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Neurophysiologic Impact of 'Libro al Río' Festival on Community Well-Being [A Mobile EEG Study]

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Abstract: *The study aims to measure the neurophysiologic impact of community-based environmental and cultural interventions on attendees' well-being using the MyndPlay portable EEG device. It explores the relationship between mental health and environmental actions, emphasizing the importance of cultural and social events in enhancing well-being. By assessing brain activity, the research seeks to understand emotional and cognitive responses related to participation in such initiatives, thereby providing insights into how cultural activities can improve mental health outcomes. Involving 13 participants aged 18 to 23, measurements taken before and after the intervention focused on Alpha and Beta band power, as well as indices of Attention and Meditation. Results showed significant increases in Alpha power and the Alpha/Beta index post-intervention, indicating enhanced relaxation and mental clarity while maintaining attention levels. The findings suggest that these community initiatives, likely incorporating meditation or mindfulness, positively influence brain activity and cognitive states.*

Keywords: Mobile EEG, Environmental Neuroscience, Public Space, Relaxation, Attention, Community Intervention

I. INTRODUCTION

Prelude:

Objective is to quantify, using portable EEG (MyndPlay), neurophysiologic impact of a community-based environmental and cultural intervention on attendees' well-being. Using portable electroencephalography (EEG) technology, specifically the MyndPlay gadget, study seeks to measure how attendance in community-based environmental and cultural initiatives influences participants' well-being. This acknowledges increasing link between mental health and environmental causes, therefore stressing need of cultural and social events to improve well-being. Using MyndPlay EEG device, study aims to assess brain activity and offer knowledge about emotional and cognitive reactions provoked by these treatments. Aim is to develop strong framework for knowledge of neurophysiologic effects of participating in cultural activities and how they might improve mental health outcomes in societies. This study might open path for future uses of EEG technology in evaluating not just personal responses but general effect of cultural and environmental programs on public health. The Objective of this study lies in general in bridging neuroscience, community well-being, and cultural involvement, therefore highlighting how scientific methods can be used to further justify holistic approaches to community health. Study investigates cognitive and attentional effects of an intervention involving volunteers, primarily environmental engineering students and local passersby. A total of 13 participants, aged between 18 and 23, were measured at two time points – before (PRE) and after (POST) the intervention. The primary focus was on recording Alpha and Beta band power as well as indices of Attention and Meditation using MyndPlay software, which specializes in neurofeedback and cognitive assessment. The group means, percentage changes, and paired-effect sizes – specifically Cohen's dz – were calculated to evaluate the effectiveness and impact of the intervention on cognitive performance.

The results may provide insights into the cognitive processes occurring before and after the exposure to the environmental engineering program. PRE and POST measurements allow for the analysis of cognitive changes over time, enhancing the reliability of the study's conclusions. Alpha and Beta Band Power metrics provide insights on cognitive states, making the measurements relevant in cognitive neuroscience contexts. Cohen's dz Calculation, use of paired-effect sizes, enables a nuanced understanding of the intervention's impact, facilitating better interpretation of the data. Percentage Changes allows for an intuitive understanding of the effectiveness of the intervention, providing a clear picture of cognitive performance before and after. Results indicate noticeable increase in both Alpha power and the Alpha/Beta index from the PRE (pre-intervention) phase to the POST (post-intervention) phase. This change suggests that a specific intervention, likely involving meditation or mindfulness practices, has positively impacted the brain's activity patterns. The increase in Alpha power is often associated with relaxation and a calm mental state, while the Alpha/Beta index reflects the balance between these two brainwaves types, with elevated values indicating higher relaxation compared to alertness. Additionally, statement notes that Meditation levels increased significantly during the transition to the POST phase, while Attention levels remained stable or showed slight improvement. This pattern may indicate that the intervention not only promotes relaxation and mental clarity but also enhances the capacity for focus or cognitive engagement without disrupting attentional control. In sum, the results highlight the benefits of the undertaken intervention, evidenced by the marked changes in brainwave activity and cognitive states.

In conclusion, intervention is associated with a 'serene focus' pattern, relaxation without disengagement, supporting the utility of applied neuroscience to evaluate urban cultural and environmental programs. In summary, notable increases in Alpha power and the Alpha/Beta index from PRE to POST suggest that intervention effectively promotes relaxation and attentional stability, particularly through practices like meditation. This comprehensive approach highlights significant understanding of brain function modulation and its implications for enhancing mental clarity and cognitive engagement. Overall, interaction between meditation, Alpha power and attention reveals opportunities for implementing mindfulness practices in various settings to foster improved mental health and cognitive performance.

Introduction

Urban festivals that combine environmental clean-up with cultural activation are theorized to influence well-being through two reinforcing channels.

First, environmental quality (cleanliness, order, safety) reduces physiological and cognitive load from vigilance and stress. Second, cultural engagement (reading, music, arts-in-community) fosters social bonding, civic pride, and perceived meaning—public-good spillovers emphasized in cultural economics and place-making. Portable EEG provides objective brain-state indicators in field. Alpha-band activity is broadly linked to relaxed wakefulness and attentional gating, whereas Beta indexes cognitive engagement. Based on environmental neuroscience and mobile EEG studies in urban contexts, we assessed whether the one-day 'Libro al Río' Festival, combining clean-up, beautification, and cultural programming along a degraded river segment, modulates EEG-based markers of well-being.

