

Category-Specific Excitatory and Inhibitory Processes in Human Extrastriate Cortex

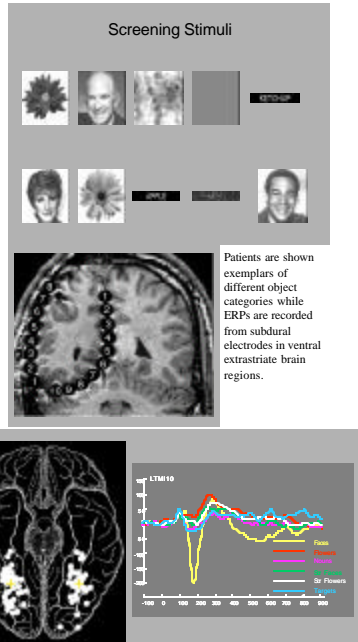
Truett Allison[†], Aina Puce^{*}, and Gregory McCarthy[‡]

[†]Department of Neurology, Yale University School of Medicine, ^{*}Brain Sciences Institute, Swinburne University of Technology
[‡]Brain Imaging and Analysis Center, Duke University Medical Center

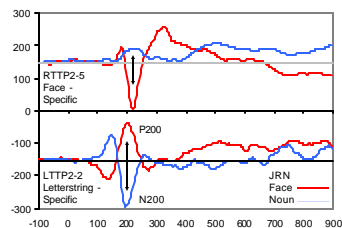
INTRODUCTION

Single-cell recordings from the temporal lobe of monkeys viewing stimuli show that cells may be highly selective, responding for example to particular complex non-objects (e.g. Fujita et al., 1992) or to objects such as faces (e.g. Perrett et al., 1992). However, stimulus-selective cells may be inhibited by non-preferred stimuli (e.g. Perrett et al., 1991). Can such inhibitory "sharpening" mechanisms be detected in human visual cortex? The fusiform gyrus generates N200 ERPs to specific categories of stimuli such as faces and words (e.g. Allison et al., 1999). Laminal recordings and CSD analysis in animal cortex (e.g. Mehta et al., 2000) suggest that the human N200 reflects excitatory depolarizing potentials in apical dendrites of pyramidal cells. We found that 26% of face-specific N200 sites generate a P200 ERP to words. Conversely, 56% of word-specific sites generate P200s to faces. P200 likely reflects hyperpolarizing inhibition of apical dendrites. These results suggest that: cells responsive to one stimulus category inhibit cells responsive to another category; inhibition of word-specific cells by faces appears to be stronger than the converse; inhibition also requires energy, hence it is likely that fMRI studies of face and word processing activate areas involved both in "center" excitation and "surround" inhibition

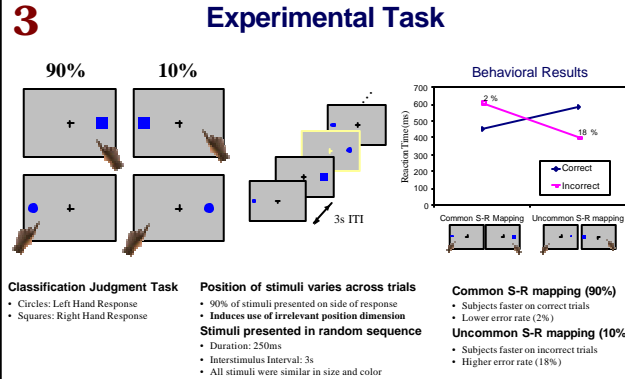
1 Category-Specific ERPs in Extrastriate Visual Cortex



