# Project Notes:

**Project Title: Effectiveness of Music Frequencies Mitigating the Symptoms of Attention Deficit Hyperactivity Disorder Patients**

**Name: Heidy Rodriguez**

**Note Well:** There are NO SHORT-cuts to reading journal articles and taking notes from them. Comprehension is paramount. You will most likely need to read it several times, so set aside enough time in your schedule.

**Contents:**

# Knowledge Gaps:

This list provides a brief overview of the major knowledge gaps for this project, how they were resolved and where to find the information.

| Knowledge Gap | Resolved By | Information is located | Date resolved |
|---|---|---|---|
| Brain Waves | Researching/reading articles | Different Types Of Brain Waves And Their Benefits (curejoy.com) | 11/20/23 |
| If certain frequencies can induce certain action | Researching/ reading articles | Inaudible, low-frequency bass makes people boogie more on the dancefloor : NPR | 9/18/23 |
| Background information on Neurofeedback | Researching/ reading articles | Neurofeedback in ADHD: a single-blind randomized controlled trial - PubMed (nih.gov) | 10/5/23 |
| Connections between ADHD and brain waves | Researching/reading articles | ADHD Brain vs 'Normal' Brain: Understanding the Differences (psycom.net)<br><br>ADHD brain waves are different - SimplyWellbeing | 12/13/23 |
| Music relation to brain waves | | | |
| How does binaural beats work (through testing and steps to enact process) | | | |

# Literature Search Parameters:

These searches were performed between (Start Date of reading) and XX/XX/2024.
List of keywords and databases used during this project.

| Database/search engine | Keywords | Summary of search |
|---|---|---|
| https://www.livescience.com/2346-happiness-partly-inherited.html, Live Science Article 1 | Genes | Researched how genes could impact emotions/behaviors. Found articles relating to how genes could partly impact emotions |
| https://www.livescience.com/personality-age-change.html, Live Science Article 2 | Personality | Researched personality and how it can change as one gets older. Found articles pertaining to the subject, including an article on how "core" personality doesn't change, just how you express it. |
| Role of Genotype in the Cycle of Violence in Maltreated Children \| Science, Science.org Article 3 | Genes | Researched how genes could impact emotions/behaviors. Found articles relating to how genes could partly impact behavior |
| AMS :: Mathematical Moments #159: Pinpointing How Genes Interact, AMS.org Article 4 & 5 | Genes | Researched how genes interact by searching it in AMS. Found an article talking about epistasis and how genes interact. |
| NPR - Breaking News, Analysis, Music, Arts & Podcasts : NPR -NPR Article 6 & 7 | Music, Frequency | Researched how music is processed. Found articles about how music and certain frequencies can impact behavior. |
| Neurofeedback in ADHD: a single-blind randomized controlled trial - PubMed (nih.gov)-Google (specifically used MentalHealth Daily Article 8 | Brainwaves | Researched how brainwaves and certain frequencies can impact ADHD. Found articles pertaining to the subject. |
| Binaural beats to entrain the | Binaural Beats | Researched how binaural beats |

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| brain? A systematic review of the effects of binaural beat stimulation on brain oscillatory activity, and the implications for psychological research and intervention - PMC (nih.gov)-Google Article 9 | | impact the brain through google, Found articles pertaining to subject. |
| More attentional focusing through binaural beats: evidence from the global–local task - PMC (nih.gov)- Google Article TBD | ADHD, Binaural Beats | Researched how Binaural beats could impact ADHD, Found article pertaining to subject |
| Effects of the Alpha, Beta, and Gamma Binaural Beat Brain Stimulation and Short-Term Training on Simultaneously Assessed Visuospatial and Verbal Working Memories, Signal Detection Measures, Response Times, and Intrasubject Response Time Variabilities: A Within-Subject Randomized Placebo-Controlled Clinical Trial - PMC (nih.gov) -Google Article 11 | Brain waves | Researched brain waves on google, found article |
| Different Types Of Brain Waves And Their Benefits (curejoy.com) - Google Article 12 | Brain Waves | Researched basic information on brain waves, found article |
| Google Article 13 and beyond | ADHD, Brain waves, binaural beats | Researched brain waves and binaural beats and their impact on ADHD |

# Tags:

| Tag Name | |
|---|---|
| Frequencies | Neurofeedback |
| Genes | Music |
| Personality | Behavior |

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|---|---|
| ADHD | Binuaral Beats |

# Article Notes: Template

Article notes should be on separate sheets

**KEEP THIS BLANK AND USE AS A TEMPLATE**

| | |
|---|---|
| **Source Title** | |
| **Source citation (APA Format)** | |
| **Original URL** | |
| **Source type** | |
| **Keywords** | |
| **#Tags** | |
| **Summary of key points + notes (include methodology)** | |
| **Research Question/Problem/ Need** | |
| **Important Figures** | |
| **VOCAB: (w/definition)** | |
| **Cited references to follow up on** | |
| **Follow up Questions** | |

# Article #1 Notes: Happiness is Partly Inherited 6/10/23

| | |
|---|---|
| **Source Title** | Happiness is Partly Inherited |
| **Source citation (APA Format)** | updated, L. S. S. last. (2008, March 4). *Happiness Is Partly Inherited*. Livescience.Com. https://www.livescience.com/2346-happiness-partly-inherited.html |
| **Original URL** | https://www.livescience.com/2346-happiness-partly-inherited.html |
| **Source type** | Science Journal |
| **Keywords** | Genes |
| **#Tags** | Genes |
| **Summary of key points + notes (include methodology)** | • According to Psychologists at the University of Edinburgh and the Queensland Institute for Medical Research in Australia, common genes that result in personality traits can incline people to be optimistic.<br>• People who have this gene wont be happy all the time, however, they can manage to be positive or be happy during moments of stress or doubt.<br>• 50% of differences in a person's happiness can still be caused by external factors, such as relationships, health, and careers. |
| **Research Question/Problem/ Need** | How do genes impact happiness? |
| **Important Figures** | N/A |
| **VOCAB: (w/definition)** | Genes-a unit of heredity |
| **Cited references to follow up on** | N/A |
| **Follow up Questions** | Can different emotions be inherited?<br>How much does the environment impact emotions or happiness in this case? |

# Article #2 Notes: Does your Personality Change as You Get Older? 7/25/23

| | |
|---|---|
| **Source Title** | Does your Personality Change as You Get Older? |
| **Source citation (APA Format)** | Whitcombpublished, I. (2020, August 23). *Does your personality change as you get older?* Livescience.Com. https://www.livescience.com/personality-age-change.html |
| **Original URL** | https://www.livescience.com/personality-age-change.html |
| **Source type** | Science Journal |
| **Keywords** | Personality |
| **#Tags** | Personality |
| **Summary of key points + notes (include methodology)** | • As one grows up, they grow in maturity and in self control-conforming to society's expectations of the maturity one is supposed to have as they grow older.<br>• The person themself doesn't change. That is, a person's core, or vital personality doesn't change in construct, though it may change how it shows itself as a person grows older.<br>• Ex. a person whose core is shyness, will continue to act shy, though they do this in different ways as they grow older and become more mature.<br>• A person's core will always stay the same, though may present itself differently based on the growth and maturity the person has.<br>• A person's core are their core personality traits, such as extroversion, agreeableness, conscientiousness, openness, and neuroticism, which stay the same as a person grows older. |
| **Research Question/Problem/ Need** | Can personality change? |
| **Important Figures** | N/A |
| **VOCAB: (w/definition)** | Personality: the combination of characteristics that define who a person is |
| **Cited references to follow up on** | Why Do People Have Different Personalities? \| Live Science |
| **Follow up Questions** | How do you determine a person's core? |

# Article #3 Notes: Role of Genotype in the Cycle of Violence in Maltreated Children 9/10/23

| | |
|---|---|
| **Source Title** | Role of Genotype in the Cycle of Violence in Maltreated Children |
| **Source citation (APA Format)** | Caspi A., MCclay J., Moffitt T. E., Mill J. ,Martin J., Craig I. W., Taylor A., Poulton R. (2002, June 13). Role of Genotype in the Cycle of Violence in Maltreated Children. Science, 297(5582), 851-854. 10.1126/science.1072290. https://www.science.org/doi/10.1126/science.1072290 |
| **Original URL** | Role of Genotype in the Cycle of Violence in Maltreated Children \| Science |
| **Source type** | Science Article |
| **Keywords** | Genes |
| **#Tags** | Personality, Behavior |
| **Summary of key points + notes (include methodology)** | • While most may suspect that when faced with maltreatment and abuse, especially at very young ages, a child can develop antisocial behaviors, the opposite is true if they have a specific gene.<br>• A study conducted an experiment, testing participants from childhood to adulthood to see if they developed antisocial behaviors when faced with maltreatment. Some developed this behavior and others did not.<br>• Children who have high levels of the MAOA gene are less likely to develop antisocial behaviors-whereas children who have low levels of the gene are more likely to develop them. |
| **Research Question/Problem/ Need** | How do genes impact the way children respond to violence? |

