



Introduction

Binaural beats are an auditory illusion perceived when two different pure-tone sine waves are presented to a listener through each ear and are perceived as a single tone to the listener. The single tone can fall into one of five categories (Fig 1) and is theorized to provide certain benefits depending on frequency. While binaural beats are commonly used in many parts of the world for sleep and meditation, its use in medical procedures and specifically dental procedures have not been studied in depth. Some studies have shown that theta waves can reduce anxiety in a health care setting but are mostly limited to adults.

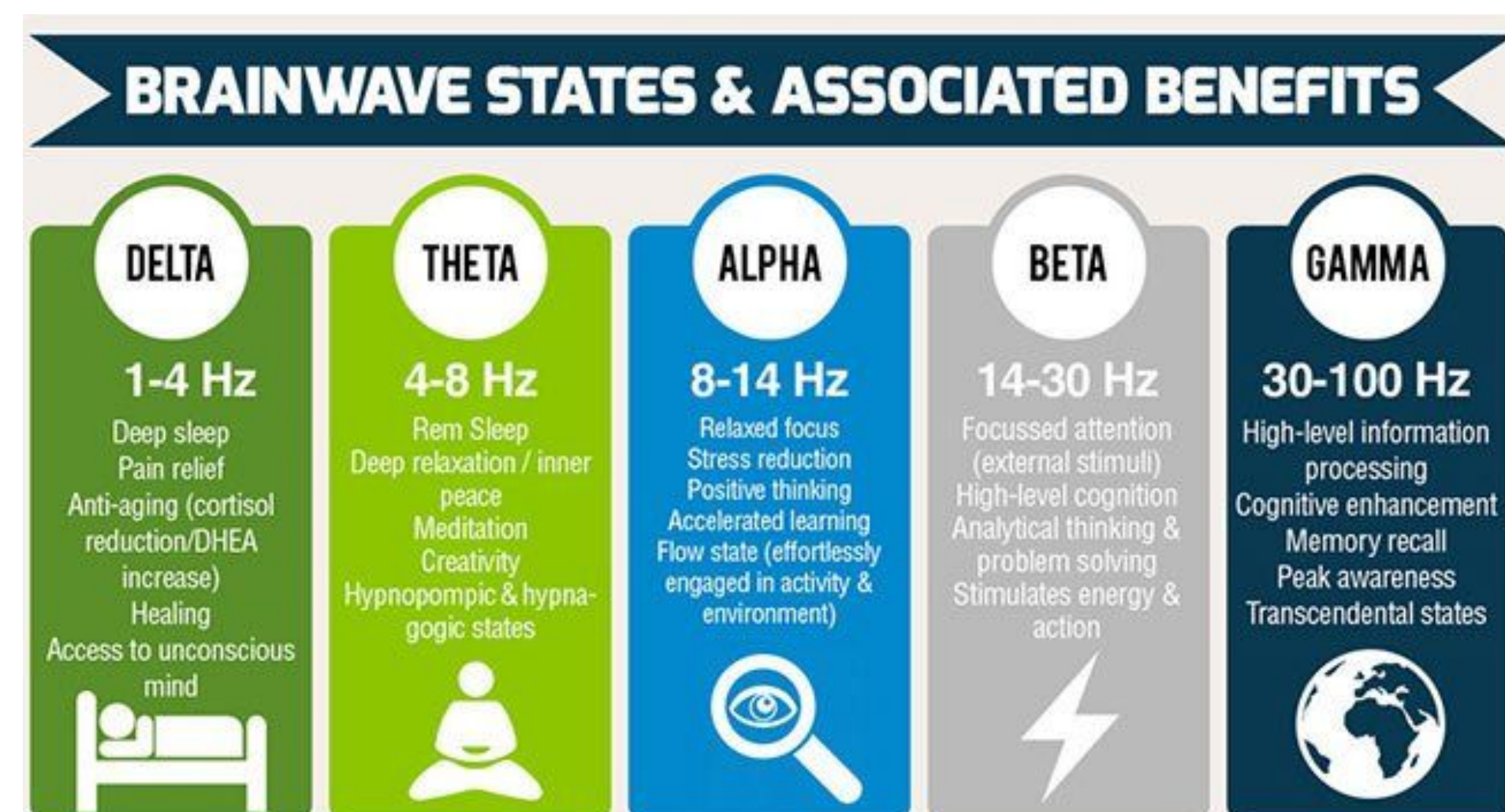


Fig.1: Categorization of brainwave states and associated benefits

Many techniques in pediatric dentistry, such as tell-show-do (TSD) and Nitrous Oxide (N2O), are designed to reduce anxiety in the dental chair, however such techniques may not be as beneficial to pre-teens or teenagers who are more aware of the procedures being done in the chair. The most common way anxiety is measured in studies such as these are with a Visual Face Anxiety Scale (VFAS). While VFAS is a useful tool, it is solely a subjective measure of anxiety. Heart rate (HR), on the other hand, can provide more objective data in how patients respond.

Methods

Study Objectives

To determine if theta waves can reduce heart rate during the preoperative time period, including the administration of local anesthesia, and if a patient's own perceived anxiety level is reduced after listening to theta waves.

Subjects

18 subjects (9 test group and 9 control) were included in this study, with no gender or race exclusion criteria. Only patients ages 10-15 were included in this study.

Patient Selection

Inclusion Criteria: Patients ages 10-15 presenting to any of the SBH dental clinics for operative dental work requiring local anesthesia

Exclusion Criteria: Patients with special needs who are unable to complete the VFAS, hearing disabilities, poor cooperation, dental work that doesn't require local anesthesia, or epilepsy specifically triggered by sound

Control group: Patients wearing noise cancelling headphones with no music playing

Data Collection

Data was collected during operative appointments (either restorative requiring local anesthesia or extractions). Patients were asked to fill out the VFAS to determine a baseline of dental anxiety before the procedure started (scale of 0 to 10). HR was measured initially. Patients were then told that they will listen to music for 10 minutes with noise canceling headphones (control group wore the headphones but with no music playing). Topical anesthesia was placed for 1-2 minutes and local anesthesia was administered at the 3 minute mark. During the 10 minutes span, HR was recorded every minute (11 total readings). The headphones were removed, and patients were asked to fill out the VFAS once more.