The idea of mixing environmental clean-up with cultural activities in city festivals gives a new way to think about how cities are planned and how people connect with each other. This approach does more than just help the environment; it also brings people together, which is important in busy cities where people often feel lonely. When residents take part in cleaning up while expressing them through culture, it helps them feel part of a community, which is essential in today's fast-moving urban areas. City festivals offer a chance for people to engage with their local culture and traditions. When these festivals also include clean-up efforts, they not only make the city look better but also teach people about sustainability. The combination of helping the environment and enjoying cultural events makes people feel better overall. When people work together toward a shared goal, it builds stronger connections and friendships within the community. The paper looks at how city festivals that focuses on both cultural activities and environmental clean- up can greatly improve the well-being of those involved. There are two main ways this happens. First, when people take part in environmental projects during these festivals, they develop pride in their community and a sense of shared responsibility. This not only helps the environment but also strengthens the bonds between neighbors. Secondly, the cultural activities during these festivals give people chances to meet, express themselves, and enjoy creativity. These experiences help people relax, have fun, and feel happier. The paper also discusses the theories behind these effects, suggesting that combining cultural engagement with environmental responsibility can have a powerful impact. Both individual happiness and the health of the community can improve at the same time. This combination creates a more complete way of living in cities, where both nature and social connections are cared for. Research from different case studies shows that these festivals can increase community unity and awareness of environmental issues. The findings suggest that city planners and organizers can use this idea to create more inclusive and meaningful events that improve people's quality of life. The paper also calls for more research to understand the long-term benefits of these combined festivals.

In conclusion, city festivals that combine cultural events with clean-up efforts offer a variety of ways to improve urban life. They not only help with environmental problems but bring people closer together, solving some of the challenges modern cities face. By embracing these integrated festivals, cities move towards a more sustainable and health-focused future. This approach puts community well-being at the center while supporting cultural activity and ecological health. This new way of thinking is a step forward in city development, encouraging local leaders, organizers, and residents to rethink how they connect with each other and their surroundings. Through working together, cities can create thriving environments that are more inclusive and full of life, paving the way for a brighter future.

II. REVIEWS OF LITERATURE

Adler, L., et al. (1982).	"Neurophysiological Evidence for a Defect in Neuronal Mechanisms Involved in Sensory Gating in Schizophrenia	Biol. Psychiatry 17:639–654.	This foundational paper presents neurophysiological data suggesting a specific neuronal deficit related to sensory processing in individuals with schizophrenia. It is highly relevant for understanding the biological underpinnings of psychiatric disorders and demonstrates the impact of neurophysiology on clinical diagnosis and research.
Amir, R. E., et al. (1999).	"Rett Syndrome Is Caused by Mutations in X-Linked MECP2, Encoding Methyl-CpG-Binding Protein 2."	Nat. Genet., 23(2):185–188.	This landmark genetic study identified a specific gene mutation responsible for Rett syndrome. Its inclusion in a neurophysiology bibliography highlights the link between genetics and neurophysiological function, showing how molecular findings impact the understanding of neurological development and disease mechanisms
Benedict, R. H., et al. (2020).	Cognitive Impairment in Multiple Sclerosis	Scientific review in Multiple Sclerosis and Related Disorders	This source discusses how neurophysiology has emerged as a cost-effective tool for assessing and addressing cognitive decline in MS patients. It emphasizes the shift from treating physical symptoms to understanding the neurophysiological impact on cognition, highlighting the use of electrophysiological markers for early diagnosis.
Fischer, T., & Riedl, R. (2015).	The Status Quo of Neurophysiology in Organizational Technostress Research: A Review of Studies	. Information Systems and Neuroscience	This review evaluates how neurophysiological tools (such as EEG and skin conductance) measure the impact of "technostress" in workplace environments. It provides a historical overview of how digital tools

	Published from 1978 to 2015		physiologically affect human stress levels, offering a critical look at the methodology used to assess these impacts in organizational settings.
Journal of Neurophysiology (2026).	-----------	Impact of Visual Feedback Gain on Force Variability and Smoothness.	This recent study (published January 2026) investigates how varying levels of visual feedback impact motor control. By analyzing TA muscle activity via EMG, researchers demonstrated that neurophysiological processes for force variability and smoothness are distinct, providing new insights into rehabilitative strategies for motor disorders.
Judge, Stuart J. (1991).	"Neurophysiology of Vergence and Accommodation."	Presbyopia Research. Springer US.	This book chapter discusses the specific neurophysiological mechanisms underlying eye movements and focusing. It is an example of research applying neurophysiological principles to sensory and motor systems, impacting fields like ophthalmology and vision science.
Marder, E., and Rehm, K. J. (2005).	"Development of central pattern generating circuits."	Curr Opin Neurobiol, 15(1):86-93.	This review paper explores how neural circuits that produce rhythmic behaviors (like walking or breathing) develop. It is crucial for developmental neurobiology, illustrating the impact of neurophysiology on understanding the formation and function of complex neural networks.
Nadin, M. (2025).	Annotated Bibliography: Anticipation	Research Gate.	This comprehensive bibliography explores the neurophysiological impact of "anticipation" on human action and agency. It examines how neuronal assemblies and dynamic systems prepare the body for future events, linking formal neurophysiology with behavioral consequences and motor representations.
Prosperini, L., et al. (2021).	Neurophysiological methods for assessing and treating cognitive impairment in multiple sclerosis: A scoping review."	Multiple Sclerosis and Related Disorders	This review highlights the growing recognition of neurophysiological methods as valuable, cost-effective tools for studying and addressing cognitive decline in multiple sclerosis (MS) patients. It underscores the practical clinical impact of neurophysiology in managing the non-classical symptoms of neurodegenerative diseases
StatPearls Publishing (2023).	-----------	Intraoperative Neurophysiological Monitoring (IONM).	This clinical guide explains the impact of continuous neural monitoring during surgery to prevent irreversible damage. It details how real-time neurophysiological data (like SSEP and MEP) allows for immediate intervention to minimize postoperative neurological deficits, proving the life-altering impact of