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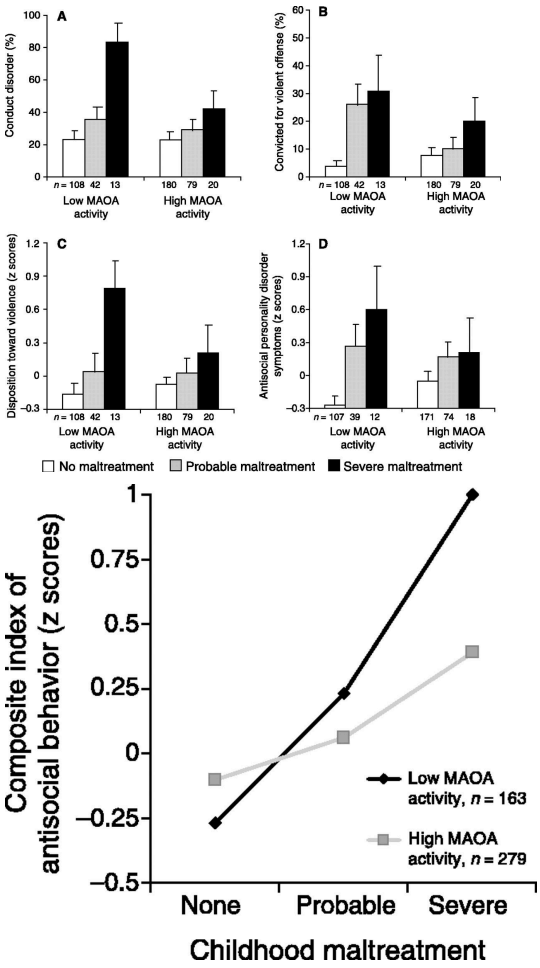
| **Important Figures** |  <br>**Child maltreatment gene in association with behavior** |
| **VOCAB: (w/definition)** | MAOA (Metabolizing Enzyme Monoamine Oxidase A)-determines the effects that maltreatment has on people and how they respond to it. |
| **Cited references to follow up on** | https://wpi.primo.exlibrisgroup.com/discovery/openurl?institution=01WPI_INST&vid=01WPI_INST:Default&url_ver=Z39.88-2004&rft_id=info:doi%2F10.1126%2Fscience.2704995&rft_id=info:pmid%2F2704995&rft.aufirst=C.%20S.&rft.aulast=Widom&rft.jtitle=Science&rft.title=Science&rft.date=1989&rft.volume=244&rft.spage=160 |
| **Follow up Questions** | Can genes impact how people respond to other environmental factors such as radiation? Could those factors impact behavior? |

# Article #4 Notes: Pinpointing how Genes Interact - 8/18/23

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|---|---|
| **Source** | Pinpointing how Genes Interact |
| **Source citation (APA Format)** | Crawford, L. (n.d).*Pinpointing how Genes Interact.*American Mathematical Society. AMS :: Mathematical Moments #159: Pinpointing How Genes Interact |
| **Original URL** | AMS :: Mathematical Moments #159: Pinpointing How Genes Interact |
| **Source type** | Online Resource |
| **Keywords** | Genes |
| **#Tags** | Genes |
| **Summary of key points + notes (include methodology)** | In order to interact, genes do a process called “epistasis”, in which the one gene variant depends on the other present gene variants. Statisticians and computer scientists are developing technologies and certain ways to make this process more efficient and time effective. At the moment, they have developed a system in which instead of studying all of the possible gene variants individually for epistasis, they are looking at the combined impacts of other genes. |
| **Research Question/Problem/ Need** | Central Question: What is the process and technologies used to determine how genes affect genes? How do they? |
| **Important Figures** | DNA has 20,000 genes |
| **VOCAB: (w/definition)** | Epistasis: One gene variant depending on the other gene variant that are present |
| **Cited references to follow up on** | Pinpointing How Genes Interact \| Mathematical Moments #159 - YouTube - Video by Author |
| **Follow up Questions** | 1. When they interact, are genes showing a physical connection, such as how a neuron can be seen physically interacting with other neurons?<br>2. Can and how would they know the total possible gene variants for one trait when studying solely the gene?<br>3. Do genes interact similarly with or due to environmental factors? How do genes know certain environmental factors and adapt based on them? |

# Article #5 Notes: Mapping Heredity: Using Probabilistic Models and Algorithms to Map Genes and Genomes - 8/18/23

| | |
|---|---|
| **Source Title** | Mapping Heredity: Using Probabilistic Models and Algorithms to Map Genes and Genomes |
| **Source citation (APA Format)** | Lander, E. S. (1997). Mapping heredity: Using probabilistic models and algorithms to map genes and genomes. In D. Jerison, I. Singer, & D. Stroock (Eds.), *Proceedings of Symposia in Pure Mathematics (Vol. 60, pp. 137–148)*. American Mathematical Society. https://doi.org/10.1090/pspum/060/1460280 |
| **Original URL** | Mapping Heredity: Using Probabilistic Models and Algorithms to Map Genes and Genomes (ams.org) |
| **Source type** | Science Journal |
| **Keywords** | Genes |
| **#Tags** | Genes |
| **Summary of key points + notes (include methodology)** | In order to detect similarities in the genemoes, instead of studying each gene, they are using fingerprint technology to see how similar they are based on the overlap. This technology uses short segments of genes, called STP's, which enable it to be scanned in the YAC library to view overlaps and similarities more easily and create a physical map for heredity. Though using STP's poses a coverage problem of data, due to joining certain points of data instead of randomizing them to get complete coverage. |
| **Research Question/Problem** | Central Question: How is fingerprint technology used to analyze heredity? |
| **Important Figures** | -Large genomes require large subclones of length greater than 100,000 bp |
| **VOCAB: (w/definition)** | STP-short segments of genes;<br>YAC- Library to view similarities in genes |
| **Cited references to follow up on** | A. Kong, Efficient methods for computing linkage of recessive diseases in inbred pedigrees, Genetics and Epidemiology 8 (1991), 81–103 |
| **Follow up Questions** | 1. What process would they go through should a fingerprint have an error or be unclear?<br>2. In forensics, STR technology can narrow DNA down to 6 possible matches. Is this represented in our fingerprints or are there some other factors that impact the way our fingerprints are identical? (Assuming there is a direct correlation between DNA and fingerprints)<br>3. How do STP's data join at certain points? |

# Article #6 Notes: How the brain processes music, with a little help from Pink Floyd - 9/2/23

| | |
|---|---|
| **Source Title** | How the brain processes music, with a little help from Pink Floyd |
| **Source citation (APA Format)** | Rascoe, A., & Benk, R. (2023, August 20). How the brain processes music, with a little help from Pink Floyd. *NPR*. https://www.npr.org/2023/08/20/1194905143/how-the-brain-processes-music-with-a-little-help-from-pink-floyd |
| **Original URL** | How the brain processes music, with a little help from Pink Floyd : NPR |
| **Source type** | Online Resource |
| **Keywords** | Music |
| **#Tags** | Music |
| **Summary of key points + notes (include methodology)** | *Researchers studied the brain activity recordings of 29 epilepsy patients who were previously implanted with electrodes that played Pink Floyds “Another Brick In the Wall, Part One”.<br>* They were able to see the brain waves of the patients and detect the song that they were listening too-similar to knowing and “listening” to the song on a piano without actually hearing the notes but instead seeing someone play them.<br>* May be used to extend computer algorithms to understand what people are imagining (specifically for hearing aids or speech-assisting devices), and include emotion and tone based on a person's facial features. |
| **Research Question/Problem/ Need** | How can brain waves be shown to detect the songs that others were listening to?<br>How can the environment impact brain waves? |
| **Important Figures** | Brain Waves can be detected to find what song people were listening to-outside environment can impact the brain waves of someone |
| **VOCAB: (w/definition)** | Brain waves-Electrical impulse in the brain |
| **Cited references to follow up on** | NPR Classical |
| **Follow up Questions** | 1. Can how a person feels about the music (music taste) impact their levels of brain waves and how they respond to it? |

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| | 2. Could the environment impact this?<br>3. Could the specific artist/genre/frequency have an impact on the brain waves, could it be impacted by genes? |

# Article #7 Notes: Inaudible, low-frequency bass makes people boogie more on the dancefloor - 9/18/23

| | |
|---|---|
| **Source Title** | Inaudible, low-frequency bass makes people booglie more on the dancefloor |
| **Source citation (APA Format)** | Venkat, M., Intagliata, C., & Chang, A. (2022, November 10). Inaudible, low-frequency bass makes people boogie more on the dancefloor. *NPR*. https://www.npr.org/2022/11/10/1135856162/inaudible-low-frequency-bass-makes-people-boogie-more-on-the-dancefloor |
| **Original URL** | Inaudible, low-frequency bass makes people boogie more on the dancefloor : NPR |
| **Source type** | Online Resource |
| **Keywords** | Frequency |
| **#Tags** | Music, Frequency |
| **Summary of key points + notes (include methodology)** | *Findings: Low frequencies bass makes people 12% more likely to move their bodies than normal<br>*Experiment:<br>*In a electronic music concert (Orphx), participants were given headbands on their head that had a motion capture sensor-they also had to fill out questionnaires<br>*Vestibular system (sense of balance)-inner ear structures, which are sensitive to low-frequency stimulation (volume does have an affect, louder frequency=more sensitive)<br>*Mechanoreceptors on skin and body move from vibration-also sensitive to low frequency stimulation (ex. stood next to loudspeaker)<br>*Vestibular and mechanoreceptors can feel the low-frequency vibrations that we may not hear due to vibration<br>*Feeds into our motor system in brain<br>*People dance due to social bonding + other undiscovered ideas |
| **Research Question/Problem/ Need** | Can certain frequencies cause people to be more likely to dance? |
| **Important Figures** | Low-bass-frequencies cause people to be 12% more likely to move their bodies than normal |
| **VOCAB: (w/definition)** | Low frequency-(in radio) 30–300 kilohertz.<br>Vestibular-relating to vestibule, specifically in inner ear, or general sense of balance<br>Mechanoreceptors-A cell that responds to mechanical stimuli ( touch or sound) |
| **Cited references to follow up on** | N/A |

