



Abstract

Binaural beats are a phenomenon where two different frequency tones are presented to each ear separately yet are processed by the brain as a single unified tone. This is due to binaural integration. Previous research indicates binaural integration brings changes to regions of the brain and can promote feelings of well-being. While a substantial amount of research has shown music, both in clinical and non-professional settings, to be an effective method of therapy, there is a comparative paucity of research examining the efficacy of binaural beats to treat, e.g., anxiety or depression. The proposed study will investigate the effects of binaural beats on levels of anxiety and depression, particularly as compared to classical music. A pre-post design will be utilized, with levels of state anxiety, depression, and mood serving as dependent measures, and binaural beats as the independent variable. A control group will be exposed to classical music. Potential results are discussed in the context of clinical practice and the viability of binaural beats as an alternative to the use of prescription drugs for treating anxiety and depression are explored.

Background

Anxiety and depression affect a significant amount of the population. Specifically, anxiety disorders affect 7.3% of the world's population, or 284 million according to recent statistics (Baxter, Scott, Vos, & Whiteford, 2013). According to the ADAA (2018), 322 million people worldwide are living with depression. Both of these mental health illnesses can have severe and long-lasting repercussions, including negative effects on mental health, sleep habits, physical health, and trigger bad habits such as drug addiction (ADAA, 2018).

Unfortunately, there is a high comorbidity between depression and anxiety, and evidence that anxiety can trigger or enhance the influence of other disease symptoms, such as depression (Sareen et al., 2005). Furthermore, co-occurring anxiety and depression can result in brain deficits and changes such as lower working memory performance (Dotson, Szymkowicz, Kirton, McLaren, Green, & Rohani, 2015). Thus, reducing the prevalence and symptom severity of both depression and anxiety is vitally important from a public health perspective. A common approach for reducing severe anxiety and depression is the use of drugs (though this is less likely for more minor symptoms). Legal use of drugs requires a prescription, which is not always easily accessible. Additionally, using drugs habitually can become costly and result in negative side effects and potentially addiction. Thus, a cheap and accessible alternative could potentially benefit a large number of people suffering with these issues. One possible alternative that has received a lot of attention, both in clinical settings and as self-therapy, is the use of music.

Research shows that music can improve the effects of less than ideal psychological states. However, there is some discrepancy among contemporary research as to whether or not binaural beats should be considered a form of music. Some sources refer to binaural beats as a "physical phenomenon," while others refer to binaural beats as "acoustic beats." Regardless, binaural beats occur when two different frequency tones are presented dichotically (Ungan, Yagiogiu, & Ayik, 2019). While the frequencies are presented to each ear separately, the brain will process it in such a way that it is unified and interpreted as a single tone because of the process of binaural integration (Lentz et al., 2014). Current research supports the idea that binaural beats change the functional connectivity between regions of the brain (Gao et al., 2014; Karino, 2006; Karino et al., 2004). In addition, research supports the idea of connectivity of cortical networks also being altered (Beauchene, Abaid, Moran, Diana, & Leonessa, 2016; Beauchene, Abaid, Moran, Diana, & Leonessa, 2017; Ioannou, Pereda, Lindsen, & Bhattacharya, 2015).

A number of research methods have been used to test binaural beats effects on mental well-being. Theta/delta-band frequencies have already been utilized to lower anxiety levels (Isik, Esen, Büyükerkmen, Kiliç, & Menziletoglu, 2017). One study tested binaural beats at a 5 Hz frequency using a multi-layer perception classifier and Low-Resolution Brain Electromagnetic Tomography to compare before and after effects on anxiety (da Silva Junior, de Freitas, dos Santos, da Silva, Rodrigues, & Conde, 2018). This study showed significant changes in High Alpha state, but unfortunately only used a very small sample size. Meta-regression results from another study with binaural beats show that background white noise is not needed for effective results (Argibay, Santed, & Reales, 2018).

The literature presents an ever-growing pool of research supporting the use of binaural beats for improving cognitive well-being. However, there is a less substantial amount of research examining binaural beats' effect on anxiety, and few studies that have been conducted on its effect on depression. This indicates a gap in the current binaural beats research literature. There is also still lack of consensus on the success of binaural beats entrainment, where one's brain synchronizes with the binaural beat, and the individual can then experience the benefits of that brainwave state (da Silva Junior, de Freitas, dos Santos, da Silva, Rodrigues, & Conde, 2018). Binaural entrainment is also known as Frequency Following Response, and its success is still in discussion (Vernon, Peryer, Louch, & Shaw, 2014).

Methods

The proposed study will examine the effects musical frequencies on the human state of mind. Specifically, the effect of binaural beats on state

anxiety and depression will be evaluated. Binaural beats will be systematically manipulated in an experimental setting by having participants listen to them via headphones during a 8-minute session with calming visuals. A control group will listen to classical music with nature visuals. Anxiety and depression will be assessed before and after the listening session through a pre and post test questionnaire. These questions will be based on the Positive and Negative Affect Schedule (PANAS), the Beck Anxiety Inventory (BAI), the Penn State Worry Questionnaire, and Affective Slider to assess the participants' current emotions. The primary hypothesis is that participants will report decreased anxiety and depression following a listening session.

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