

Exploring the Neurological Impact of Sound Therapy Through EEG-Based Brainwave Analysis

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Introduction

Anxiety is among one of the most common mental condition characterized by excessive apprehensiveness about real or perceived threats that can reduce quality of life, lead to physical health issues, social isolation, substance abuse, and suicidal thoughts experienced by adults in the United States (Terlizzi & Zablotsky, 2024). Various sound therapy techniques have been used in substitution for medications and surgeries to decrease anxiety. This includes, but is not limited to, including sound bath meditations (Gurvendra et al., 2023) and sound stimulation in the form of music and language (Kim et al., 2022). Heightened beta waves are connected to anxiety levels, and an EEG can measure when those waves fluctuate. The hypothesis of this study is that listening to brown noise for a short period of time during anxiety will have the greatest chance to reduce beta waves significantly faster compared to white noise, bird noises, rain noises, and silence.



Materials and Methods

1. Collect information from participants via paper (verbal consent, age range, and M/F/nonbinary/prefer not to say)
 2. Have participants sit in an enclosed room with no distracting sounds
 3. Make sure EEG and sound machine are fully calibrated and ready
 4. Place EEG device on participant's head
 5. With eyes closed, record the resting EEG brain waves for 1 minutes
 6. With eyes open, place the math question in front of the participants and play loud distracting music/sounds for 1 minute
 8. Have subject state how they are feeling
 9. Ask: "How did that make you feel?"
- Part one: Eyes closed
(Example order)
Play "B" for 1 minute
Play anxiety inducing noise 30 sec
Play "W" for 1 minute
Play anxiety inducing noise 30 sec
Play "R" for 1 minute
Play anxiety inducing noise 30 sec
Play "A" for 1 minute
Anxiety noise 30 seconds
Measure "N" for 1 minute after the experiment
Total time ~ 10 minutes
B (Brown Noise), W (White Noise), R (Rain), A (Aviary/Birds Chirping), and N (silence)

Part Two: Questionnaire
"Which of the 5 sounds lowered your anxiety down the fastest?"
"Which one would you want to listen to for a long period of time?" (30 minutes+)

