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2023

Neural Coding of Vibration Intensity

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Neural Coding of Vibration Intensity

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Publication Date:

Presenter: Brendon Murphy

Presentation Date: October 19th, 2023

Abstract Abstracted

Background

All of us are surrounded by different vibrations every day, whether it be cars driving outside, the multitudes of machines running around us, or those we succumb ourselves with the music we listen to and electronics we carry with us everyday.

This article explains how these vibrations are perceived by our bodies and what effect they may have. They used EEG to examine correlation of the brain with different intensities of vibration applied to the phalanx of the left index finger using a vibrotactile actuator (shown on the right).



Introduction



How the brain perceives vibration

- **Alpha Frequency**

When your brain is operating at the alpha frequency, you're able to absorb new information with ease and you're significantly more creative.

- **Beta Frequency**

Beta frequency allows you to keep your attention focused. Analytical thinking and solving problems. Stimulating energy and action.



Different parts of the brain



Frontal

Collection of cognitive skills including the capacity to plan, organise, initiate, self-monitor and control one's responses in order to achieve a goal.



Middle Central

Helps a person identify objects, understand spatial relationships, and interpret pain and touch in the body.



Contralateral Somatosensory

Informs us about objects in our external environment through touch and about the position and movement of our body parts through the stimulation of muscle and joints.



Ipsilateral Somatosensory

Processes afferent somatosensory input and contributes to the integration of sensory and motor signals necessary for skilled movement.



Participants

- 29 Individuals
- 9 female and 20 males
- Between the ages of 18-55
- Right Handed
- With no prior touch or sensation difficulty
- Measured on Alpha, Beta, and locational standards



Methods

0

No Vibration

99.03 % of the participants confirmed that no vibration was felt.

1.56 g

Low Vibration

98.31 % of the participants reported very weak or weak vibration.

2.26 g

High Vibration

89.16% of the participants reported strong or very strong vibration.

Perception of Vibration

People perceive vibration differently depending on their personal standards of vibration.

Meaning that differentiating exposure to vibration may change how those perceive it. Allowing some to have an easier time to identify high vibrations even if it is typically harder to do so.



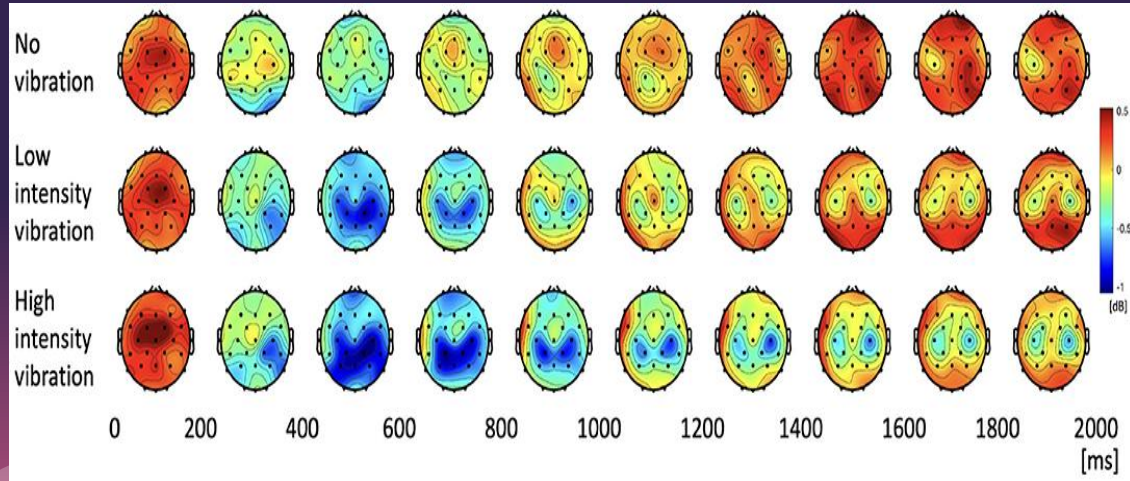
Alpha Frequency Findings

Alpha PSD immediately increased at the onset of the stimulation in all three categories. Although the participants did not experience any vibration in the no vibration condition, the alpha power increased within 200 ms, especially in the middle central and frontal areas.