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| **Follow up Questions** | 1. Why do certain people respond to the low-bass frequencies differently (not dance or move), could this be due to differences in vestibular system or genes?<br>2. Do these certain frequencies also impact the mental state of a person? What are the direct correlations? |

# Article #8 Notes: Neurofeedback in ADHD: a single-blind randomized controlled trial 10/5/23

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|---|---|
| **Source Title** | Neurofeedback in ADHD: a single-blind randomized controlled trial |
| **Source citation (APA Format)** | Bakhshayesh, A. R., Hänsch, S., Wyschkon, A., Rezai, M. J., & Esser, G. (2011). Neurofeedback in ADHD: A single-blind randomized controlled trial. *European Child & Adolescent Psychiatry*, *20(9), 481–491.* https://doi.org/10.1007/s00787-011-0208-y |
| **Original URL** | Neurofeedback in ADHD: a single-blind randomized controlled trial - PubMed (nih.gov) |
| **Source type** | Science Journal |
| **Keywords** | Music, Brainwaves |
| **#Tags** | Music, Neurofeedback |
| **Summary of key points + notes (include methodology)** | • Other studies do not properly employ randomized reinforcer-control design (other variables)<br>• These variables are the two biofeedback training variants : EEG neurofeedback aiming at theta/beta ratio reduction & EMG biofeedback aiming at muscle relaxation<br>• Test: 35 children with ADHD (26 boys & 9 girls, 6-14 years old) randomly assigned to therapy group NF, or BF (control). Both groups went through 30 sessions<br>• Post and pre treatment were psychophysiological measures, behavioral and psychometric measures<br>• Conclusions: reduced theta & Beta ratios & EMG levels in NF and BF groups<br>• Parents said more reductions in ADHD symptoms in NF group<br>• NF improved attention and reaction times on psychometric measures |

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| | • Study does not consider or test hyperactivity and impulsivity in behavioral contingencies, structured learning environment (may affect impact of neurofeedback) |
| **Research Question/Problem/ Need** | How can neurofeedback affect ADHD? |
| **Important Figures** | 35 children were tested: NF; n=18 and NF n=17<br>NF reduced theta/beta ratios significantly |
| **VOCAB: (w/definition)** | • Neurofeedback: Practice used to adjust a person's brain waves-alternative to Adderall alternative for ADHD<br>• QEEG/EEG-ways to test brain waves<br>• Biofeedback-sensors attached to body to learn physiological functions |
| **Cited references to follow up on** | 1. Is neurofeedback an efficacious treatment for ADHD? A randomised controlled clinical trial - PubMed (nih.gov)<br>2. https://pubmed.ncbi.nlm.nih.gov/36536438/ |
| **Follow up Questions** | 1. Can we translate these frequencies into music?<br>2. Can the music frequencies have the same impact as the |

# **Article #9 Notes:** Binaural beats to entrain the brain? A systematic review of the effects of binaural beat stimulation on brain oscillatory activity, and the implications for psychological research and intervention 10/12/23

**Data base**

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|---|---|
| **Source Title** | Binaural beats to entrain the brain? A systematic review of the effects of binaural beat stimulation on brain oscillatory activity, and the implications for psychological research and intervention |
| **Source citation (APA Format)** | Ingendoh, R. M., Posny, E. S., & Heine, A. (2023). Binaural beats to entrain the brain? A systematic review of the effects of binaural beat stimulation on brain oscillatory activity, and the implications for psychological research and intervention. *PLOS ONE, 18(5), e0286023.* https://doi.org/10.1371/journal.pone.0286023 |
| **Original URL** | Binaural beats to entrain the brain? A systematic review of the effects of binaural beat stimulation on brain oscillatory activity, and the implications for psychological research and intervention - PMC (nih.gov) |
| **Source type** | Science Journal |
| **Keywords** | Binaural Beats |
| **#Tags** | Frequencies |
| **Summary of key points + notes (include methodology)** | -Binaural beats elicit systematic changes in EEG parameters<br>-Basically when there are two slightly different frequencies being heard, brain waves conform to this and makes up the difference<br>-Must be max 1000 Hz-people can only encode sound waves with 1kHz<br>-Max difference between two tones is 30 Hz<br>-up to 20 Hz fluctuate in loudness, below 3 Hz is rotating tone- can control perception of binaural beats by focusing on one tone separately<br>-Monaural beat-two tones of different frequencies presented to one ear only<br>-Binaural beats have been found to affect specific EEG frequency bands, like cognitive processings, affective states, mood, pain perception, meditation and relaxation, mind wandering, or creativity<br>-Impacts are merely assumed (of binaural beats)<br>Ex. Goodin testing binaural beats has not been finding changes in frequency<br>Though studies have shown that it does work: Dragonava demonstrated using BWE (1-4 Hz range) and theta frequency range. |

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| | Ex. -Seifi Ala (applied 7 hz binaural beats) found changes in theta power<br><br>-Problems:<br>-EEG usage is diverse, auditory system are time specific-ASSR and FFR<br>-Measurement in BWE difference<br>-Have variety binaural beat simulation<br><br>-Experiment included:<br>Getting studies that pertain to the criteria of:<br>-Adults, no medical problems, normal hearing, human range binaural beats<br>-Have multiple test<br>-Specific ranges<br>-Have control and experimental groups<br>-Binaural beats and EEG<br><br>-Found 14 list of studies pertaining to specific criteria<br>-Crespo-Archives of Acoustics Spain- Effects of Binaural beat Simulation and theta + beta ranges and on attention<br>-Lopez Caballero Frontiers in Human Neuroscience -Spain-Effects of Binaural beats on oscillatory activity in specific EEF bands and heart rate and sin conductance<br><br>Conclusion:<br>-Enough info to deduce that brain waves can be impacted by binaural beat stimulations |
| **Research Question/Problem/ Need** | Can binaural beats impact/change frequencies EEG? |
| **Important Figures** | N/A |
| **VOCAB: (w/definition)** | Binaural beat-<br>-Monaural beat-two tones of different frequencies presented to one ear only<br>-brainwave entrainment hypothesis- suggests that auditory or visual stimulation at a specific frequency will lead the brain's electrocortical activity to oscillate at the external signal's frequency |
| **Cited references to follow up on** | Binaural Beats through the Auditory Pathway: From Brainstem to Connectivity Patterns - PMC (nih.gov) |
| **Follow up Questions** | Can certain combinations of frequencies compiled in binaural beats impact the EEG?<br>Can genres of music of frequencies be used as binaural beats?<br>Is there a combination between binaural beats and monaural beats? |

# Article #10 Notes: Do Binaural Beats Really Affect Brainwaves? 10/15/23

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|---|---|
| **Source Title** | Do Binaural Beats Really Affect Brainwaves? |
| **Source citation (APA Format)** | The Autodidacts. (2015, June 22). Do Binaural Beats Really Affect Brainwaves? — The Autodidacts. https://www.autodidacts.io/binaural-beat-openbci-eeg-experiment/ |
| **Original URL** | Do Binaural Beats Really Affect Brainwaves? — The Autodidacts |
| **Source type** | Online Resource |
| **Keywords** | Binaural Beats |
| **#Tags** | Frequencies |
| **Summary of key points + notes (include methodology)** | Experiment:<br>-Used EEG with OpenBCI board (32 bit model) with passive golden-cup electrodes and Ten20 brand conductive paste)<br>-Used electrode positions F3, F4, C3, C4, T5, T6, O1, O2, used OpenBCI's reference electrode SRB2 on left mastoid (earlobe) and the Bias on right.<br>-Experiment recorded in OpenViBE, using Python script in it to control the SBaGen Binaural beat audio generating program.<br>-Audio played on Sony MDR-7506 headphones, used pink noise for control, and pink boise with 17 Hz binaural beats for trial<br>-17Hz because are of spectrum with no big activity, making it easier to see effects of binaural beats<br>30 seconds of silence:<br>1. Control 1: 5 minutes of pink noise<br>2. Trial 1: five minutes of 17 HZ BINAURAL BEATS<br>3. Control 2: same as control 1<br>4. Trial 2: same as trial 1<br>Results:<br>No visible change between control and trial on spectrum<br>Conclusion:<br>Binaural beats did not produce significant entrainment of subjects brainwaves<br>The experiment also had conclusions which could have impacted it more, such as trial length, frequency, and subject.<br>Only did it on 2 subjects, trial was for a short time, frequencies could be different to show more on how binaural beats could impact it. |