- EEG headband (Muse 2)
- Sanitizing wipes
- Cell phone
- 20 participants

Figures and Charts

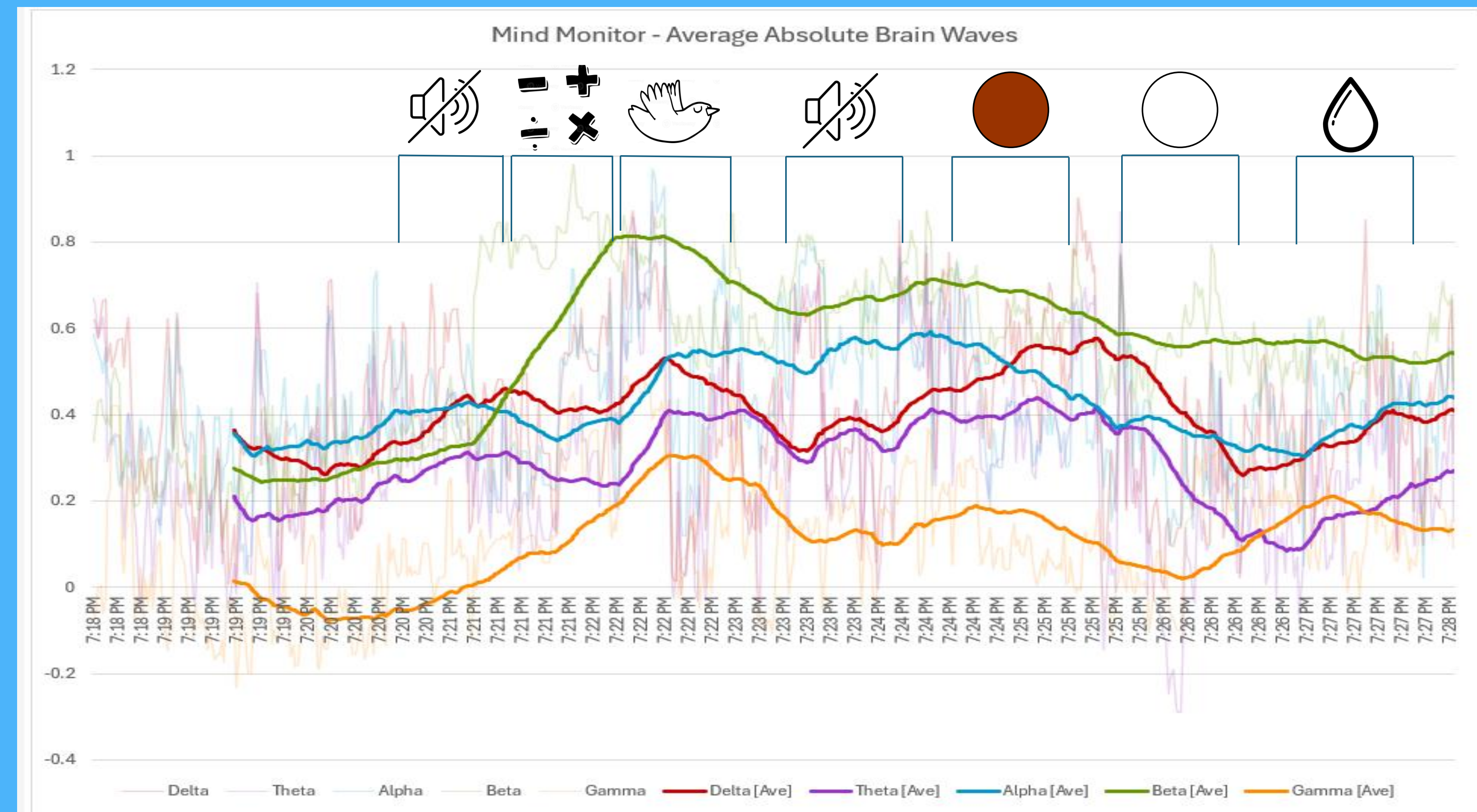


Figure 1. Participant 9 EEG

Anxiety-Reducing Sounds (EEG lowest beta waves)

