

## **Conscious and unconscious perception and their relation to short and long-range synchronization**

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In my talk I will present evidence which suggests that long-distance synchronization in the gamma frequency range plays a crucial role in conscious perception. I will present several studies where long-distance synchronization and local gamma synchronization were measured during the presentation of visible versus invisible words and letters.

We hypothesize that brain states associated with conscious processing should be characterized by a high degree of synchrony, i.e. temporal coherence of activity between distant cerebral assemblies, whereas unconscious processing would be characterized by local synchronization. In a first experiment we studied the sequence of electrophysiological events leading to conscious perception. We found that the earliest electrophysiological marker that distinguished visible from invisible stimuli was a brief burst of long-range synchrony in the gamma frequency range. In a second experiment we studied how bottom-up information is modulated by top-down representations. Higher-order representations might serve the crucial role of stabilizing percepts and bringing them into conscious perception in an environment where stimuli can be either ambiguous or where constant changes in low-level stimulus parameters occur (e.g., contrast variations). It is currently unknown how such top-down influence is reflected in brain activity, and how neuronal activity related to perceptual awareness is modulated by top-down and bottom-up influences. To investigate this question, we measured electroencephalographic activity in a visual paradigm where we generated perceptual hysteresis by gradually increasing and then decreasing the visibility of an initially hidden stimulus in a stepwise manner. Under these conditions, perceptual hypotheses are built up as soon as the subject perceives the stimuli, which in turn increases the visibility of subsequent lower contrast stimuli. Our behavioral results confirmed this effect by demonstrating a shift in the visibility threshold. In addition, we found that long distance synchronization correlates with conscious perception (seen vs. unseen stimuli), whereas gamma oscillations correlate with the hysteresis phenomenon itself, i.e. the

presence or absence of a preceding top-down concept. Furthermore, analysis of event-related potentials showed that impoverished stimuli that are visible due to top-down effects correlate with lower amplitude of the P2 and P3 component (repetition suppression).

In summary, our studies suggest that precise synchronization of oscillatory neuronal responses in the high frequency range plays an important role in gating the access of sensory signals to the workspace of consciousness.