

Binaural popular brain-hacking technology since the last decade.

[Psychology](#), [Behaviorism](#)



Binaural beats, a brainwave entrainment technology, have been propelled into the realm of science since the 1840s and are becoming an increasingly popular brain-hacking technology since the last decade. Binaural beats use a phenomenon that occurs within the cortex to take subjects into different frequency brain wave states. When two different frequencies are presented in each ear, hemispheric synchronisation occurs meaning the electrical activity of the two hemispheres of the brain unite into a single synchronous pattern with an overall frequency that corresponds to the difference between the two originally presented tones (Beauchène & Abaid 2016). The overall brain activity then tends to match with that frequency, entering that brain state and allowing for a potent form of brainwave entrainment (Edrington, & Allen, 1985). Furthermore, several studies have found that binaural beats (BB) improve overall working memory performance (Beauchène & Abaid 2016, Cowan, 2008; Kennerly, 1994; Ostrander & Schroeder, 1991; Schack et al.

, 2005; Wahbeh & Calabrese, 2007). Working memory is the multi-component system in control of the processing and organisation of information for reasoning, comprehension and goal-directed behavior (Baddeley & Hitch, 1974; Baddeley, 2000 cited in Beauchène & Abaid 2016; Cowan, 2008). Two processes make part of this WM, named free recall and recognition.

Free recall- or simply recall- transfers a memory from the immediate memory storage (iconic memory) to the WM, where it can be accessed and worked with. Recognition, on the other hand, involves a process of

comparison of newly acquired information with previously acquired memories. Indeed previous studies have shown that an increase in electrocortical phase synchronisation promotes neural communication, stimulates neural plasticity, and improves working memory (Fell & Axmacher, 2011 cited in Beauchène & Abaid 2016).

Inversely, increased phase synchronization is required for successful encoding of information during a memory task (Fell et al., 2001, cited in Beauchène & Abaid, 2016). These studies suggest that BB have the potential to significantly alter network topology for improving memory. In this study we opted for beta frequency BB as most research has proven to be successful concerning recall and recognition in this frequency range (Beauchène & Abaid, 2016; Buzsáki et al., 2004; Kennerly, 1994; Mehta et al., 2002; Sauseng et al., 2004).

Despite all these results, research about the effects of BB on WM is still in its infancy. Additionally, most studies have demonstrated increases in WM performance using other forms of brainwave training, and those using BB training did not use a double-blind methodology. This means that the studies are prone to contain placebo effects and confounding variables, reason for which the current study has chosen for a double-blind experiment. Another important point is that BB training might allow the brain to 'heal itself'.

The work of Patterson and Capel (1983) accurately illustrates this. They found that different waveforms triggered different neurotransmitters. A 10 Hz signal, for instance, boosts the production rate of serotonin. Consider

Prozac, a well-known drug that alleviates depression by increasing serotonin levels.

According to Patterson and Capel, a similar increase in the level of serotonin in the brain could be achieved through the use of a 10 Hz signal. In this way, one can alter the brain's neurochemistry and thereby its functioning with modifications of brainwave frequency, allowing for a return to the pre-trauma neurochemical state, providing a vast range of possibilities for the medical world. Indeed several studies have found positive results concerning the treatment of neurological disorders such as depression (Peniston, & Kulkosky, 1989), anxiety (Wahbeh & Calabrese, 2007), ADHD and dyslexia (Hutchison, 1994). In the field of education, beta training has produced average IQ increases of 23 percent that were permanent (Othmer et al., 1999). Supposing that beta training is actually creating new neural pathways as Russell and Carter suggest, then it might also be able to expand normal mental capacities, a field the current study wishes to approach. Due to its low cost, easy accessibility and seeming effectiveness, BB training represents an opportunity to improve the quality of life of a broad scope of individuals. Thus the focus of this study shall be on the influence of the use of beta frequency binaural beats on overall working memory performance.

Expected is that BB will be responsible for an increase in the number of correct answers in the recall test, meaning WM improves with the use of BB. For the Recognition test however, the study of Kennerly has shown no significant results in terms of improved WM performance while these were expected. Thus our aim is to see whether we have additional proof that

defends this point or refutes it. Beta frequency audio signals were used by means of a headset to investigate the effects of beta range BB on two distinct WM tasks.

The explanatory variable is the use of BB and the response variable is WM performance in terms of the The Word List Recall Test and the The Recognition/Recall Test.