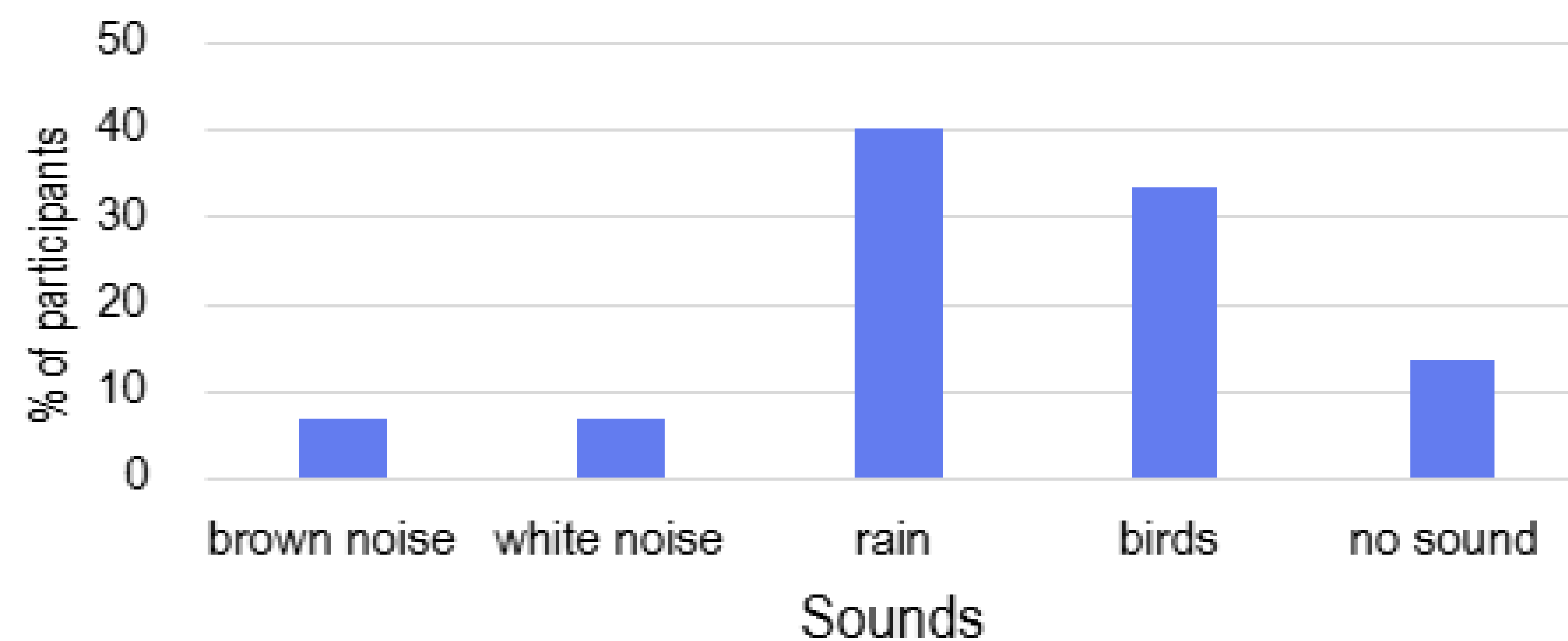


Figure 2. Sounds that reduced anxiety were measured by the lowest beta waves of each participant using an EEG (N=15).

Results

Sounds of rain and birds reduced beta waves significantly more than sounds of brown noise, white noise, and no sound (1-way ANOVA, $F_{4,70}=2.44$, $p=0.0055$, Figure 2). There were no significant differences in the sounds which participants reported they thought reduced their anxiety the fastest when choosing between brown noise, white noise, rain, birds, and no sound (1-way ANOVA, $F_{4,70}=0.82$, $p=0.5179$, Figure 3).

Figures and Tables

"Which sound lowered your anxiety the fastest?"