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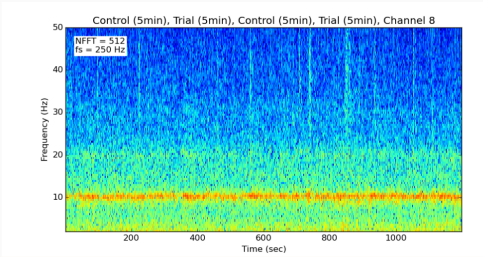
| **Research Question/Problem/ Need** | Can binaural beats impact brain waves? |
| **Important Figures** |  <br>Spectrogram of all control and trial segments, from channel 8.<br>Frequencies of brian waves |
| **VOCAB: (w/definition)** | Beat Frequency-pulsing sound inside the head, will happen depending on whether or not frequency during binaural beats is right.<br>Munroe Institute & Centrepointe Institute-purportedly use binaural beats to entrain brain waves<br>OpenBCI system-helps to do a more careful experiment with Binaural Beats, they record EEG electrical activity |
| **Cited references to follow up on** | www.autodidacts.io |
| **Follow up Questions** | Can higher frequencies make a greater impact on brain waves for binaural beats? |

# Article #11 Notes: Effects of the Alpha, Beta, and Gamma Binaural Beat Brain Stimulation and Short-Term Training on Simultaneously Assessed Visuospatial and Verbal Working Memories, Signal Detection Measures, Response Times, and Intrasubject Response Time Variabilities: A Within-Subject Randomized Placebo-Controlled Clinical Trial 11/6/23

| | |
|---|---|
| **Source Title** | Effects of the Alpha, Beta, and Gamma Binaural Beat Brain Stimulation and Short-Term Training on Simultaneously Assessed Visuospatial and Verbal Working Memories, Signal Detection Measures, Response Times, and Intrasubject Response Time Variabilities: A Within-Subject Randomized Placebo-Controlled Clinical Trial |
| **Source citation (APA Format)** | Rakhshan, V., Hassani-Abharian, P., Joghataei, M., Nasehi, M., & Khosrowabadi, R. (2022). Effects of the Alpha, Beta, and Gamma Binaural Beat Brain Stimulation and Short-Term Training on Simultaneously Assessed Visuospatial and Verbal Working Memories, Signal Detection Measures, Response Times, and Intrasubject Response Time Variabilities: A Within-Subject Randomized Placebo-Controlled Clinical Trial. *BioMed Research International*, *2022*. https://doi.org/10.1155/2022/8588272 |
| **Original URL** | Effects of the Alpha, Beta, and Gamma Binaural Beat Brain Stimulation and Short-Term Training on Simultaneously Assessed Visuospatial and Verbal Working Memories, Signal Detection Measures, Response Times, and Intrasubject Response Time Variabilities: A Within-Subject Randomized Placebo-Controlled Clinical Trial - PMC (nih.gov) |
| **Source type** | Scientific Journal |
| **Keywords** | Frequencies |

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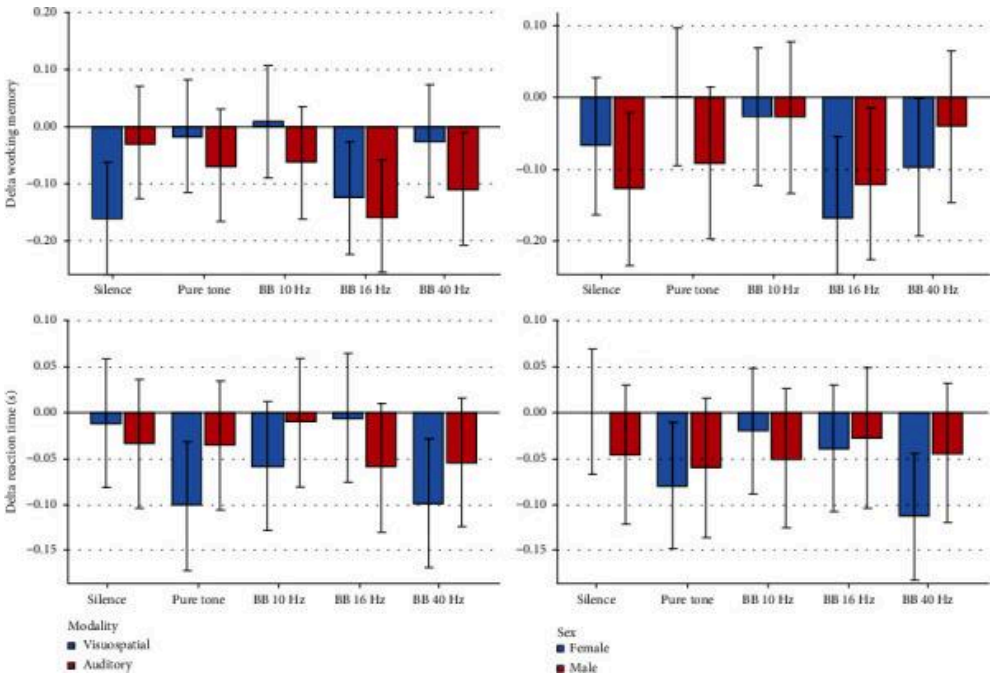
| **#Tags** | Binaural Beats |
| **Summary of key points + notes (include methodology)** | 115 in healthy right handed subjects ( 17 W, 14 M, 30.84+- 6.16 yrs), all listened to 8 minute sessions of 10 Hz, 16 Hz, and 40 Hz binaural beats vs 240 Hz pure tone and silence. Cognitive-behavior parameters were tested. Effects of sound interventions were calculated and analyzed statistically (linear regression model and one-sample t-tests)<br>Results:<br>10 Binaural beats reduced the response time variability and reduced the extent of decline over time in the case of<br>Viseospatial : memory, sensitive and hit rate.<br>Auditory: verbal modality, reduced hit rate, alarm rate and sensitive<br>Span difference in two groups in reaction time.<br>Faster reactions: Greater hit rates, working memory, lower false alarm rates<br>Slower reactions: Older lower hit rates, working memories and sensitivities ← increasing volume of audio interventions may accelerate at it<br>Binaural beat entrainment may have few enhancing effects with visuospatial modality,<br>Short term training can improve working memory and attention |
| **Research Question/Problem/ Need** | How, through the use of binaural beats, certain brainwaves can impact the cognitive behavioral parameters of working memory and attention? |
| **Important Figures** |  <br>Delta for working memory and delta response time in each of the modalities and sexes in 5 sound group |

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| **VOCAB: (w/definition)** | Working Memory:<br>Information without making us losing track of what were doing<br>Binaural Beats<br>Reflects differences in frequencies |
| **Cited references to follow up on** | https://pubmed.ncbi.nlm.nih.gov/16060806 |
| **Follow up Questions** | Could this also be reflected for ADHD to improve working memory?<br>Would overall binaural beats have better results  if it was studied during the test? |

# Article #12 Notes: Different Types Of Brain Waves And Their Benefits 11/20/23

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| **Source Title** | Different Types Of Brain Waves And Their Benefits |
| **Source citation (APA Format)** | Editorial, C. (2016, January 27). *Different Types Of Brain Waves And Their Benefits*. CureJoy. https://curejoy.com/content/different-types-brain-waves/ |
| **Original URL** | Different Types Of Brain Waves And Their Benefits (curejoy.com) |
| **Source type** | Website |
| **Keywords** | Brainwaves |
| **#Tags** | Behavior |
| **Summary of key points + notes (include methodology)** | - Brain waves are divided into bands describing slow, moderate, and fast waves<br>- Brainwaves vary in frequency and in amplitude<br>- Alpha Waves:<br>  - Frequency range: 8hz-12hz<br>  - Emitted when we are in a state of physical and mental relaxation (awake, but not processing much information)<br>  - Increase beta-endorphin, norepinephrine and dopamine<br>  - Linked to feelings of mental clarity and generate internal environment for new learning and accessing previously learned info<br>  - Benefits:<br>  - Reduce Anxiety<br>  - Reduce stress & depression<br>  - Reduce high blood pressure<br>  - Helps athletic performance<br>  - Increase motivation, energy, and happiness<br>- Beta Waves:<br>  - Flight for fight response<br>  - 12 hz-27hz<br>  - Emitted when person feels alert, agitated, tense, or afraid<br>  - People who have insufficient beta activity are more likely to have mental or emotional disorders |

- Benefits:
    - Responsible for fight or flight
    - Improves concentration and alertness
    - Improved logic, reasoning, and critical thinking
- Theta Waves:
    - 3hz-8hz
    - State of reduced consciousness, light sleep, or extreme relaxation
    - Receptive mental state proven to be useful for hypnotherapy & self-hypnosis using recorded affirmations and suggestions
    - Benefits:
        - Physical Healing
        - More restful sleep
        - Release beneficial hormones related to health and longevity
        - Reduce mental fatigue
        - Reduce anxiety and stress
- Delta Waves:
    - .2hz-3hz
    - Emitted during sleep and dreamless sleep (where there is unconsciousness)
    - Slowest band of brainwaves
    - Benefits:
        - Anti-aging hormones (melatonin and DHEA)
        - Human growth hormone (HGH) is anti-aging, which is increased with delta brainwaves, can also heal physical pain
- Gamma Waves:
    - 27hz-and up
    - Formation of ideas, language, memory processing and various types of learning.
    - Been shown to disappear during deep sleep (induced by anesthesia), and return in transition to wakeful state
    - Benefits:
        - High levels of intelligence
        - Compassionate
        - High amounts of self-control
        - Greater than average feelings of natural happiness
        - Increased awareness through 5 senses
- What happens when brain waves are out of balance?
    - Cause problems in emotional and neuro-physical health
    - Anxiety disorders, sleep problems, nightmares, agitated depression, chronic nerve pain and spasticity