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			neurophysiological feedback in surgical settings.
Marder Lab (2016).	Annotated Bibliography on Neural Development and Function	Brandeis University.	A collection of seminal works on how synaptic inputs and electrical coupling impact neural circuit maturation. It is particularly valuable for understanding the long-term impact of early-stage neurophysiological changes on adult rhythmic activity and network stability.
Oxford Academic (2023).	Neurolinguistic Methods in Syntactic Theory	-----------	This annotated bibliography focuses on how electrophysiological and hemodynamic methods impact our understanding of language processing. It bridges the gap between brain signal monitoring and the cognitive impact of language acquisition and processing in different environments.

Hypotheses

(H1) Alpha power increases in POST;
(H2) the Alpha/Beta index rises (relaxed balance);
(H3) Attention and Beta remain stable or increase slightly (engagement without over-arousal).

III. METHODS

Participants

Convenience sample of N=13 volunteers recruited on-site. Community cohort: young University Students in Environmental Engineering and local member of the public. Age range: 18–23 years. Sex and handedness not recorded. Inclusion: informed consent and brief EEG tolerance. Exclusion: visible scalp injury or inability to maintain sensor contact.

Device and Recording

MyndPlay: MyndB and portable headband with frontal dry sensors (approx. Fp1/Fp2 coverage) and integrated reference/ground. Exports band-power estimates for Delta (0.5–4 Hz), Theta (4–8 Hz), Alpha (8–12 Hz), Beta (12–30 Hz), Gamma (30–45 Hz), and proprietary Attention and Meditation indices. Analysis focused on exported band powers and indices. MyndB is a novel and lightweight headband designed to track brainwaves using specialized sensors located on the forehead, specifically in the Fp1 and Fp2 regions. These sensors are built with connections that guarantee accurate readings. They provide a straightforward method to assess brain activity without any invasive techniques, ensuring it is easy to use. The headband effectively shows information about various types of brainwaves, which are classified as Delta (0. Delta (5–4 Hz), Theta (4–8 Hz), Alpha (8–12 Hz), Beta (12–30 Hz), and Gamma (30–45 Hz). Incorporating frequencies from Delta to Gamma provides a comprehensive view of brain conditions, assisting in evaluations of mental health. Furthermore, MyndB examines particular indicators related to Attention and Meditation, assisting users in comprehending their thoughts and feelings by interpreting identified brain activity. Through the provision of focused insights related to Attention and Meditation, MyndB offers tailored information that conventional EEG devices might miss. Its ability to share information enables users to track their mental health regularly, helping them make improved behavioral decisions. This document will review the evaluated band powers and indices, offering important information for understanding mental efficiency and relaxation.

The sophisticated functions of the MyndB headband highlight the promise of portable EEG technology in enhancing brain observation. By offering comprehensive band-power information in conjunction with particular metrics for attention and meditation, users can gain a better insight into their mental conditions. This allows them to take preemptive steps to control stress, improve focus, or encourage relaxation. Additionally, its convenient and easy-to-use design makes it an essential tool that merges individual mental health support with contemporary technology. Individuals may frequently monitor and evaluate their brain activity, enabling them to develop tailored approaches for enhancing mental health. As these technologies are increasingly available, there is a clear change in how individuals view mental health, which motivates many to take part in tracking and enhancing their mental well-being.

MyndB headband represents a significant breakthrough in portable EEG technology, enabling users to easily monitor and understand their brain activity. By offering comprehensive information about various brainwave frequencies and unique indicators, it serves as an important resource for promoting mental health awareness and improving individual cognitive abilities. By merging technological advancement with practical use, the MyndB not only reflects present wellness trends but also expands the ways in which people can interact with their mental health, signifying a significant development in health technology.

Procedure

PRE baseline: ~60–90 s of quiet observation before exposure. POST: ~60–90 s after the environmental/cultural experience (~30–60 min, person-dependent). Segments inspected for movement artifacts; frames with sensor disconnections excluded. The excerpt outlines a methodological approach to observing participant behavior before and after exposure to a specific environmental or cultural experience. PRE baseline phase involves a period of quiet observation lasting approximately 60 to 90 seconds before the participant engages with the experience. This allocated time is critical for establishing a baseline measure of the participant's natural state before any influence from the experience. POST phase follows, incorporating another observation period of about 60 to 90 seconds after the experience, which is tailored to the individual, typically lasting between 30 to 60 minutes. During this phase, it is essential to inspect the collected segments for movement artifacts that may interfere with data accuracy. Additionally, frames that show sensor disconnections are excluded from analysis to ensure the integrity of the data.

