"Category-specific visual responses: an intracranial study comparing gamma, beta, alpha and ERP response selectivity"

By Juan R Vidal (INSERM U821, Brain Dynamics & Cognition)

Summary

The specificity of neural responses to visual objects is a major topic in visual neuroscience. In humans, functional magnetic resonance imaging (fMRI) studies have identified several regions of the occipital and temporal lobe that appear specific to faces, letter-strings, scenes, or tools. Direct electrophysiological recordings in the visual cortical areas of epileptic patients have largely confirmed this modular organization, using either single-neuron peri-stimulus time-histogram or intracerebral event-related potentials (iERP). In parallel, a new research stream has emerged using high-frequency gamma-band activity (50-150 Hz) (GBR) and low-frequency alpha/beta activity (8-24 Hz) (ABR) to map functional networks in humans. An obvious question is now whether the functional organization of the visual cortex revealed by fMRI, ERP, GBR, and ABR coincide. We used direct intracerebral recordings in 18 epileptic patients to directly compare GBR, ABR, and ERP elicited by the presentation of seven major visual object categories (faces, scenes, houses, consonants, pseudowords, tools, and animals), in relation to previous fMRI studies. Remarkably both GBR and iERP showed strong category-specificity that was in many cases sufficient to infer stimulus object category from the neural response at single-trial level. However, we also found a strong discrepancy between the selectivity of GBR, ABR, and ERP with less than 10% of spatial overlap between sites eliciting the same category-specificity. Overall, we found that selective neural responses to visual objects were broadly distributed in the brain with a prominent spatial cluster located in the posterior temporal cortex. Moreover, the different neural markers (GBR, ABR, and iERP) that elicit selectivity towards specific visual object categories present little spatial overlap suggesting that the information content of each marker can uniquely characterize high-level visual information in the brain.