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| | - OCD, aggressive behavior, panic attacks, bipolar disorder, anorexia, diabetes, explosive behavior<br>- Benefits to Altering Brainwaves<br>  - One brainwaves state is predominate at given time<br>  - Remaining 4 brain states are present in the mix of brain waves at all times<br>  - Knowledge of brainwave states enhances a person's ability to use characteristics defined in each state. |
| **Research Question/Problem/ Need** | What are brain waves and what are the different types? |
| **Important Figures** | N/A |
| **VOCAB: (w/definition)** | Neurons: Brain cells in brain (are billions in brain)<br>Brainwaves: Combination of neurons sending signals at once creates electrical activity.<br>- Synchronized electrical pulses from masses of neuron communication are Brainwaves.<br>- Measured with Hertz (cycles per second)<br>Frequency: Waves occurring within a period of time<br>Amplitude: the depth and height of each wave. |
| **Cited references to follow up on** | N/A |
| **Follow up Questions** | What brainwave do pink noises or white noises use? |

# Article #13 Notes: ADHD brain waves are different 12/13/23

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| **Source Title** | ADHD brain waves are different |
| **Source citation (APA Format)** | ADHD brain waves are different—SimplyWellbeing. (n.d.). *Https://Www.Simplywellbeing.Com/*. Retrieved December 13, 2023, from https://www.simplywellbeing.com/insights/being-adhd/adhd-brain-waves-are-different/ |
| **Original URL** | ADHD brain waves are different - SimplyWellbeing |
| **Source type** | Website |
| **Keywords** | Theta, Beta, ADHD |
| **#Tags** | Brainwaves |
| **Summary of key points + notes (include methodology)** | - There are 4 different types of brain waves:<br>- Theta<br>- Gama<br>- Beta<br>- Delta<br>- Alpha<br>The people with ADHD have an inbalance of beta and theta brain waves<br>Cause an overall imbalance to mood<br>Causing ADHD symptoms |
| **Research Question/Problem/ Need** | What causes ADHD? |
| **Important Figures** | N/A |

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| **VOCAB: (w/definition)** | Brainwaves-Electrical signals in the brain |
| **Cited references to follow up on** | N/A |
| **Follow up Questions** | What is the exact imbalance of brain waves? |

# Article #14 Notes: More attentional focusing through binaural beats: evidence from the global–local task 12/13/23

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| **Source Title** | More attentional focusing through binaural beats: evidence from the global–local task |
| **Source citation (APA Format)** | Colzato, L. S., Barone, H., Sellaro, R., & Hommel, B. (2017). More attentional focusing through binaural beats: Evidence from the global–local task. *Psychological Research*, *81*(1), 271–277. https://doi.org/10.1007/s00426-015-0727-0 |
| **Original URL** | More attentional focusing through binaural beats: evidence from the global–local task - PMC (nih.gov) |
| **Source type** | Scientific Journal |
| **Keywords** | Frequencies |
| **#Tags** | Frequencies |
| **Summary of key points + notes (include methodology)** | This study explores the impact of gamma-frequency (40 Hz) binaural beats on attentional processing during a global-local task. Binaural beats, produced when two slightly different frequencies are presented separately to the left and right ears, create a perceptual illusion that can influence cognitive processing. While previous research demonstrated that binaural beats affect the allocation of |

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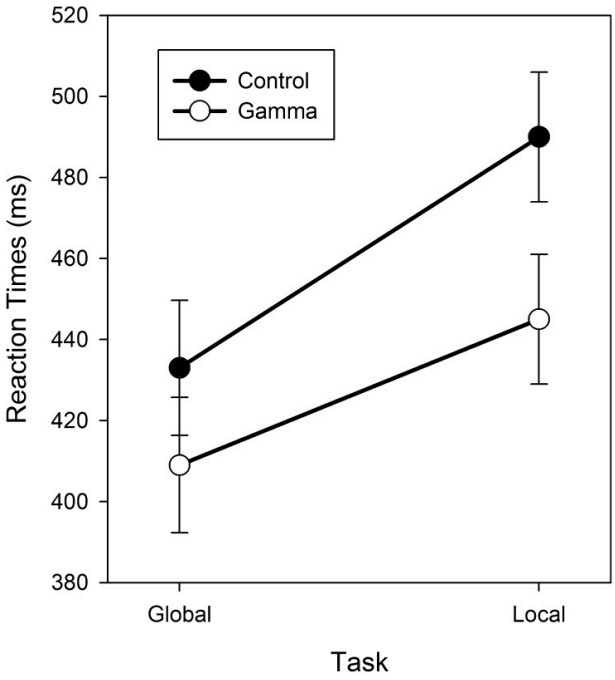
| | attention over time, this study specifically investigates their influence on attentional focusing and top-down control over irrelevant information. Results indicate that exposure to gamma-frequency binaural beats before and during the task reduces the global precedence effect, suggesting a more focused attentional processing style compared to a control condition with a constant tone. The findings imply that high-frequency binaural beats may bias individual attention towards a reduced spotlight, highlighting their potential impact on visual attention and cognitive control.<br>This summary was provided by Chat GPT |
| **Research Question/Problem/ Need** | How binaural beats can impact attention span? |
| **Important Figures** |  <br>Shows changes in Gamma Waves |
| **VOCAB: (w/definition)** | Gamma waves:<br>have frequencies of 27 hz and above, and are associated with higher levels of intelligence, and self control |
| **Cited references to follow up on** | N/A |
| **Follow up Questions** | Can minimizing theta waves gain the same effect? |

# Article #15 Notes: Binaural Beats through the Auditory Pathway: From Brainstem to Connectivity Patterns 12/13/23

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|---|---|
| **Source Title** | Binaural Beats through the Auditory Pathway: From Brainstem to Connectivity Patterns |
| **Source citation (APA Format)** | Orozco Perez, H. D., Dumas, G., & Lehmann, A. (2020). Binaural Beats through the Auditory Pathway: From Brainstem to Connectivity Patterns. *eNeuro*, *7*(2), ENEURO.0232-19.2020. https://doi.org/10.1523/ENEURO.0232-19.2020 |
| **Original URL** | Binaural Beats through the Auditory Pathway: From Brainstem to Connectivity Patterns - PMC (nih.gov) |
| **Source type** | Scientific Journal |
| **Keywords** | EEG, Brainwaves, Binaural beats |
| **#Tags** | Brainwaves |
| **Summary of key points + notes (include methodology)** | In this study, the researchers investigated the impact of binaural beats on neural entrainment and mood modulation compared to a control rhythmic stimulus. They conducted a passive, single-blind listening task with participants exposed to both binaural and monaural control conditions while recording brain activity and mood self-reports. The results showed that binaural beats entrained the brain, but the control condition exhibited stronger entrainment, and neither had a significant effect on mood. The study explored subcortical and cortical responses, revealing that monaural beats elicited higher cortical entrainment at the beat frequency compared to binaural beats. Interestingly, both binaural and monaural beats failed to modulate mood. Additionally, the study examined short-range and long-range connectivity patterns, finding differential effects between beat types and frequencies. Cross-frequency connectivity patterns were observed for binaural |

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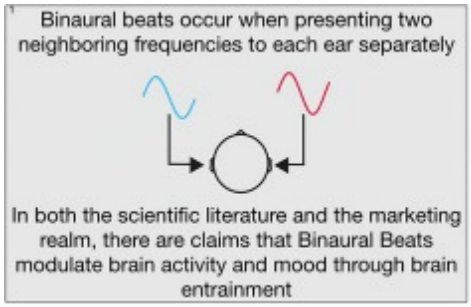
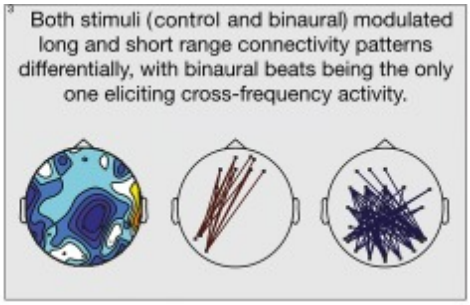
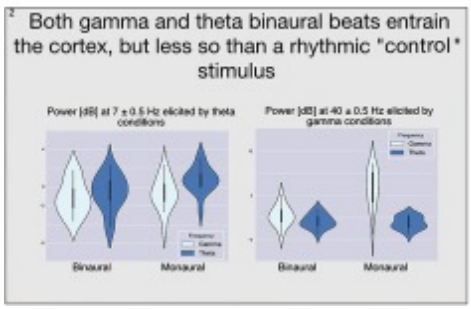
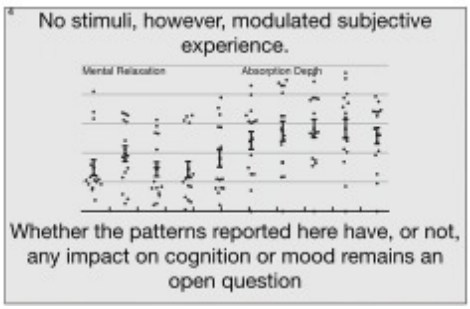
| | beats, suggesting potential large-scale integration. The study emphasizes the importance of rigorous experimental design and proper analysis in investigating the neural and mood effects of binaural beats, providing a framework for further exploration of sound-based mood regulation practices.<br>This summary was provided by Chat GPT |
| **Research Question/Problem/ Need** | How does binaural beats work in the brain in terms of the auditory pathway? |
| **Important Figures** |  <br>  <br>  <br>  |
| **VOCAB: (w/definition)** | Brain waves:<br>Electrical signals in the brain<br>Gamma waves<br>have frequencies of 27 hz and above, and are associated with higher levels of intelligence, and self control.<br>Theta waves<br>have frequencies of 3hz to 8hz, and are known to reduce anxiety, stress, and mental fatigue, while increasing the activity of daydreaming.<br>Beta waves<br>have frequencies of 12 hz to 27 hz, and are responsible for improved concentration, alertness, logic, reasoning, and critical thinking. |
| **Cited references to follow up on** | Binaural auditory beats affect vigilance performance and mood - PubMed (nih.gov) |
| **Follow up Questions** | How does binaural beats impacted by how it is received in auditory pathway based on age or other human factors? |