In the case of low- and high-vibration intensity conditions, event-related desynchronization in the contralateral somatosensory was observed up to 400 ms. After 400 ms, the alpha ERD appeared bilaterally in the low- and high-intensity vibration conditions, which rebounded again after 800 ms in the case of low-intensity vibration. However, in the case of high-intensity vibration, alpha ERD was sustained until the end of the task period.



Alpha Frequency Findings



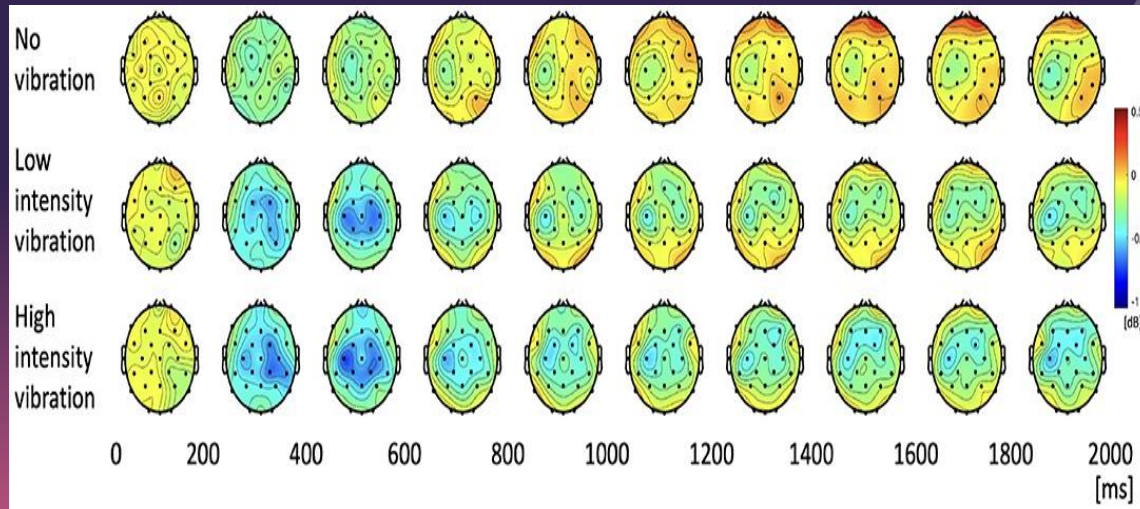
Beta Frequency Findings

In the low- and high-vibration intensity conditions, ERDs appeared in the contralateral somatosensory from 200 to 400 ms, and bilaterally from 400 to 600 ms.

However, unlike alpha PSD, bilateral ERD did not appear after 600 ms. In addition, ERD was sustained longer in the ipsilateral somatosensory in the beta band, unlike the alpha band, where ERD was sustained longer in the contralateral somatosensory.



