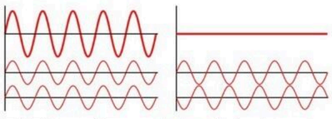
# Wave interference

Article Talk

*For interference in radio communications, see Interference (communication).*

*"Interference pattern" redirects here. For Moiré patterns, see Moiré pattern. For the medical term, see Interference pattern (electromyography).*

In physics, **interference** is a phenomenon in which two coherent waves are combined by adding their intensities or displacements with due consideration for their phase difference. The resultant wave may have greater amplitude (**constructive interference**) or lower amplitude (**destructive interference**) if the two waves are in phase or out of phase, respectively. Interference effects can be observed with all types of waves, for example, light, radio, acoustic, surface water waves, gravity waves, or matter waves as well as in loudspeakers as electrical waves.



The interference of two waves. In phase: the two lower waves combine (left panel), resulting in a wave of added amplitude (*constructive* interference). Out of phase: (here by 180 degrees), the two lower waves combine (right panel), resulting in a wave of zero amplitude (*destructive* interference).

# Neural synchrony

Article Talk

*This article is about the correlation of brain activity across two or more people. For the general concept in a single nervous system, see Neural oscillation.*

**Neural synchrony** is the correlation of brain activity across two or more people over time. In social and affective neuroscience, neural synchrony specifically refers to the degree of similarity between the spatio-temporal neural fluctuations of multiple people. This phenomenon represents the convergence and coupling of different people's neurocognitive systems, and it is thought to be the neural substrate for many forms of interpersonal dynamics and shared experiences. Some research also refers to neural synchrony as inter-brain synchrony, brain-to-brain coupling, inter-subject correlation, between-brain connectivity, or neural coupling.

Research exploring the physiological effects of Schumann Resonance (SR) and the concept of phase-locking is largely speculative, but some studies have investigated correlations between the Earth's natural electromagnetic (EM) field and human biology. The central theory of phase-locking is that the human brain and other biological rhythms may synchronize, or entrain, with the Earth's natural electromagnetic pulsations, specifically the fundamental SR frequency of 7.83 Hz.

This idea is still a subject of scientific investigation, and evidence of a direct, causal link is limited. However, the concept is supported by the fact that the brain operates on a bioelectrical basis and that the fundamental SR frequency overlaps with human brainwave patterns.

## Proposed mechanisms of phase-locking

Researchers propose several ways the extremely low-frequency (ELF) Schumann Resonance could physiologically influence the body:

- **Brainwave entrainment:** The brain's electrical activity naturally produces different frequency bands, such as theta waves (4–8 Hz) and alpha waves (8–12 Hz). The fundamental SR frequency of 7.83 Hz sits directly in the crossover region between these two states, which are associated with deep relaxation, meditation, and calm alertness. Proponents suggest that the brain can naturally align with or be "entrained" by the SR frequency, promoting these peaceful states.
- **Modulation of cellular processes:** Extremely low-frequency electromagnetic fields may influence the flow of ions, such as calcium ( $Ca^{2+}$), across cell membranes. Since calcium ions are critical for nerve cell communication, muscle contraction, and other cellular signaling processes, modulating their movement could affect brain function, heart rhythms, and overall health.
- **Impact on the autonomic nervous system (ANS):** The autonomic nervous system regulates involuntary bodily functions like heart rate, blood pressure, and breathing. Some research has found correlations between geomagnetic activity, SR power, and changes in heart rate variability (HRV), which is a key indicator of ANS balance. Exposure to SR-matched frequencies has been shown to reduce stress and normalize blood pressure in some studies.
- **Regulation of circadian rhythms:** Natural electromagnetic fields, including the SR, are thought to serve as a metronome or synchronizing signal for the body's internal biological clock. For instance, SR may influence melatonin and serotonin levels, which are critical for regulating sleep-wake cycles. Disruption of the SR, such as by exposure to artificial electromagnetic fields (EMFs) or the absence of the Earth's field in space, has been linked to fatigue and sleep issues.

Inter-brain synchrony is the physiological phenomenon where the brain activity of two or more people becomes coupled and synchronized during social interaction. It is thought to be a mechanism for social interaction that involves the matching of neural oscillations, such as EEG rhythms, between individuals. This synchrony is associated with increased social connection, understanding, and performance in joint tasks, and is mediated by the release of neurochemicals like oxytocin and dopamine.

## Physiological mechanisms and evidence

- **Neural Oscillations:** Inter-brain synchrony is primarily observed by measuring the synchronization of brain rhythms (e.g., alpha, beta, gamma waves) between individuals using techniques like EEG hyperscanning.
- **Brain Regions:** Synchronous activity is often observed in frontal and temporal-parietal regions during coordinated tasks like joint finger tapping, communication, and creative activities.
- **Neurochemical Influence:** The process is linked to the release of neurochemicals. For example, synchronized interactions can trigger the release of oxytocin, which promotes trust, and dopamine, which enhances reward and value.
- **Hyper-brain Modules:** In some cases, synchronized activity between brains can lead to the formation of "hyper-brain modules," which are areas in different brains that work together in a synchronized fashion to enhance interpersonal behavior.

## Behavioral and social outcomes

- **Improved Social Interaction:** Inter-brain synchrony facilitates social connection and is associated with more positive relational outcomes. It helps individuals adjust and update their responses in real-time with their interaction partners.
- **Enhanced Performance:** Synchrony is linked to better performance in collaborative tasks, from joint action and decision-making to creative endeavors and learning.

wavelength".

- **Increased Sociality:** This phenomenon is thought to have played a role in the evolution of sociality, as synchronized experiences are often enjoyable and reinforce social bonds.