# Article #16 Notes: A Review of Issues Related to Data Acquisition and Analysis in EEG/MEG Studies 12/13/23

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|---|---|
| **Source Title** | A Review of Issues Related to Data Acquisition and Analysis in EEG/MEG Studies |
| **Source citation (APA Format)** | Puce, A., & Hämäläinen, M. S. (2017). A Review of Issues Related to Data Acquisition and Analysis in EEG/MEG Studies. *Brain Sciences*, *7*(6), 58. https://doi.org/10.3390/brainsci7060058 |
| **Original URL** | A Review of Issues Related to Data Acquisition and Analysis in EEG/MEG Studies - PMC (nih.gov) |
| **Source type** | Scientific Article |
| **Keywords** | EEG, Brainwaves |
| **#Tags** | Brainwaves |
| **Summary of key points + notes (include methodology)** | The EEG/MEG community is expanding, with researchers from various disciplines contributing to brain studies. While analysis methods are improving, they are also becoming more complex. The field encounters challenges in training new researchers and facilitating data sharing. It is crucial to use common terminology and solid concepts for effective communication in the scientific community. This involves detailing data acquisition and analysis procedures in a manner that allows for reproducibility and study replication. The provided suggestions and resources aim to address these issues and promote the growth of EEG/MEG methods in cognitive and social neuroscience research.<br>This summary was provided by Chat GPT |

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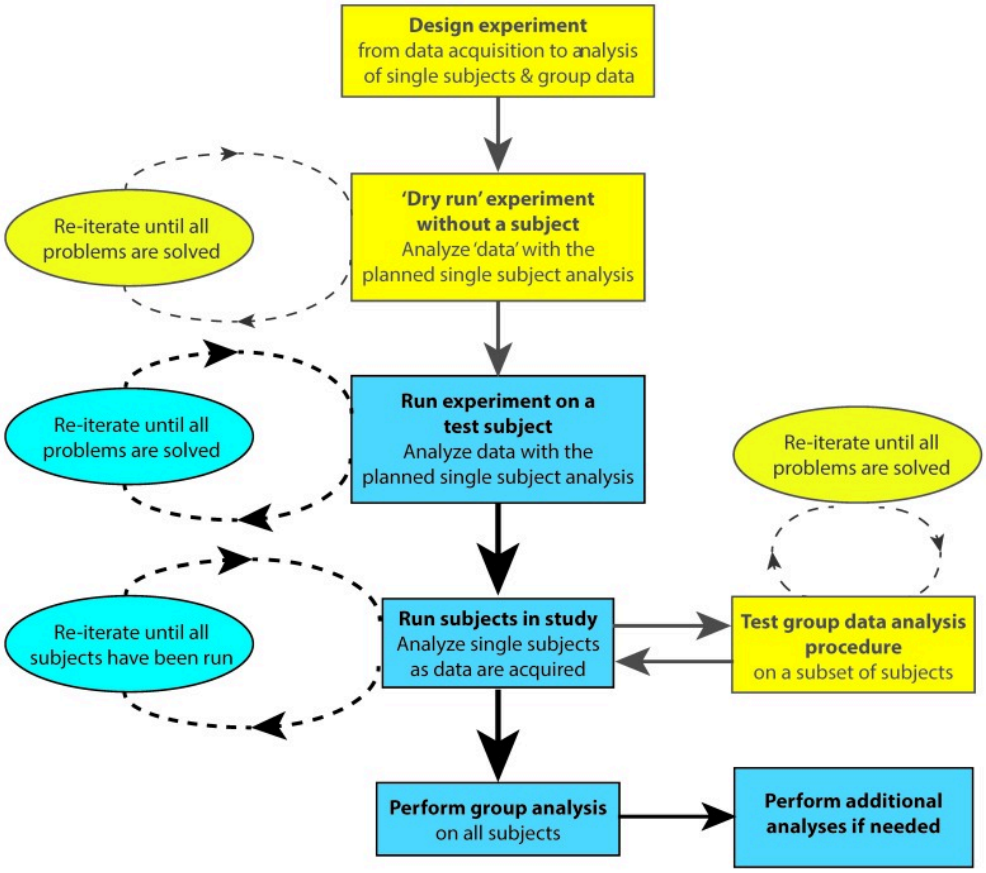
| **Research Question/Problem/ Need** | Problems relating to the analysis of EEG data? |
| **Important Figures** |  <br>Flowchart of experiment |
| **VOCAB: (w/definition)** | EEG- Device that tests brain waves |
| **Cited references to follow up on** | Spatial sampling of head electrical fields: the geodesic sensor net - PubMed (nih.gov) |
| **Follow up Questions** | Can the person being tested on impact the data analysis of EEG data? |

# Article #17 Notes: Reverse effect of home-use binaural beats brain stimulation 12/13/23

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| **Source Title** | Reverse effect of home-use binaural beats brain stimulation |
| **Source citation (APA Format)** | Klichowski, M., Wicher, A., Kruszwicka, A., & Golebiewski, R. (2023). Reverse effect of home-use binaural beats brain stimulation. *Scientific Reports*, *13*(1), Article 1. https://doi.org/10.1038/s41598-023-38313-4 |
| **Original URL** | Reverse effect of home-use binaural beats brain stimulation \| Scientific Reports (nature.com) |
| **Source type** | Scientific Journal |
| **Keywords** | Binaural beats |
| **#Tags** | Binaural beats |
| **Summary of key points + notes (include methodology)** | In Study 1, involving 400 individuals, 369 participants meeting the baseline accuracy criterion were analyzed. The study aimed to investigate the impact of binaural beats presented as neutral or stimulating sounds on cognitive test performance. Contrary to the hypothesis, a 2 × 2 × 2 ANOVA revealed a significant deterioration in test scores by nearly 6% after binaural beats intervention, with no significant interactions. The subsequent analysis of score changes indicated a substantial decrease in performance for both the Neutral Sounds and Stimulating Sounds groups across different tests. A 2 × 2 ANOVA showed no significant differences between the groups or tests in the extent of score deterioration. These findings suggest that home-use 15 Hz binaural beats brain stimulation, regardless of the |

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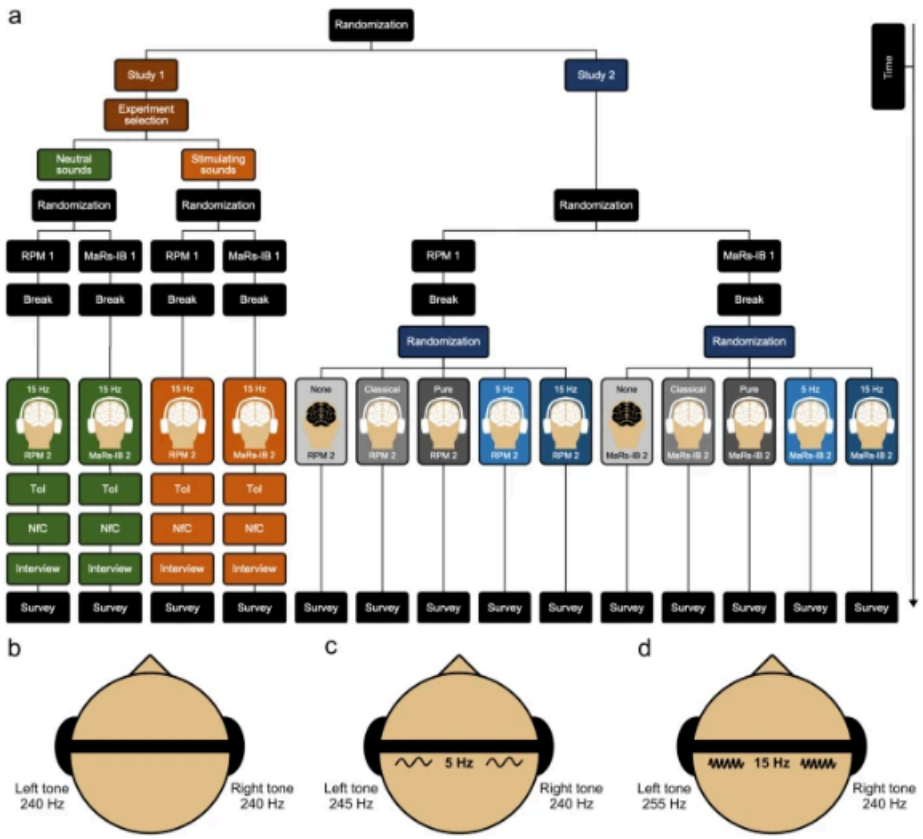
| | suggested nature of the sounds, may hinder rather than enhance cognitive task performance.<br>This summary was provided by Chat GPT |
| **Research Question/Problem/ Need** | How does binaural beats impact cognitive testing? |
| **Important Figures** | **Figure 1**<br>  <br>Chart of experiment |
| **VOCAB: (w/definition)** | Binaural Beats<br>Reflects differences in frequencies |
| **Cited references to follow up on** | Tracking EEG changes in response to alpha and beta binaural beats - ScienceDirect |
| **Follow up Questions** | What other specific factors that can impact effectiveness of Binaural beats that cannot be detected by EEGs? |