Beta Frequency Findings



What does this all mean

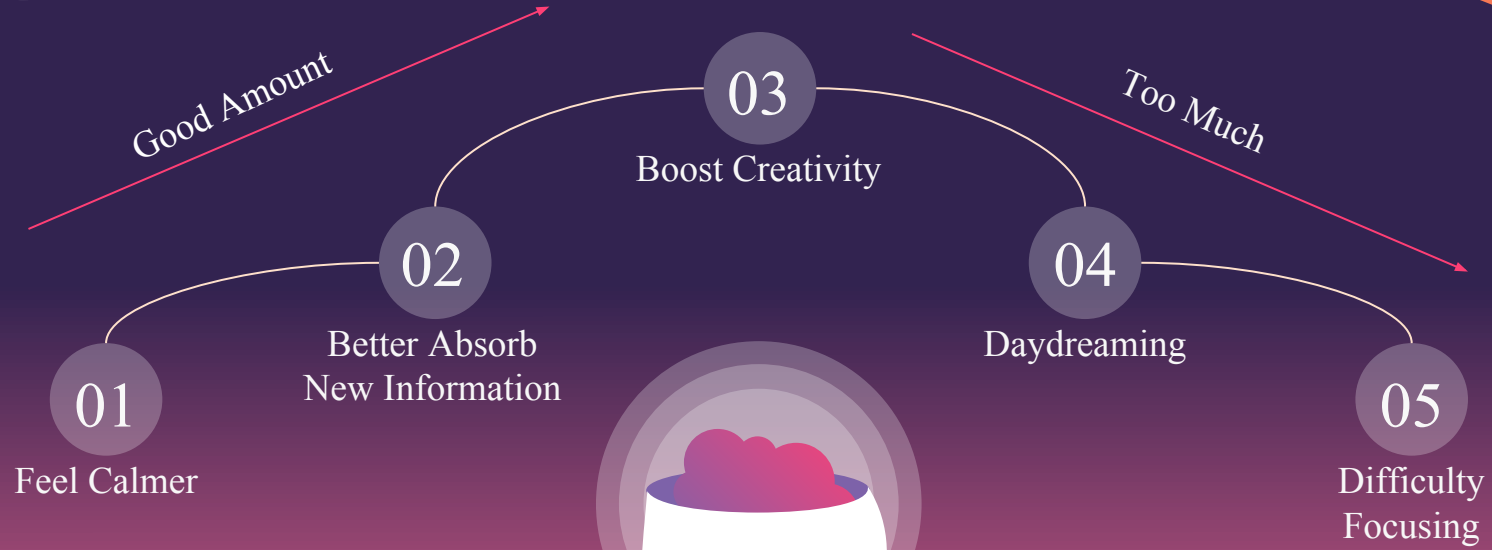
Strong vibration stimulate the mechanoreceptors of the skin more strongly. Thus, the firing of the nervous system may be stronger and last longer.

Meaning that stronger vibrations may overall increase the intensity of response in the brain over an elongated period causing the body mechanical stress.