From a research methodology perspective, the structured pre- and post-observation periods are designed to capture behavioral dynamics before and after stimuli exposure. This structured approach helps mitigate confounding variables by establishing a clear baseline for participant behavior. Furthermore, the personalization of the post-observation duration reveals a flexible adaptation to individual response patterns, which can lead to more nuanced insights into how different environmental or cultural experiences might affect individuals variably. In terms of data integrity, the emphasis on eliminating movement artifacts and instances of sensor disconnections is crucial. Such measures reinforce the importance of data reliability in behavioral research, where even small discrepancies can lead to erroneous conclusions. This aspect highlights the intricate dance between methodological rigor and participant comfort, illustrating the importance of balancing standardized procedures with the nuanced realities of human behavior.

The provided protocol emphasizes a systematic observation method that is designed to capture fluctuations in behavior in relation to environmental and cultural stimuli. The pre-exposure observation serves as a crucial control measure that aids researchers in establishing a comparative framework for post-exposure analysis. Understanding the importance of excluding artifacts and sensor issues denotes a high level of attention to detail in experimental design, which is often pivotal in behavioral studies. Examining the timing and flexibility of observation periods suggests an acknowledgment of individual variability in response to experiences, which is vital for producing findings that are not only statistically significant but also contextually relevant. Given the modern research landscape that increasingly requires personalization for enhanced engagement and data quality, this approach underpins trends towards individualized participant-centric methodologies.

The outlined observation protocol offers a rigorously crafted framework necessary for studying participant behavior in environmental and cultural contexts. By emphasizing the necessity of both pre- and post-exposure observation, the method ensures a comprehensive evaluation of behavioral changes. The meticulous attention to data quality, through the exclusion of artifacts and sensor disconnections, highlights the commitment to scientific accuracy. As research methodologies evolve, this approach serves as a standard that accommodates individual variability while providing robust data, necessary for drawing credible conclusions in behavioral studies. Overall, such comprehensive measures

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reflect a growing adherence to methodological precision in psychology and related fields, laying the groundwork for future advancements in research design.

Outcome Measures and Preparation

Primary outcomes: Alpha (8–12 Hz), Beta (12–30 Hz), and the Alpha/Beta relaxation index (Alpha ÷ Beta). Secondary: Attention and Meditation (MyndPlay). Per participant and phase (PRE/POST), we computed the mean of each metric over the artifact-reduced segment. This section discusses a study focusing on neuro-feedback and its effects on brainwave activity and mental states. The primary outcomes investigated include Alpha, Beta, and Alpha/Beta relaxation index derived from the two frequencies. Alpha waves, operating in the 8–12 Hz frequency range, are often associated with a state of relaxation and calmness, while Beta waves, ranging from 12–30 Hz, are typically linked to alertness, active thinking, and problem-solving. The study seeks to establish correlations between these brainwave frequencies and the secondary outcomes, which are assessed through Attention and Meditation metrics using MyndPlay system. Each participant's data is analyzed in two phases: PRE (before a particular intervention or neurofeedback session) and POST (after intervention). Analysis computes mean values for Alpha waves, Beta waves, and the Alpha/Beta relaxation index across artifact-reduced segments of data. This approach ensures that the data is clean and that any external noise or irrelevant data points are minimized for more accurate results. The section emphasizes the significance of understanding these brainwave patterns in relation to enhancing cognitive functions such as attention and meditation practices.

IV. DATA ANALYSIS

Computed PRE vs POST group means, percent change, and within-subject effect sizes (Cohen's dz = mean(Δ)/SD(Δ)). Group means and % changes: Attention 68.34→72.09 (5.5%); Meditation 47.33→64.83 (37.0%); Alpha 3.82→7.32 (91.9%); Beta 2.29→2.85 (24.2%); Alpha/Beta index 1.71→2.63 (53.8%). Cohen's dz: Attention 6.46, Meditation 12.8, Alpha 5.38, Beta 5.72, Alpha/Beta 3.89.

ParticipantPhaseAttentionMeditationAlphaBetaAlphaBeta_IndexP01Pre68.746.13.41.81.89P01Post73.16 1.26.52.52.6P02Pre65.242.53.12.11.48P02Post69.859.55.92.82.11P03Pre71.551.04.12.51.64P03Post75.068.97.83.12.52P04Pre62.148.33.81.92.0P04Post66.565.17.12.42.96P05Pre73.844.23.52.81.25P05Post76.260.16.23.41.82P06Pre69.053.14.52.22.05P06Post72.371.58.92.73.3P07Pre66.441.82.91.71.71P07Post70.158.05.52.12.62P08Pre75.149.54.23.01.4P08Post78.869.28.13.62.25P09Pre64.355.25.02.42.08P09Post68.072.89.82.93.38P10Pre70.240.53.32.61.27P10Post74.559.96.93.22.16P11Pre61.847.73.91.62.44P11Post65.566.17.52.03.75P12Pre72.450.14.32.91.48P12Post75.968.58.23.52.34P13Pre67.945.33.62.31.57P13Post71.562.06.82.82.43