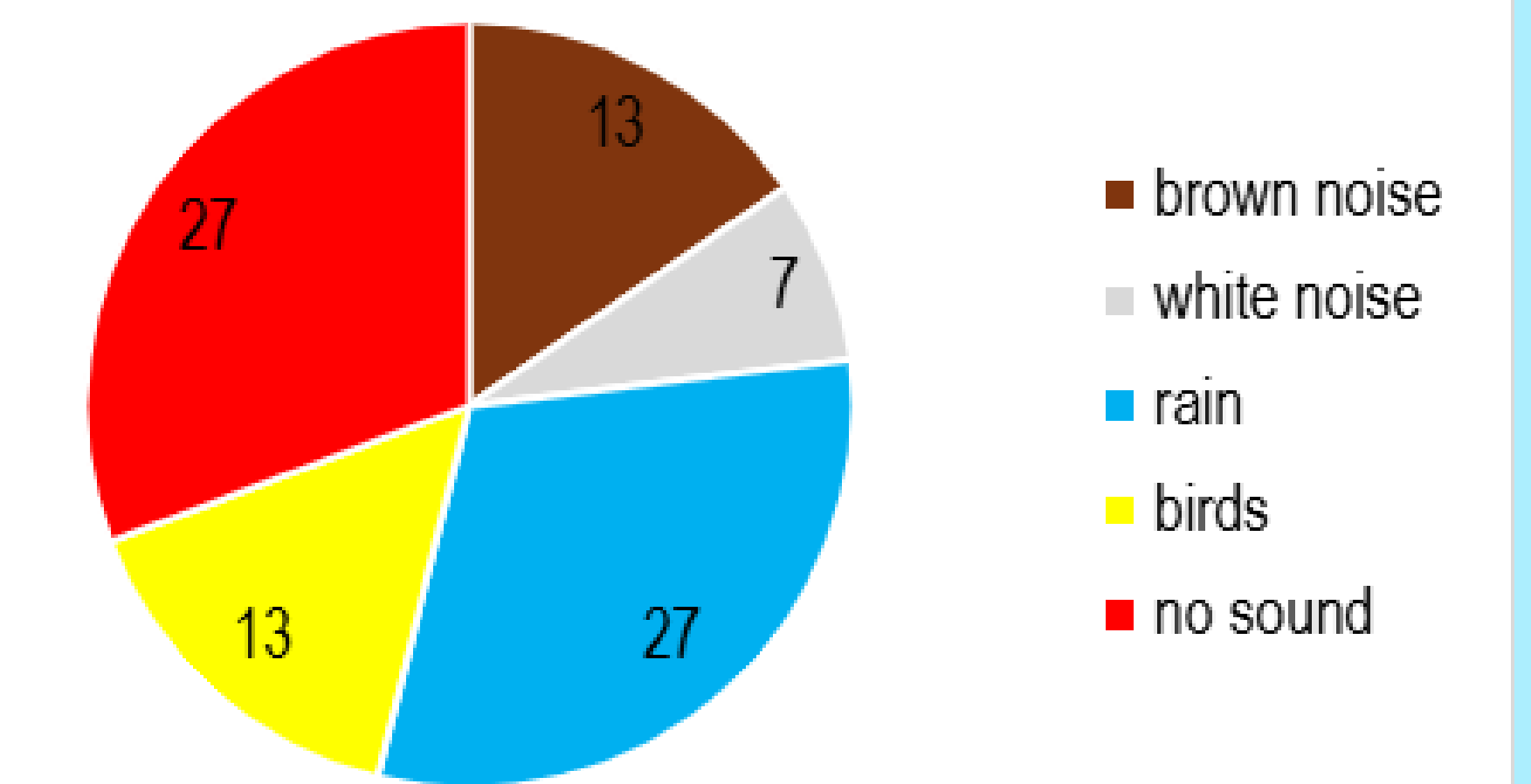


Figure 3. Participant responses to the question "Which sound lowered your anxiety the fastest?" (N=15).

"Which sound would you listen to the longest?"