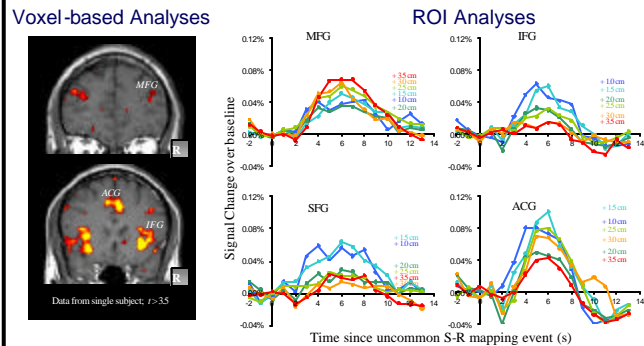
2 General Method



Study I: Stimulus-Response Mapping

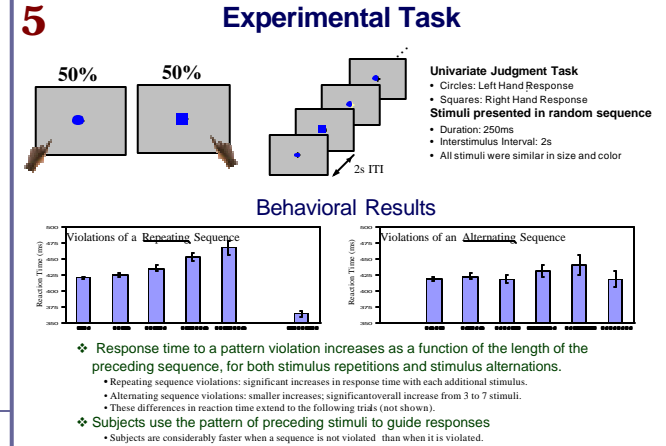


4 fMRI Results: PFC activity is modulated by changes in perceived S-R mapping

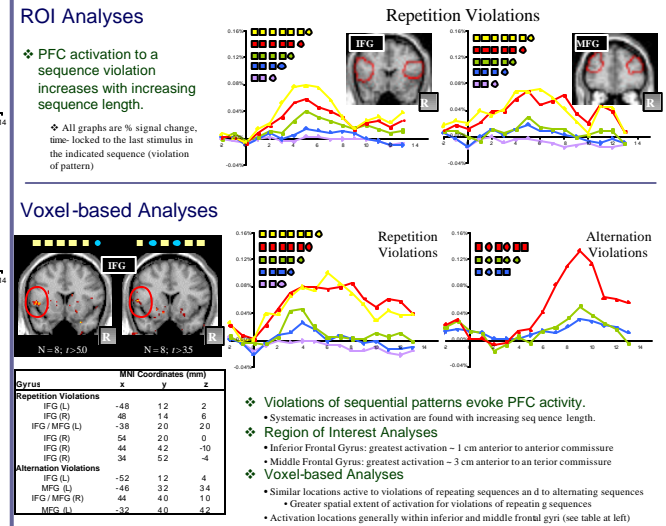


- These results extend previous studies using Oddball paradigms: Infrequent S-R mappings, not response or stimulus novelty, elicit PFC activation
 - Activation to uncommon stimulus-response mapping trials evoked activity in IFG, MFG, SFG, and ACG.
 - No activity was observed in white matter control regions for such trials.
- ROI analyses: Anterior-posterior patterns of activation differ across gyri
 - Inferior frontal gyrus: posterior → anterior with greatest activation - 1 cm anterior to AC.
 - Middle frontal gyrus: anterior → posterior, with greatest activation - 3.5 cm anterior to AC.
 - Superior frontal gyrus: posterior → anterior with greatest activation - 1.5 cm anterior to AC.
 - Anterior cingulate gyrus: posterior → anterior with greatest activation - 1.5 cm anterior to AC.
- Voxel-based analyses: ACG, IFG, and MFG foci
 - Across subjects, distinct foci of activation were found in three regions (all bilateral):
 - Inferior frontal gyrus: along inferior edge (ascending rami of Sylvian fissure) about 1 cm anterior to AC
 - Anterior cingulate gyrus: about 1 cm anterior to AC
 - Middle frontal gyrus: inferior edge of gyrus, usually about 3 cm anterior to AC

Study II: Stimulus Sequence



6 fMRI Results: PFC activity is modulated by stimulus sequence



CONCLUSIONS

- Prefrontal cortex activity is evoked by changes in response strategy on a trial-by-trial basis.

- These results extend previous oddball studies by demonstrating that infrequent stimulus-response mappings elicit PFC activity, independent of response changes.
- Similar results were found for violations of repeating and of alternating sequences, suggesting that PFC activity may be associated with changes in response strategy.