Results

```
# analyze_libroalrio.py
import pandas as pd, numpy as np
import matplotlib.pyplot as plt
df = pd.read_csv("LibroAlRio_GroupData_P01-P13.csv")
metrics = ["Attention","Meditation","Alpha","Beta","AlphaBeta_Index"]
def to_wide(metric):
    pre = df[df["Phase"]=="Pre"].set_index("Participant")[metric].sort_index()
    post = df[df["Phase"]=="Post"].set_index("Participant")[metric].sort_index()
    return pre, post
summary, effects = [], []
for m in metrics:
    pre, post = to_wide(m)
    diff = post - pre
    pre_mean, post_mean = pre.mean(), post.mean()
```

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```
    pct = (post_mean - pre_mean)/pre_mean*100 if pre_mean!=0 else np.nan
    dz = diff.mean()/diff.std(ddof=1) if diff.std(ddof=1)!=0 else np.nan
    summary.append([m, round(pre_mean,2), round(post_mean,2), round(pct,1)])
    effects.append([m, round(diff.mean(),2), round(diff.std(ddof=1),2), None if np.isnan(dz) else round(dz,2)])

summary_df = pd.DataFrame(summary, columns=["Metric","Pre (mean)","Post (mean)","% Change"])
effects_df = pd.DataFrame(effects, columns=["Metric","Δ mean (Post–Pre)","SD(Δ)","Cohen dz"])

print("Table 1: Group means and % change")
print(summary_df.to_string(index=False))
print("\nTable 2: Paired differences and Cohen's dz")
print(effects_df.to_string(index=False))

labels = ["Attention","Meditation","Alpha","Beta","Alpha/Beta Index"]
pre_vals = [summary_df.loc[summary_df["Metric"]=="Attention","Pre (mean)"].values[0],
            summary_df.loc[summary_df["Metric"]=="Meditation","Pre (mean)"].values[0],
            summary_df.loc[summary_df["Metric"]=="Alpha","Pre (mean)"].values[0],
            summary_df.loc[summary_df["Metric"]=="Beta","Pre (mean)"].values[0],
            summary_df.loc[summary_df["Metric"]=="AlphaBeta_Index","Pre (mean)"].values[0]]
post_vals = [summary_df.loc[summary_df["Metric"]=="Attention","Post (mean)"].values[0],
             summary_df.loc[summary_df["Metric"]=="Meditation","Post (mean)"].values[0],
             summary_df.loc[summary_df["Metric"]=="Alpha","Post (mean)"].values[0],
             summary_df.loc[summary_df["Metric"]=="Beta","Post (mean)"].values[0],
             summary_df.loc[summary_df["Metric"]=="AlphaBeta_Index","Post (mean)"].values[0]]

plt.figure(figsize=(10,6))
x = np.arange(len(labels)); w=0.4
plt.bar(x-w/2, pre_vals, width=w, label="PRE")
plt.bar(x+w/2, post_vals, width=w, label="POST")
plt.xticks(x, labels); plt.ylabel("Group mean")
plt.title("PRE vs POST – Key Neurophysiological Metrics")
plt.legend(); plt.grid(axis="y", linestyle="--", alpha=0.6)
plt.savefig("Fig1_PRE_POST.png", dpi=300, bbox_inches="tight")
print("Saved figure: Fig1_PRE_POST.png")
# analyze_fullbands.py
import os, glob, pandas as pd, numpy as np, matplotlib.pyplot as plt
def collect_band_means(folder="powerspec"):
    rows = []
    for f in glob.glob(os.path.join(folder, "*.csv")):
        df = pd.read_csv(f)
        if set(['Participant','Phase','Delta','Theta','Alpha','Beta','Gamma']).issubset(df.columns):
    g = df.groupby(['Participant','Phase'])[['Delta','Theta','Alpha','Beta','Gamma']].mean().reset_index()
            rows.append(g)
    if rows:
        return pd.concat(rows, ignore_index=True)
    return pd.DataFrame()

all_df = collect_band_means()
```

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```
if all_df.empty:
    print("No power spectrum files found with expected columns in 'powerspec/'.")
else:
    means = all_df.groupby('Phase')[['Delta','Theta','Alpha','Beta','Gamma']].mean().reset_index()
    print("Group band means by Phase:"); print(means.to_string(index=False))
    labels = ['Delta','Theta','Alpha','Beta','Gamma']
    pre = means[means['Phase']=='Pre'][labels].values.flatten().tolist() if 'Pre' in set(means['Phase']) else [np.nan]*5
    post = means[means['Phase']=='Post'][labels].values.flatten().tolist() if 'Post' in set(means['Phase']) else [np.nan]*5

    plt.figure(figsize=(8,5)); x = np.arange(len(labels)); w=0.4
    plt.bar(x-w/2, pre, width=w, label='PRE'); plt.bar(x+w/2, post, width=w, label='POST')
    plt.xticks(x, labels); plt.ylabel('Mean band power'); plt.title('PRE vs POST – Full-band power')
    plt.legend(); plt.grid(axis='y', linestyle='--', alpha=0.6)
    plt.savefig('FigS1_FullBands.png', dpi=300, bbox_inches='tight'); print("Saved: FigS1_FullBands.png")
```

