthens the response to music.

Some people can recognize the beat of music and synchronize their body well, but it varies from person to person [10]. The reason would be that each person has different cultural background, past experiences, and other personal situations, which have deep influences. There are many different regions and cultures on the earth. People who were brought up in certain cultures are accustomed to a certain rhythm and beat feeling. Furthermore, people who have been musically trained since childhood tend to have a high sensitivity to rhythm. An example can be presented as a four-beat rhythm music. Anyone can clap their hands, bend their knees, and lower their center of gravity at the point of 1st and 3rd beat. However, it is rather difficult to feel and dance for emphasizing the off-beat. In the case of talented dancers and jazz players, they can easily perform body movements along the off-beat rhythm. Such well-trained people can allow audiences and listeners for feeling a subtle shift in rhythm, creating tension, excitement and elation.

Regarding these phenomena of synchronizing the body movement, the specific term ‘entrainment’ has been used as Auditory-Motor Entrainment [11]. The research of rhythmic entrainment has been developed in biology and psychology. Among them, energy effect of walking rhythms, synchronization with music or efficacy of music rehabilitation on patients with stroke. Entrainment has been known as natural phenomena which were translated into synchronization. They refer to the situations where systems and objects have shared some common periodicity and started to move together. They have observed in physical movements and biological rhythms, in addition to the conditions where the human body and coefficients were synchronized to the musical rhythm. Such phenomena have been investigated for crucial academic topics in natural sciences, neuroscience, biology, psychology and so on. In human cases, entrainment are usually observed in the music experiences with various rhythms. Specially, hearing music and also body movements are simultaneously synchronized together with influencing each other. Such phenomena are regarded as the basis of rhythmic movement and dancing which binds music and physical movements.

In summary, general information and recent perspectives were described concerning auditory-motor synchronization (AMS), coupling mechanism between sound rhythm and physical movement. When adequate music is given, it is easier for human body to move in time with the regular rhythm. It is expected that this article will become useful and beneficial for future research.

Conflict of Interest

The authors declare no conflict of interest.

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