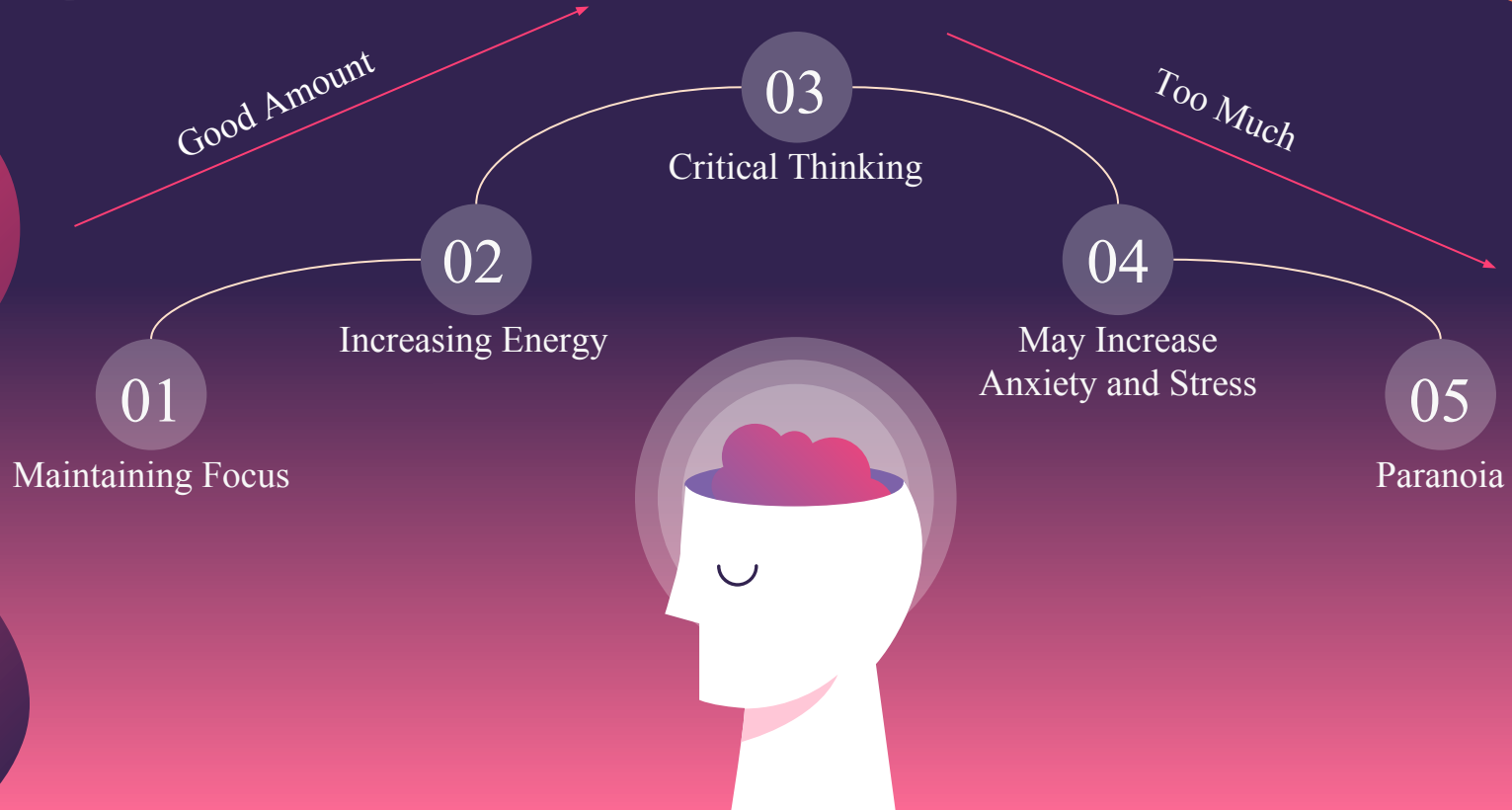
This may cause things such as paranoia, anxiety, stress, daydreaming, and overall inability to pay attention.



Real Life Application Alpha



Real Life Application Beta



Discussion

- Small Sample Size.
- Visual and auditory stimuli interference being equal for all levels of vibration.
- Difference in perceived stimuli from participants.
- Absence of any commercial or financial relationships that could be construed as a potential conflict of interest.
- No analysis of participant self finger movement.
- Need further exploration of the topic.



Discussion

The time course alpha and beta PSD analysis showed significant differences in ERD associated with the three levels of vibration intensity. Low- and high-intensity vibrations are associated with stronger alpha and beta ERD than no vibration condition. In alpha PSD, rebound of no vibration and low vibration conditions occurred after 700 ms, but in the high-intensity vibration condition, PSD was sustained longer. Findings of the present study can be used to provide a quantitative measurement for the perceived vibration intensity based on brain activation. Lots of studies are still being done on the effects of frequency and vibration on the brain.

Discussion Questions

- How may we be able to expand on this topic even further?
- What impact could these kinds of research have on society?
- What new technologies may this research influence?
- How may we maintain a healthy frequency of vibration and why may this pose difficult?
- What kind of effect would you predict carrying things like phones, smart watches, and other devices that output vibration have on us?

Thanks!

Does anyone have any questions?

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Citations

Article

Park, W., Kim, S.-P., & Eid, M. (2021, October 4). *Neural coding of vibration intensity*. *Frontiers*. <https://www.frontiersin.org/articles/10.3389/fnins.2021.682113/full>

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