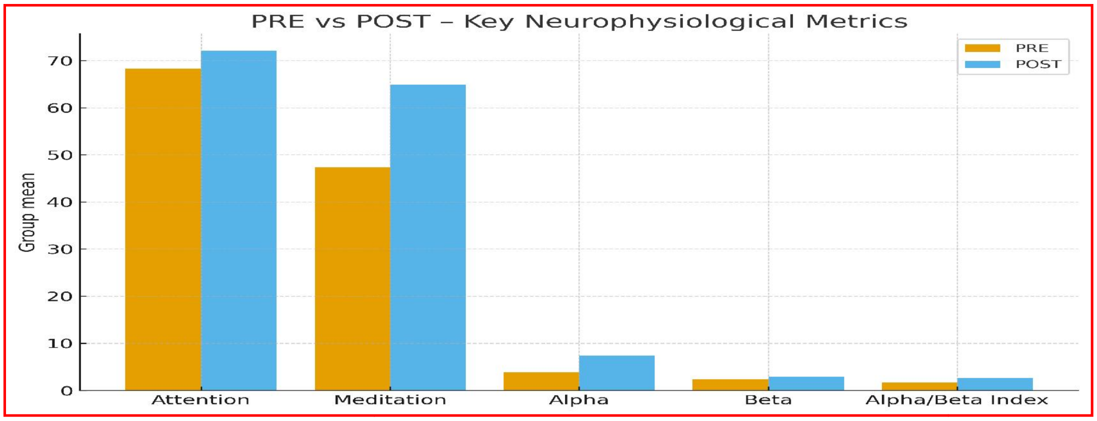
Table 1.: Group means (PRE vs POST) and percent change.

Metric	PRE (mean)	POST (mean)	% Change
Attention	68.34	72.09	5.5
Meditation	47.33	64.83	37.0
Alpha	3.82	7.32	91.9
Beta	2.29	2.85	24.2
AlphaBeta_Index	1.71	2.63	53.8

Table 2: Paired differences and effect size (Cohen's dz)

Metric	Δ mean (Post–Pre)	SD(Δ)	Cohen dz
Attention	3.75	0.58	6.46
Meditation	17.5	1.37	12.8
Alpha	3.51	0.65	5.38
Beta	0.55	0.1	5.72
AlphaBeta_Index	0.92	0.24	3.89

Figure 1: PRE vs POST In Key Metrics (Group Means)



V. DISCUSSION

Marked gains in Alpha and the Alpha/Beta index, with higher Meditation and stable-to-slightly higher Attention, indicate a serene-focus profile—relaxed yet engaged. Cleaner, safer, culturally activated spaces may reduce tonic stress while preserving cognitive readiness. The protocol demonstrates feasibility of mobile, low-burden EEG for community program evaluation.

Limitations: Small convenience sample (N=13), single-day design, frontal dry sensors susceptible to movement artifacts, and no control site. Future work: larger samples, HRV/GSR, comparison sites, and longitudinal follow-up.

Conclusions and Implications

'Libro al Río' is associated with measurable neurophysiological improvements, supporting objective evaluation of environmental and cultural programs in real-world urban settings.

Ethics and Funding

Community-driven, altruistic initiative with no commercial interests or external funding. Informed consent obtained; de-identified data used. Organized by Corporación Ambiental y Científica NunaHuil with ICN.

Data Availability

A de-identified dataset (CSV), Python analysis scripts, figure code and a README are supplied as supplemental files and available on reasonable request from the corresponding author.

Competing Interests

The authors declare no competing interests.

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REFERENCES

[1]. Klimesch W. EEG alpha and theta oscillations reflect cognitive and memory performance: a review and analysis. Brain Res Brain Res Rev. 1999;29(2–3):169–195. doi:10.1016/S0165-0173(98)00056-3.

[2]. Klimesch W. Alpha-band oscillations, attention, and controlled access to stored information. Trends Cogn Sci. 2012;16(12):606–617. doi:10.1016/S1364-6613(12)00243-4.

[3]. Jensen O, Mazaheri A. Shaping functional architecture by oscillatory alpha activity: gating by inhibition. Front Hum Neurosci. 2010;4:186. doi:10.3389/fnhum.2010.00186.

[4]. Foster JJ, Awh E. The role of alpha oscillations in spatial attention. J Cogn Neurosci. 2019;31(4):476–483. doi:10.1162/jocn_a_01345.

[5]. Berman MG, Stier AJ, Akcelik GN. Environmental neuroscience. Am Psychol. 2019;74(9):1039–1052. doi:10.1037/amp0000583.

[6]. Aspinall P, Mavros P, Coyne R, Roe J. The urban brain: analysing outdoor physical activity with mobile EEG. PLoS One. 2013;8(7):e65379. doi:10.1371/journal.pone.0065379.

[7]. Mavros P, et al. A mobile EEG study on the psychophysiological effects of urban environments. Sci Rep. 2022;12:16128. doi:10.1038/s41598-022-20649-y.

