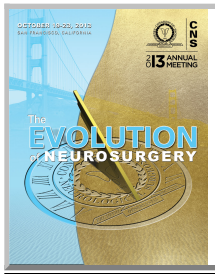

How Context Influences the Physiology of Perception: The Sub-second Dynamics of Repetition Suppression in Inferior Temporal Cortex

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Introduction

Inferior temporal brain areas are known to have sub-regions that are specialized for processing specific categories of stimuli; the “fusiform face area” is the most well known of these. These areas have primarily been identified using functional MRI (fMRI). Because of the ~5s timescale fMRI averages over, the fine temporal dynamics of category-specific processing remain unknown.

Methods

In this study, electrocorticographic (ECoG) electrodes were placed on the inferior temporal brain surface for seizure monitoring. Simple pictures of faces and houses (with blank screen in between) were shown for 400ms at a time. A real-time correlate of local neural population activity, so-called “broadband spectral change”, was extracted from the ECoG power spectrum.

Results

Broadband change reveals a robust category-specific response to each type of stimulus in adjacent cortical sites (1-2cm apart), with face-specific loci lateral to house specific loci. Single stimuli were classified with ~98% accuracy, with peak inferotemporal response 200-250ms post-presentation. Portions of the percept-to-percept response variability could be explained by stimulus repetition: peak activity is faster and the total activity is greater for novel stimuli (e.g. faces following houses and vice-versa), than it is for repeated within-class stimuli.

Learning Objectives

1) understand how population dynamics in the visual stream are captured for single perceptual events on the timescale of ~10 milliseconds.

2) understand how repetition suppression is a cortical process for augmenting perception of novelty (rather than actually reflecting suppression).

Conclusions

Repetition suppression has been proposed as either an effect of the engaged visual pathway being "optimized for efficiency" by requiring less population activity for processing - with accelerated dynamics, versus being "optimized for novelty" by allocating more computational resources for novel stimuli. These findings demonstrate that, at the population level, the brain is optimized for novelty. Novel types stimuli are allocated more computational power - with faster processing time - from category-specific inferotemporal neuronal populations.

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