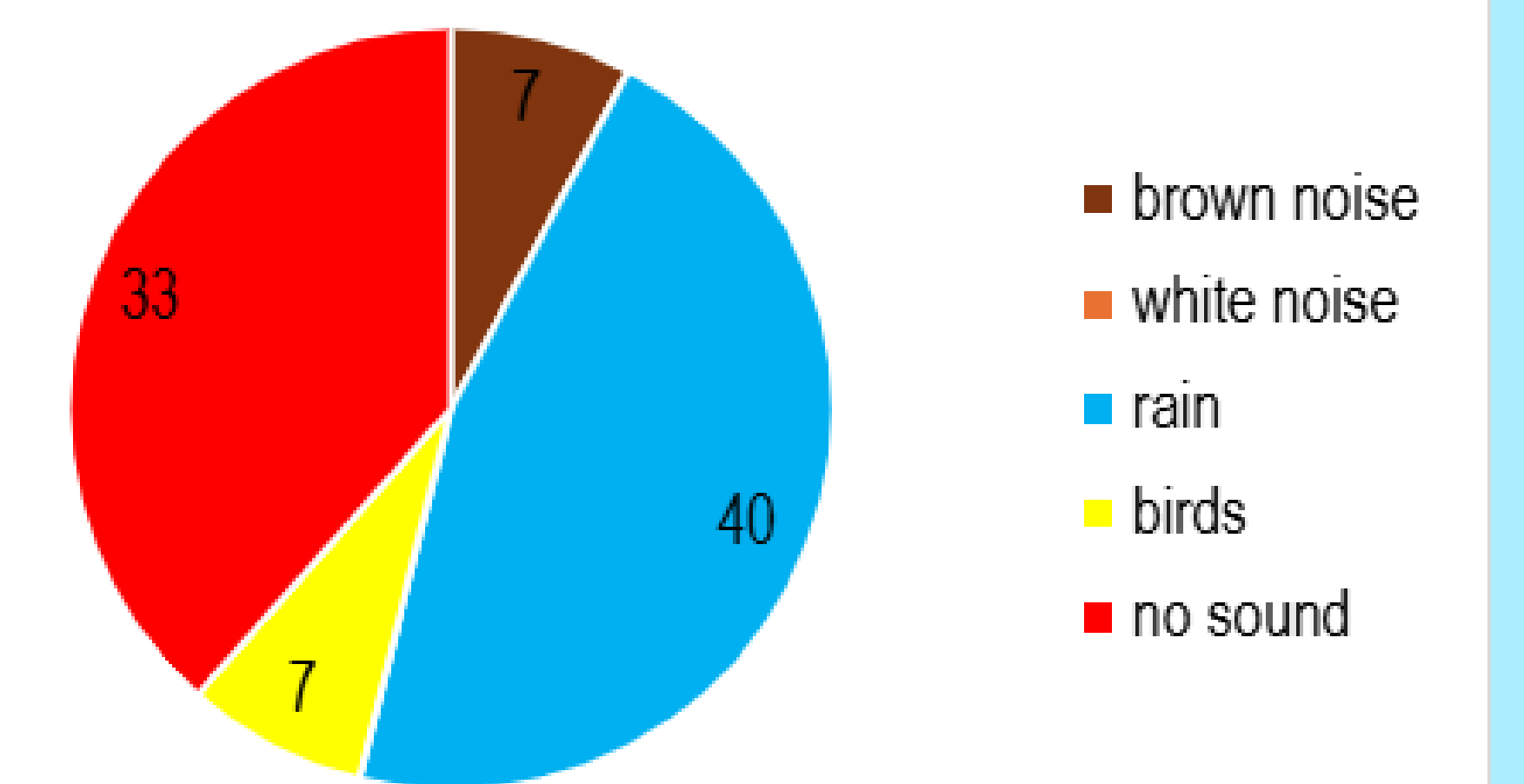


Figure 4. Participant responses to the question "Which sound would you listen to the longest?" (N=15).

Discussion

The results of this study demonstrate that when exposed to natural sound frequencies, specifically rain and bird sounds, it greatly reduces beta brain wave activity, which is commonly associated with anxiety and heightened alertness. Additional research has also found that sound therapies, such as sound bath meditations, aid in the transition of brain waves from an alert state (beta) into a more relaxed state (alpha and theta) (Gurvendra et al., 2023). These findings give insight to other tools and treatment methods to treat the most common mental illness in America.

Literature Cited

- Gurvendra, G., Amrit Lal Gurvendra, & Kulkarni, J. (2023). *GAP iNTERDISCIPLINARITIES A Global Journal of Interdisciplinary Studies EFFECT OF SOUND HEALING MEDITATION ON INCREASED ANXIETY & STRESS IN WOMEN*.
Kim, D., Woo, J., Jeong, J., & Kim, S. (2022). The sound stimulation method and EEG change analysis for development of digital therapeutics that can stimulate the nervous system: Cortical activation and drug substitution potential. *CNS Neuroscience & Therapeutics*, 29(1), 402-411. <https://doi.org/10.1111/cns.14014>
Terlizzi, E., & Zablotsky, B. (2024). Symptoms of Anxiety and Depression Among Adults: United States, 2019 and 2022. *National Health Statistics Reports Number, 213*(213).