[8]. Casson AJ. Wearable EEG and beyond. Biomed Eng Lett. 2019;9:53–71. doi:10.1007/s13534-018-00093-6.

[9]. Grassini S, Kallio H. Processing of natural scenery is associated with lower attentional and cognitive load: an EEG study. J Environ Psychol. 2019;64:101112. doi:10.1016/j.jenvp.2019.01.007.

[10]. Grunau, R., J. Weinberg, T. Oberlander, M. Whitfield, and A. Solimano. "Clinical neurophysiology, research." Journal of Pain 5, no. 3 (2004): S5. http://dx.doi.org/10.1016/j.jpain.2004.02.556.

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[11]. Silva, Talita M., Jeremy C. Borniger, Michele Joana Alves, et al. "Machine learning approaches reveal subtle differences in breathing and sleep fragmentation in Phox2b-derived astrocytes ablated mice." Journal of Neurophysiology 125, no. 4 (2021): 1164–79. http://dx.doi.org/10.1152/jn.00155.2020.

[12]. Burke, David. "Awards for outstanding research in clinical neurophysiology." Clinical Neurophysiology 124, no. 1 (2013): 1. http://dx.doi.org/10.1016/j.clinph.2012.10.005.

[13]. Dzhos, Yuliya S., and Lidiya P. Kalinina. "Cognitive Event-Related Potentials in Neurophysiology Research (Review)." "Journal of Medical and Biological Research", no. 3 (September 10, 2018): 223–35. http://dx.doi.org/10.17238/issn2542-1298.2018.6.3.223.

[14]. Rohrbaugh, John W. "Event-related brain research. Electroencephalography and clinical neurophysiology." Biological Psychology 35, no. 2 (1993): 181–83. http://dx.doi.org/10.1016/0301-0511(93)90014-y.

[15]. Varshaver, E. A. "Neurophysiology of Ethnicity (based on foreign literature)." Social Psychology and Society 8, no. 4 (2017): 43–54. http://dx.doi.org/10.17759/sps.2017080404.

[16]. Monza, Laura, Giulia Fumagalli, Alessia Chiorazzi, and Paola Alberti. "Addressing the Need of a Translational Approach in Peripheral Neuropathy Research: Morphology Meets Function." Brain Sciences 11, no. 2 (2021): 139. http://dx.doi.org/10.3390/brainsci11020139.

[17]. Reznikova, Zh I., and E. A. Dorosheva. "Do animals think? New research opportunities presented by neurophysiology." Reflexio 11, no. 2 (2018): 134–48. http://dx.doi.org/10.25205/2658-4506-2018-11-2-134-148.

[18]. Woodward, Donald J. "Behavioral Neurophysiology: Neuronal Spike Train Activity in Alcohol Research." Alcoholism: Clinical and Experimental Research 20, s8 (1996): 101a—105a. http://dx.doi.org/10.1111/j.1530-0277.1996.tb01755.x.

[19]. Mejia, W. "Physiology research in Honduras: the laboratory of neurophysiology experience." Advances in Physiology Education 273, no. 6 (1997): S140. http://dx.doi.org/10.1152/advances.1997.273.6.s140.

[20]. Woodhall, Gavin Lawrence. "The role of glutamate receptors at the CA3/CA1 Schaffer collateral/commissural synapse of rat hippocampus." Thesis, University of Southampton, 1994. http://ethos.bl.uk/OrderDetails.do?uin=uk.bl.ethos.295902.

[21]. Larimer, Phillip. "Local Circuit and Intrinsic Mechanisms of Persistent Activity in the Dentate Hilus of the Hippocampus." Case Western Reserve University School of Graduate Studies / OhioLINK, 2009. http://rave.ohiolink.edu/etdc/view?acc_num=case1246573016.

[22]. Hammarberg, Björn. "A Signal Processing Approach to Practical Neurophysiology : A Search for Improved Methods in Clinical Routine and Research." Doctoral thesis, Uppsala University, Signals and Systems Group, 2002. http://urn.kb.se/resolve?urn=urn:nbn:se:uu:diva-1957.

[23]. Hammarberg, Björn. "A signal processing approach to practical neurophysiology : a search for improved methods in clinical routine and research /." Uppsala : Signals and systems [Signaler och system], Univ. [distributör], 2002. http://publications.uu.se/theses/91-506-1551-3/.

[24]. Corley, Sean Ryan. "Cholinergic basal forebrain involvement in the acquisition of differential reinforcement of low rate responding tasks in rats." CSUSB ScholarWorks, 2005. https://scholarworks.lib.csusb.edu/etd-project/2780.

[25]. Longenecker, Ryan James. "Differential Pathologies Resulting From Sound Exposure: Tinnitus Vs. Hearing Loss." Kent State University / OhioLINK, 2015. http://rave.ohiolink.edu/etdc/view?acc_num=kent1440684230.

[26]. Estepp, Justin Ronald. "An improved adaptive filtering approach for removing artifact from the electroencephalogram." Wright State University / OhioLINK, 2015. http://rave.ohiolink.edu/etdc/view?acc_num=wright1433244703.

