

Abstract

The ability to recognize objects under ambiguous conditions is a critical neural function essential for adaptive behavior. This project aims to characterize the spatio-temporal evolution of categorical information in the human brain and to determine how these neural representations are systematically altered by sensory uncertainty. We are analyzing intracranial electrocorticography (ECoG) data from human subjects performing a visual categorization task on images of faces and houses embedded in varying levels of noise. Our initial hypothesis was that increasing levels of noise would systematically degrade the neural representation of these object categories. In our qualitative review of the high-gamma activity (HGA) and event-related potential (ERP) plots, we have begun to see the dynamics of this process. Preliminary results indicate a very strong and localized HGA increase in face-selective cortical areas upon presentation of a face stimulus. A less potent, but still significant, activation was observed in house-selective areas for the same stimuli. We found that the neural representation in face-selective areas is remarkably robust to sensory degradation; significant activity persists until the noise level approaches a 50% threshold, at which point it diminishes abruptly. In contrast, the activity in house-selective areas degrades more gradually and at lower noise levels. These initial findings support our hypothesis and suggest that the neural mechanisms for face perception are not only highly specialized but also possess a greater tolerance to sensory uncertainty compared to other object categories. The sharp performance drop-off suggests a potential "breaking point" in the evidence accumulation process. While these results are preliminary, they provide a strong foundation for our primary goal. Future work will involve testing these qualitative findings using a full multivariate decoding analysis across all electrodes to get statistical results and build a comprehensive spatio-temporal map of how the brain maintains robust object perception amidst sensory noise.

Keywords: object recognition, sensory uncertainty, electrocorticography (ECoG), high-gamma activity (HGA), face perception, multivariate decoding, neural dynamics, visual categorization.