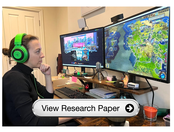
# Library of Published Research

## Research Papers for Quantum Entanglement




### Brain Synchrony During Collaborative Multi-User Neurofeedback-Based Gaming

– Frontiers in Neuroergonomics • Oct, 2021

Twenty pairs of participants with no close relationships took part in three sessions of online collaborative multi-user neurofeedback. Spectral analysis for inter-brain connectivity patterns using EEG and MEG showed that in collaborative gaming, players with higher resting state alpha content were more active in regulating their alpha brain waves to match those of their partners. Moreover, patterns for interconnectivity were the strongest between homologous brain structures in the theta and alpha bands, indicating a strong degree of neural synchrony between participants.


### US Navy scientists report that quantum entanglement occurs in brain neurons

– Naval Information Center • July, 2022

For over 20 years, scientists have been studying microtubules in brain neurons for their role in human consciousness. With a helical ring structure, microtubules were thought to possess quantum entanglement, coherent energy transfer, and quantum tunneling. U.S. Navy Scientists have recently announced proof that microtubules in the human brain exhibit quantum entanglement. This discovery expands our knowledge of quantum non-locality and multi-dimensional consciousness.


### Inter-Brain Synchronization Occurs Without Physical Presence During Online Interaction

– Neuropsychologia Journal • July, 2022

This study measured EEG from 42 subjects who were physically isolated, but collaborating in a multiplayer game. Pairs working together were found to have elevated neural coupling in the higher gamma frequency bands, showing increased inter-brain synchrony during online interactions. These results are in line with our previous findings of increased inter-brain neural synchrony during collaborative online interactions, and show that complete phase synchronization of oscillatory activity occurs during real-time coordination without any physical presence or audiovisual connections.


### EEG analysis shows that identical twins share quantum-entangled consciousness

– Computational Biotechnology • Mar, 2025

This study examined 106 pairs of identical twins to provide empirical evidence of how quantum entanglement influences human consciousness at a biophysical level. Using EEG, twin pairs were evaluated during 144 learning experiments via an IBM quantum supercomputer. The results provide robust evidence for the existence of quantum entanglement in cognitive mechanisms capable of anticipating future stimuli, representing a profound leap in our understanding of quantum consciousness and brain-to-brain interaction.


### Brain-to-Brain Interaction at a Distance: A Study Based on EEG & MEG Analysis

– Journal of Consciousness • June, 2018

This paper presents a summary of research conducted between 2014 and 2018 regarding the possibility of mental interaction between pairs of sensorially isolated subjects. A total of 85 experimental sessions were completed, during which the EEGs for each subject of the pair were recorded. The results confirm that subjects who are mentally connected online can display a significant transfer of information between them, with an increase in accuracy that averages from 12-18% over pure chance.


### Experimental Indications of Non-Classical Brain Functions

– Journal of Physics • Oct, 2022

Recent experiments on quantum-gravity show that an unknown non-classical mediator can create entanglement between two quantum systems. Applying this to the brain, proton spins serve as measurable quantum bits. Utilizing a zero quantum coherence protocol that suppresses classical signals, we detected heartbeat-like evoked signals throughout the brain that depended on conscious awareness. These findings imply that a consciousness-related mediator can generate entanglement as a mechanism for brain-to-brain communication at a distance.

## Research Papers for Haptic Stimulation


### Rhythm perception is shared between binaural audio and haptic stimulation

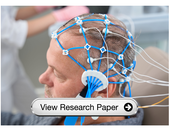
– Nature: Scientific Reports • Dec, 2022

In this study, we show striking similarities between the audio and haptic perception of rhythmic changes, and demonstrate the interaction of both modalities below 60 Hz. Using a new surface-haptic device to synthesize arbitrary audio-haptic textures, psychophysical experiments demonstrate that the perception threshold curves of audio and haptic rhythmic gradients are the same. These findings suggest that audio and haptic signals are likely to be processed by common neural mechanisms for the perception of rhythm, and provide a framework for audio-haptic stimulus.


### Haptic feedback in a virtual crowd scenario improves the emotional response

– Frontiers in Virtual Reality • Nov, 2023

This study aims to investigate the impact of kinesthetic haptics on eliciting emotional responses within virtual reality (VR) scenarios. Specifically, we examined the influence of haptic feedback on the perception of positive and negative emotions. We designed and developed different combinations of tactile and torque feedback devices and evaluated their effects on emotional responses. The results suggest that varying the type of haptic feedback can evoke different emotional responses, and we observed that participants' sense of touch being real was enhanced.




### Comparing vibrotactile stimulation to visual and auditory stimuli for 40 Hz gamma wave entrainment

– University of Colorado • Jan, 2026

In this study, we compared another sensory modality—vibrotactile stimulation delivered with a glove—to visual and auditory stimulation in 15 participants in terms of EEG responses and subjective experience. We found that vibrotactile stimulation could evoke 40 Hz EEG responses in the central, frontal and occipital cortices. We also observed distinct patterns of functional connectivity between the two stimulation modalities. Participants preferred the vibrotactile stimulation over the visual and auditory stimulation, and our study supports future investigations on vibrotactile stimulation.