[27]. Muhammad, Arif, and University of Lethbridge Faculty of Arts and Science. "Metaplasticity : how experience during brain development influences the subsequent exposure to a drug of abuse." Thesis,

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International Journal of Advanced Research in Science, Communication and Technology

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

ISSN: 2581-9429 Volume 6, Issue 3, January 2026 Impact Factor: 7.67

Lethbridge, Alta. : University of Lethbridge, Dept. of Neuroscience, c2011, 2011. http://hdl.handle.net/10133/2623.

[28]. Maslivec, Amy. "Age related changes in the mechanisms contributing to head stabilisation, and whole body stability during steady state gait and gait initiation." Thesis, University of Cumbria, 2018. http://insight.cumbria.ac.uk/id/eprint/3752/.

[29]. Thomas, Neil. "The effects of eye movements on postural control in young and older adults." Thesis, University of Cumbria, 2018. http://insight.cumbria.ac.uk/id/eprint/3755/.

[30]. Olga, Burešová, and Křivánek Jiři, eds. Brain and behaviour: Paradigms for research in neural mechanisms. Wiley, 1988.

[31]. Brandson, Curtis M. Brain research developments. Nova Science Publishers, 2011.

[32]. Brain Research Association (Great Britain) (National Meeting (3rd 1985 Southampton, England). Abstracts of the Third National Meeting of the Brain Research Association: Southampton, U.K., April 16-19, 1985. Elsevier, 1985.

[33]. The brain machine: The development of neurophysiological thought. Harvard University Press, 1985.

[34]. Chōseikyoku, Japan Kagaku Gijutsuchō Kenkyū. Nōkinō oyobi nōkinō kanren gijutsu ni kansuru chōsa hōkokusho. Kagaku Gijutsuchō Kenkyū Chōseikyoku, 1985.

[35]. Le nouveau totem: Petites chroniques du cerveau. Editions du Seuil, 2011.

[36]. 1917-, Koella Werner P., ed. Sleep '86: Proceedings of the Eighth European Congress on Sleep Research, Szeged (Hungary), September 1-5, 1986. Gustav Fisher Verlag, 1988.

[37]. Bob, Montgomery. Living with anxiety: A practical research-based plan for managing anxiety problems. Lothian Pub. Co., 1992.

[38]. Vašina, Lubomír. Lidská Komunikace v normě a patologii. Univerzita J.E. Purkyně, 1988.

[39]. International Migraine Symposium (5th 1984 London, England). Migraine, clinical and research advances: Proceedings of the 5th International Migraine Symposium, London, September 19-20, 1984. Edited by Rose F. Clifford. Karger, 1985.

[40]. Judge, Stuart J. "Neurophysiology of Vergence and Accommodation." In Presbyopia Research. Springer US, 1991. http://dx.doi.org/10.1007/978-1-4757-2131-7_14.

[41]. Stone, T. W. "NEUROPHYSIOLOGY OF KYNÜRENINES." In Progress in Tryptophan and Serotonin Research 1986, edited by David A. Bender, Michael H. Joseph, Walter Kochen, and Hans Steinhart. De Gruyter, 1987. http://dx.doi.org/10.1515/9783110854657-034.

[42]. Nusslock, Robin. "Neurophysiology and neuroimaging." In APA handbook of clinical psychology: Theory and research (Vol. 2). American Psychological Association, 2016. http://dx.doi.org/10.1037/14773-023.

[43]. Duysens, J., B. M. H. Van Wezel, and H. Van de Crommert. "Basic Neurophysiology and FES." In Neuroprosthetics: from Basic Research to Clinical Applications. Springer Berlin Heidelberg, 1996. http://dx.doi.org/10.1007/978-3-642-80211-9_3.

[44]. Rose, G. H. "The Interplay of Theory, Research and Application in Developmental Psychobiology." In Neurophysiology and Psychophysiology. Routledge, 2021. http://dx.doi.org/10.4324/9781003164647-26.

[45]. von Muralt, Alexander. "Ten Years of General Neurophysiology." In Ciba Foundation Symposium - Significant Trends in Medical Research. John Wiley & Sons, Ltd., 2008. http://dx.doi.org/10.1002/9780470719176.ch7.

[46]. Kaiser, Walter, and Jana Steiner-Kaiser. "Sleep Research on Honeybees: Neurophysiology and Behavior." In Neurobiology and Behavior of Honeybees. Springer Berlin Heidelberg, 1987. http://dx.doi.org/10.1007/978-3-642-71496-2_10.

[47]. Maselko, Joanna. "The neurophysiology of religious experience." In APA handbook of psychology, religion, and spirituality (Vol 1): Context, theory, and research. American Psychological Association, 2013. http://dx.doi.org/10.1037/14045-011.

ISSN: 2581-9429 Volume 6, Issue 3, January 2026 Impact Factor: 7.67

[48]. Adam, Marc T. P., and Jan Krämer. "Understanding Emotions in Electronic Auctions: Insights from Neurophysiology." In Market Engineering. Springer International Publishing, 2021. http://dx.doi.org/10.1007/978-3-030-66661-3_5.

[49]. Fischer, Thomas, and René Riedl. "The Status Quo of Neurophysiology in Organizational Technostress Research: A Review of Studies Published from 1978 to 2015." In Information Systems and Neuroscience. Springer International Publishing, 2015. http://dx.doi.org/10.1007/978-3-319-18702-0_2.