# Article #18 Notes: What are hertz (Hz) in music and technology? 12/16/23

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|---|---|
| **Source Title** | What are hertz (Hz) in music and technology? |
| **Source citation (APA Format)** | Hz, H. (2020, December 4). What are hertz (Hz) in music and technology? - HigherHz. *Higher Hz*. https://higherhz.com/what-is-hz-hertz/ |
| **Original URL** | What are hertz (Hz) in music and technology? - HigherHz |
| **Source type** | Article |
| **Keywords** | Frequencies |
| **#Tags** | Frequencies |
| **Summary of key points + notes (include methodology)** | Understanding hertz doesn't have to be challenging, and once you grasp the concept, you can confidently adjust computer or DAW settings for improved performance, audio quality, graphics, and more. This knowledge is particularly beneficial when choosing speakers or headphones for music production, as it enables you to select devices with an appropriate frequency response range for the full spectrum of your music. Additionally, when shopping for a new computer, considering hertz becomes a factor in making an informed decision tailored to your specific needs.<br>This summary was provided by Chat GPT |
| **Research Question/Problem/ Need** | How are hertz impacted digitally? |

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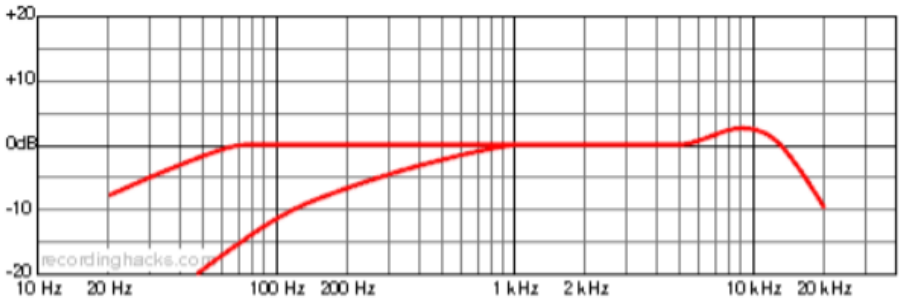
| **Important Figures** |  <br>Neumann U 87 frequency response / Recording Hacks<br><br>Frequency Chart |
| **VOCAB: (w/definition)** | Frequency : Prevalence |
| **Cited references to follow up on** | N/A |
| **Follow up Questions** | How is this impacted by multiple frequencies all at once? |

# Article #19 Notes: Efficacy of binaural auditory beats in cognition, anxiety, and pain perception: a meta-analysis 12/16/23

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|---|---|
| **Source Title** | Efficacy of binaural auditory beats in cognition, anxiety, and pain perception: a meta-analysis |
| **Source citation (APA Format)** | Garcia-Argibay, M., Santed, M. A., & Reales, J. M. (2019). Efficacy of binaural auditory beats in cognition, anxiety, and pain perception: A meta-analysis. *Psychological Research*, *83*(2), 357–372. https://doi.org/10.1007/s00426-018-1066-8 |
| **Original URL** | Efficacy of binaural auditory beats in cognition, anxiety, and pain perception: a meta-analysis \| Psychological Research (springer.com) |
| **Source type** | Scientific Journal |

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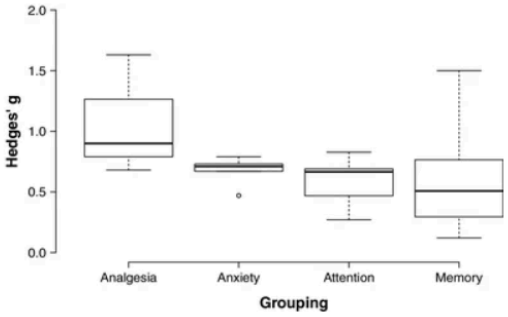
| **Keywords** | Binaural beats |
| **#Tags** | Binaural Beats |
| **Summary of key points + notes (include methodology)** | The objective the study is to see the effects of binaural beats on memory, attention, anxiety, and analgesia.<br>Before conducting the meta-analysis, the data underwent evaluation for influential studies. Analysis using DFFITS, COVRATIO, and Cook's distance identified study number 21 (Kliempt et al., 1999) as a potential outlier or influential study, standing out significantly from the others. However, no Cook's distance or DFFITS greater than 1 was observed, all remaining below 0.2. Leave-one-out sensitivity analysis indicated insignificant influences on the overall effect size and heterogeneity. The overall random-effects model showed an effect size of g = 0.446 (95% CI [.28, .62], z = 5.11,<br>= .16, I = 61.34%). After removing study 21, the effect size shifted to 0.41 (95% CI [.25, .57], z = 5.04, = .12, I = 54.98%) All studies were included in the follow-up analysis<br>This summary was provided by Chat GPT |
| **Research Question/Problem/ Need** | How does binaural beats impact memory, attention, anxiety, and analgesia? |
| **Important Figures** | **Fig. 3**<br>  <br><br>Groupings of effects |
| **VOCAB: (w/definition)** | Analgesia:<br>Inability to feel pain |
| **Cited references to follow up on** | Measuring inconsistency in meta-analyses - PubMed (nih.gov) |
| **Follow up Questions** | Can the impacts resulted in this study also be tied to ADHD symptoms? If so, to |

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| | what extent? |

# Article #20 Notes: Are ADHD Brains Different? 12/16/23

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|---|---|
| **Source Title** | Are ADHD Brains Different? |
| **Source citation (APA Format)** | *ADHD Brain vs 'Normal' Brain: Understanding the Differences*. (2023, November 13). https://www.psycom.net/adhd/adhd-brain-vs-normal-brain |
| **Original URL** | ADHD Brain vs 'Normal' Brain: Understanding the Differences (psycom.net) |
| **Source type** | Article |
| **Keywords** | ADHD |
| **#Tags** | ADHD |
| **Summary of key points + notes (include methodology)** | ADHD affects the brain in various ways, influencing neural activity, neurotransmitter function, and the prefrontal cortex (PFC). Studies reveal differences in volume, shape, circuitry, and neural activity in ADHD brains compared to those without ADHD. Neural activity, regulated by the autonomic nervous system (ANS), can be over- or under-aroused in ADHD, impacting tasks requiring attention and regulation. Dysregulation of dopamine, a key neurotransmitter, is a central aspect of ADHD, affecting information transmission and leading to challenges in memory, motor control, and motivation. The prefrontal cortex, crucial for executive functioning, experiences weaker function and structure in ADHD, affecting tasks like working memory and problem-solving. ADHD is complex, with genetic, biological, and environmental factors contributing. Genetics, accounting for 60-90% of cases, involve genes related to neurotransmitters. Biological differences and structural brain changes, particularly in dopamine-related areas, also contribute. Environmental factors, like exposure to toxins, and psychosocial |

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| | issues can exacerbate symptoms, highlighting the complexity of ADHD's causes.<br>This summary was provided by Chat GPT |
| **Research Question/Problem/ Need** | What are the symptoms and causes of ADHD in the brain? |
| **Important Figures** | N/A |
| **VOCAB: (w/definition)** | ADHD: ADHD is a significant problem in which the user has difficulty paying attention, and has excessive amounts of hyperactivity and impulsive behavior in periods of time |
| **Cited references to follow up on** | N/A |
| **Follow up Questions** | How can one control the experiment environment in order to directly see the impact binaural beats has on ADHD? |

# Article #21 Notes: Waveform-Based Musical Genre Classification 1/17/23

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|---|---|
| **Source Title** | Waveform-Based Musical Genre Classification |
| **Source citation (APA Format)** | Tripp, C., & Pontikakis, H. H. M. (n.d.). *Waveform-Based Musical Genre Classification*. https://cs229.stanford.edu/proj2006/TrippHungPontikakis-WaveformBasedMusicalGenreClassification.pdf |
| **Original URL** | https://cs229.stanford.edu/proj2006/TrippHungPontikakis-WaveformBasedMusicalGenreClassification.pdf |
| **Source type** | Scientific Journal |
| **Keywords** | Music |
| **#Tags** | Music |