Results

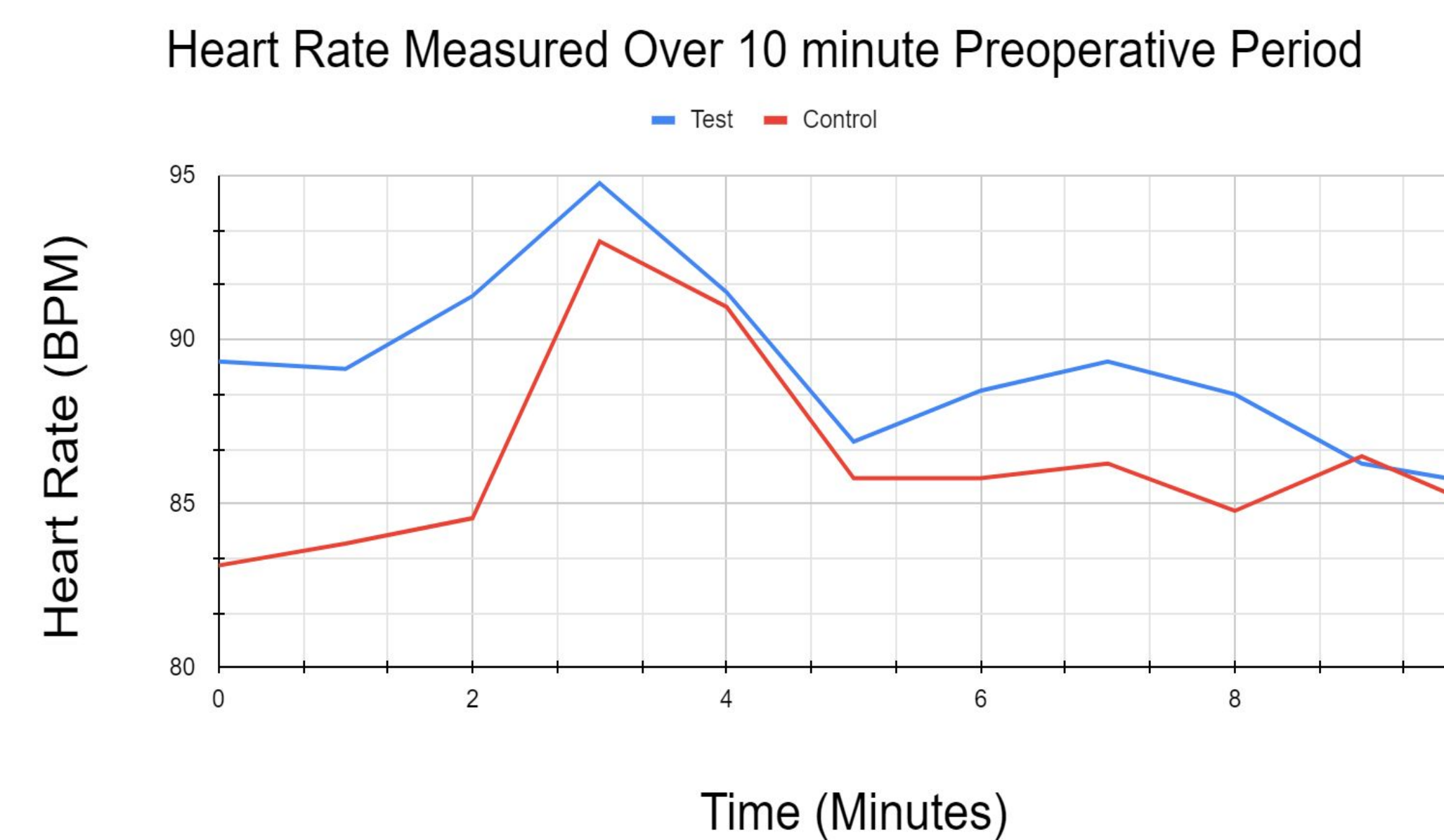


Fig.2: Heart rate monitored over 10 minute preoperative period. Local anesthesia was administered at 3 minute mark.

Group	Test	Control
Heart Rate Before	89.33	83.11
Heart Rate After	85.56	84.78
Heart Rate Change	-3.78	+1.67
VFAS Before	4.89	3.78
VFAS After	3.11	3.89
VFAS Change	-1.78	+0.11

Table 1: Average heart rate before and after preoperative period, with resulting change in heart rate. Average VFAS score before and after preoperative period, with resulting change in VFAS score. A negative change reflects a drop in value while a positive change reflects an increase in value.

Statistical Analyses

Unpaired t-test analyses were conducted on both the average change in HR (t=2.68, p=0.017, 95% confidence interval between 1.35 and 9.75) as well as the average change in VFAS score (t=3.95, p=0.001, 95% confidence interval between 0.876 and 2.9)

Discussion

- There appears to be a significant difference between the test group and the control group. This finding is consistent with prior work demonstrating the use of binaural beats in healthcare settings
- HR in both the test and control group began to increase in the moments before and during local anesthesia being administered
- Patients anecdotally reported satisfaction with the use of binaural beats as they felt more relaxed with music playing and having sounds blocked out. however this data is not statistically significant

Study Limitations

- Small sample size (N=18)
- Theta wave track not pure wave tone, combined with underlying music
- Specific type of anesthesia (location of anesthesia, and procedure type (restorative vs extraction) not standardized
- HR not monitored for entirety of procedure

Conclusions

- Theta wave binaural beats help to reduce patient anxiety levels during the preoperative period before a dental procedure
- More research is needed, specifically adding a larger sample size, a pure theta wave tone, consistency of procedure and type of anesthesia, and monitoring vitals for a longer period of time

References

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