### Synchronization of sensory gamma oscillations promotes multi-sensory communication

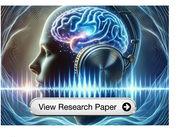
– eNeuro Journal • Sept, 2019

In this study, congruent stimuli are proposed to be mediated by increased binding between sensory cortices through coherent gamma haptic oscillations. We tested this hypothesis by applying 4-in-1 multi-electrode transcranial alternating current stimulation (tACS) with 40 Hz over visual and somatosensory cortices. Our results favor the perspective that processing multi-sensory congruence involves cortico-cortical communication rather than feature binding. Furthermore, we found control stimulation over the irrelevant hemisphere to speed responses under alpha stimulation.


### Preliminary study on haptic-stimulation based brain wave entrainment

– IEEE Xplore • Dec, 2013

Auditory and visual stimulation have been widely used for brainwave entrainment, and in this study we determine whether similar phenomena exists with haptic stimulation. By using a Phantom desktop to provide sinusoidal force stimulation, and using a Nexus EEG device for real-time brain signal monitoring, we test how the Sensory Motor Rhythm (SMR) signal of the subject responds to the haptic stimulation. Our experiments show that the energy level of SMR tends to increase 10~30% after 10-15 minutes of haptic stimulation with a 15 Hz stimulation signal.

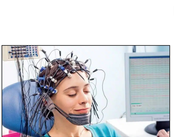



### Affective haptics: current research and future directions

– IEEE Journal • Feb, 2016

Affective haptics is an emerging field which focuses on the evaluation of systems that can capture or display emotions through the sense of touch. We first introduce affective haptics as a multidisciplinary field that integrates computing, haptic technology, and user experience. Second, we provide a thorough discussion about the effectiveness of using the haptic channel to communicate affective information. We present the conclusions that haptic stimulation can be successfully used to achieve a high level of emotional telepresence, and have demonstrated that it is effective in communicating an emotional response.

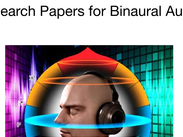
## Research Papers for Binaural Audio




### Theta and beta binaural audio for brain entrainment: an EEG analysis

– Frontiers in Psychology • Nov, 2021

The purpose of this research was to investigate whether binaural audio (specifically within theta and beta EEG bands) improves brain wave entrainment. To achieve this aim, 20 healthy volunteers were stimulated with personalized theta and beta binaural music for 20 min, and their EEG signals were collected using 22 channels. Results showed larger absolute power differences for binaural stimulation on bilateral temporal and parietal regions, and revealed alpha band desynchronization in the parieto-occipital region. Resynchronization was met with both theta and beta binaural music.




### A parametric investigation of binaural audio for brain wave entrainment

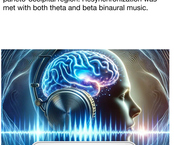
– Nature: Scientific Reports • Feb, 2025

This study experimentally tested the effects of binaural audio on both sustained attention and brain wave entrainment. 80 participants were randomized for cross-over comparison of binaural vs. control auditory stimulation. EEG data were collected to validate brain wave entrainment. Gamma frequency binaural music with a low carrier tone improved the general attention performance, suggesting binaural audio may modulate cognitive aspects rather than sustained focus. EEG results confirmed brain entrainment, which varied with binaural parameters and background noise.


### Brain wave synchronization in alpha, beta, and theta bands using binaural audio

Journal of Neuro Physiology • Nov, 2021

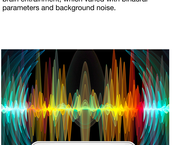
This study aimed to determine the effect of synchronization of brain waves in alpha, beta, and theta bands by binaural beat stimulation on visuospatial working memory. 60 students were selected by the available sampling method and randomly divided into three experimental groups and one control group (n=15 each). Participants in the experimental groups received binaural music stimulation of 15, 9, 5, and 6 Hz for 12 min. The findings showed that 15 Hz binaural music in the beta bands had significantly improved the subject's visuospatial working memory.




### Binaural auditory stimulation and its effects on mood states, cognition and health

– Frontiers in Psychiatry • May, 2015

Binaural audio stimulation is a promising new tool for the manipulation of cognitive processes and the modulation of mood states. Here, we review the literature examining the most current applications of auditory beat stimulation and its targets. We discuss the role of monaural and binaural-beat frequencies in cognition and mood states, in addition to their efficacy in targeting disease symptoms. We aim to highlight important points concerning stimulation parameters and try to address why there are often contradictory findings with regard to the outcomes of binaural stimulation.




### The effects on human mental states of spatially moving binaural audio stimulation

– PLOS One Journal • Jul, 2024

In this study, we hypothesized that the impact of binaural audio on cognition and EEG is linked to the spatial characteristics of the sound. Participants listened to spatially moving sounds at 6Hz and 40Hz frequencies, and EEG measurements were conducted throughout the auditory stimulation. The results indicated that binaural stimulation had a more pronounced effect on electrical brain activity than the control condition. Additionally, these findings support our hypothesis that the impact of auditory stimulation lies in the spatial attributes rather than the sensation of binaural beats.


### Binaural beats through auditory pathways: from brainstem to connectivity patterns

– eNeuro Journal • Mar, 2020

In this study we show that binaural audio can both entrain the cortex and elicit specific connectivity patterns. To do so, we compared the effects of binaural beats with a control beat stimulation (monaural beats, known to entrain brain activity but not mood). Both stimuli elicited standard subcortical responses at the pure tone frequencies of the stimulus, and entrained the cortex at the beat frequency. Furthermore, functional connectivity patterns were modulated differentially by both kinds of stimuli, with binaural beats being the only one eliciting cross-frequency activity.

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