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| **Summary of key points + notes (include methodology)** | -Got dataset of 2,600 songs, each having musical genre<br>-Choose to classify music between 5 big genres:<br>Rock<br>Hip hop<br>Techno<br>Classical<br>Pop<br>-Found 102 relevant feathers that allow LogitBoost to achieve classification accuracy of 83%<br>-A bunch of features have been proposed to examine and classify music, however, one doesnt do the job completely and still lacks 100% accuracy<br>- Practical algorithm can only handle several tens of features per song<br>-16 bit requires 20 MB of storage space<br>-Used new and old features to classify to help algorithm<br>-Many past studies have looked at vocals to classify, using the zero-crossing rate (average number of times that the waveform passes through zero per second<br>-Singing + talking tends to have waveforms with high ZCRs |
| **Research Question/Problem/ Need** | How to classify music based on waveform (generated)? |
| **Important Figures** | NA |
| **VOCAB: (w/definition)** | NA |
| **Cited references to follow up on** | NA |
| **Follow up Questions** | Specific to genre? |

# Patent #1 Notes: Writing implement with bearing coupled rotary device 12/16/23

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|---|---|
| **Source Title** | Writing implement with bearing coupled rotary device |
| **Source citation (APA Format)** | Laemle, D. A., & Puglisi, M. (2019). *Writing implement with bearing coupled rotary device* (United States Patent US10414204B2). https://patents.google.com/patent/US10414204B2/en?q=(fidget+toy+ADHD)&oq=fidget+toy+for+ADHD |
| **Original URL** | US10414204B2 - Writing implement with bearing coupled rotary device - Google Patents |
| **Source type** | Patent |

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|---|---|
| **Keywords** | ADHD |
| **#Tags** | ADHD |
| **Summary of key points + notes (include methodology)** | Rotation device (used to help with concentration and maintain focus) attached to a pencil or writing utensil.<br><br>Pros:<br>-Helps reduce ADHD symptoms<br>-No noise<br>-Can be used in school (attaches to pencil and still is a functional fidget toy-multifunctional)<br><br>Cons:<br>-Heavy<br><br>Important Components:<br>-Can rotate<br>-Plastic material (most of the time), material safe for children<br>-Has 1 center, with 3 tabs connected to it-all with equal weight, overall balanced<br>-Can attach to pencil/writing device |
| **Research Question/Problem/ Need** | What are some ways to mitigate ADHD symptoms mechanically? |
| **Important Figures** | N/A |
| **VOCAB: (w/definition)** | ADHD: is a significant problem in which the user has difficulty paying attention, and has excessive amounts of hyperactivity and impulsive behavior in periods of time |
| **Cited references to follow up on** | USD992041S1 - Fidget device for sensory therapy - Google Patents |
| **Follow up Questions** | Can these ways to mitigate ADHD impact brainwaves during binuaral beat testing? |

# Patent #2 Notes: System for diagnosing adhd based on brainwave 12/16/23

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|---|---|
| **Source Title** | System for diagnosing adhd based on brainwave |
| **Source citation (APA Format)** | 민동빈, 이재용, 금대식, 김성필, & 김민기. (2018). *System for diagnosing adhd based on brainwave* (Patent KR101868490B1). https://patents.google.com/patent/KR101868490B1/en |
| **Original URL** | KR101868490B1 - System for diagnosing adhd based on brainwave - Google Patents |
| **Source type** | Patent |
| **Keywords** | Brainwave |
| **#Tags** | Brainwave |
| **Summary of key points + notes (include methodology)** | The present invention relates to a system for diagnosing Attention Deficit Hyperactivity Disorder (ADHD) based on electroencephalogram (EEG). The system employs an EEG measuring unit, a preprocessing unit, a frequency analyzer, a characteristic information extracting unit, an integrated index conversion unit, and an ADHD diagnostic output unit. By analyzing characteristic information indicators, such as the relative power ratio of theta to beta waves, cerebral lateral deviation of alpha waves, phase delay index of theta waves, and frequency coherence index, the system aims to improve the reliability of ADHD diagnosis results. The integrated index is calculated using weights obtained through machine learning, and the ADHD diagnostic output unit determines whether the subject has ADHD based on the integrated index. The system provides a comprehensive approach to ADHD diagnosis using brain wave analysis.<br>This summary was provided by Chat GPT |
| **Research Question/Problem/** | Trying to mitigate problems with detecting ADHD with EEG and ensuring that the |

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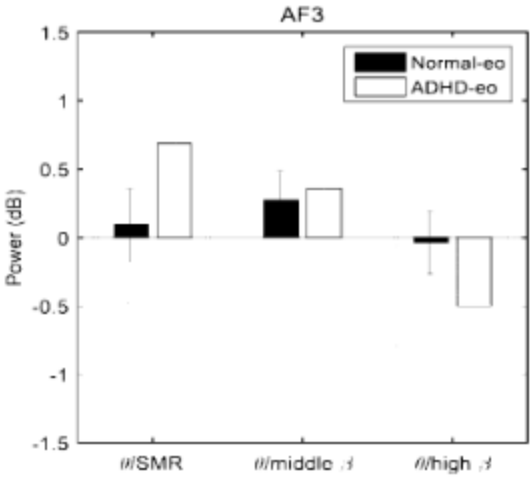
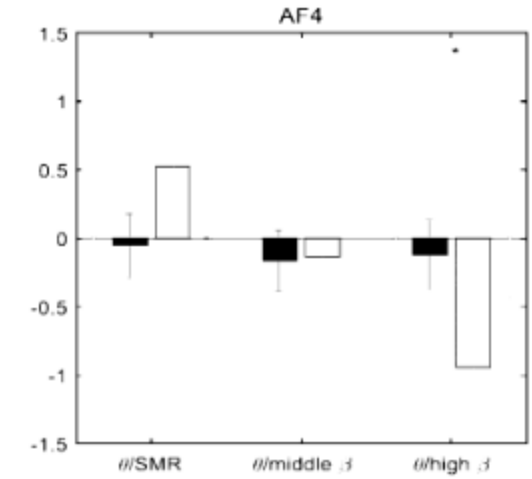
| **Need** | EEG tests are with little impacts as possible |
| **Important Figures** |  <br>  <br>Test results on ADHD diagnosis |
| **VOCAB: (w/definition)** | EEG- Device that tests brain waves |
| **Cited references to follow up on** | KR101868490B1 - System for diagnosing adhd based on brainwave - Google Patents |
| **Follow up Questions** | What are other methods that can be used in order to mitigate ADHD symptoms unrelated to brainwaves ? |

# Patent #3 Notes: Apparatus and method for remotely monitoring and altering brain waves 12/16/23

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|---|---|
| **Source Title** | Apparatus and method for remotely monitoring and altering brain waves |
| **Source citation (APA Format)** | Malech, R. G. (1976). *Apparatus and method for remotely monitoring and altering brain waves* (United States Patent US3951134A). https://patents.google.com/patent/US3951134A/en |
| **Original URL** | US3951134A - Apparatus and method for remotely monitoring and altering brain waves - Google Patents |
| **Source type** | Patent |
| **Keywords** | Brain waves |
| **#Tags** | Brain waves |
| **Summary of key points + notes (include methodology)** | This invention pertains to a method and apparatus for remotely monitoring brain waves without physical contact with the subject. Traditional methods involve attaching sensors to the subject's skull, limiting mobility and causing discomfort. In contrast, this invention employs high-frequency transmitters and antennas to radiate electromagnetic energy through the subject's skull, allowing for comprehensive monitoring of brain wave activity. The signals, modulated by the brain's electrical activity, are re-transmitted and processed remotely to provide a profile of the subject's brain waves. Additionally, the invention allows for the transmission of compensating signals to affect brain wave activity. The system has diverse applications, including continuous monitoring of individuals in critical roles, detection of seizures or sleepiness, and remote medical diagnoses. The apparatus can also control brain wave activity by transmitting signals to the subject's brain from a remote station.<br>This summary was provided by Chat GPT |

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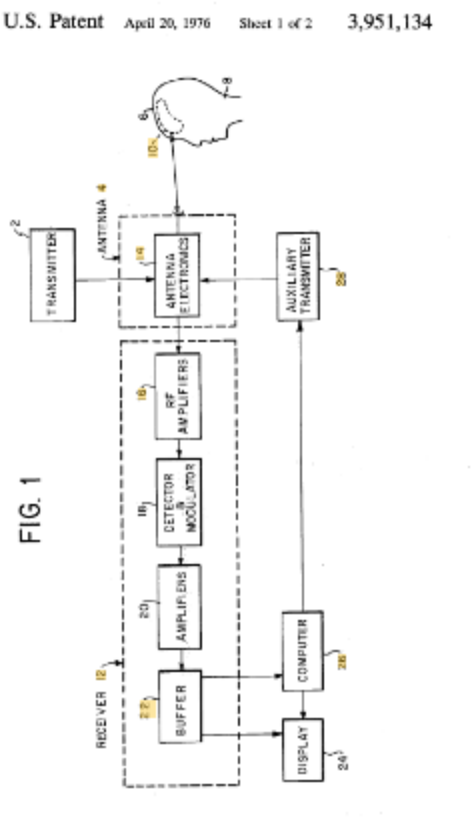
| **Research Question/Problem/ Need** | Creating an apparatus in order to monitor brain waves without contact |
| **Important Figures** |  <br>Plan on how apparatus can be used/created |
| **VOCAB: (w/definition)** | Brain waves-<br>Electrical signals in the brain |
| **Cited references to follow up on** | US3951134A - Apparatus and method for remotely monitoring and altering brain waves - Google Patents |
| **Follow up Questions** | What are the differences between using an EEG to monitor Brain waves and using the apparatus from the study? How will this impact results in correlation with tests using binaural beats? |