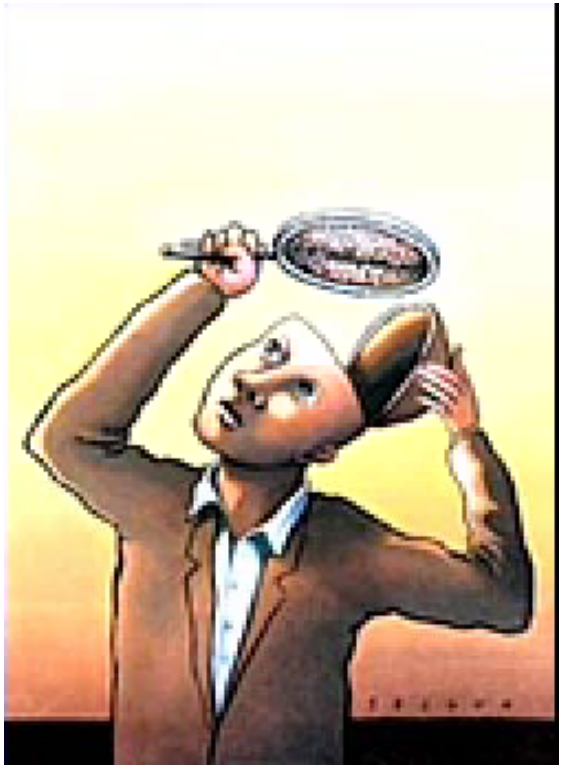
CGSC 6501F: **Neuroimaging Course**

Week1: Introduction



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Overview

- Assignments
- *CogSci: Interdisciplinary*

Complimentary (not substituent / reductive) methods to develop models and theories:

Cognitive-behavioral

Computational

constrained by

Neuroscientific

Scientific Methods and Cognitive Science (methods, tools, techniques)

- *a) **Experimentation***

Control

Decomposition

Inference

Tools and technique

Kuhn's paradigm shift

Experimentation Contd.

Behavioral measures:

- *Objective RT, Error etc.*
- *Subjective: report etc.*
- *Helps to validate neuroimaging but not always*

b) ***Computational***

- *Explict*
- *Visualized*
- *explanation*
- *Prediction sometimes*

*c) **Neuroimaging***

- *As a tool to provide biological evidence*
- *fMRI and ERP basis*
- *Design, Signal to noise etc.*
- *Constraining other methods (biological plausibility): Kuhn*
- *Bechtel: Decomposition Functionalism and structure*

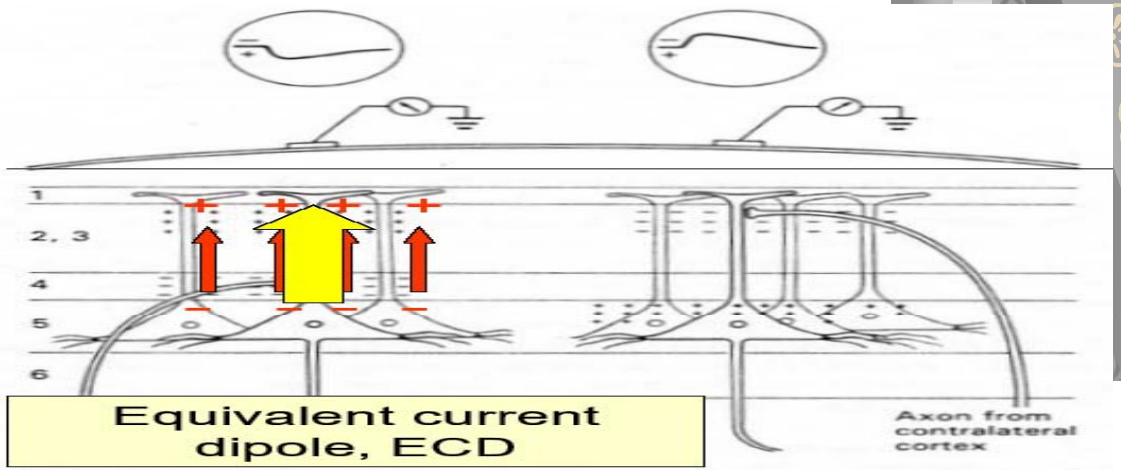
Neuroscientific Contd.

- *Neurophysiological*
- *Lesion (Real/virtual)*
- *Neuroimaging:*
- *E/MEG (Temporal)*
- *fMRI (noninvasive unlike X-ray CT PET Lesion Intracranial Drug)*
- *Basic=>resonance emit receive BOLD*
- *Preprocess-> Analysis: Epoch Event*
- *Spatial*
- *Spatial/temporal etc. tradeof (Table)*
- *Limits (more next week)*

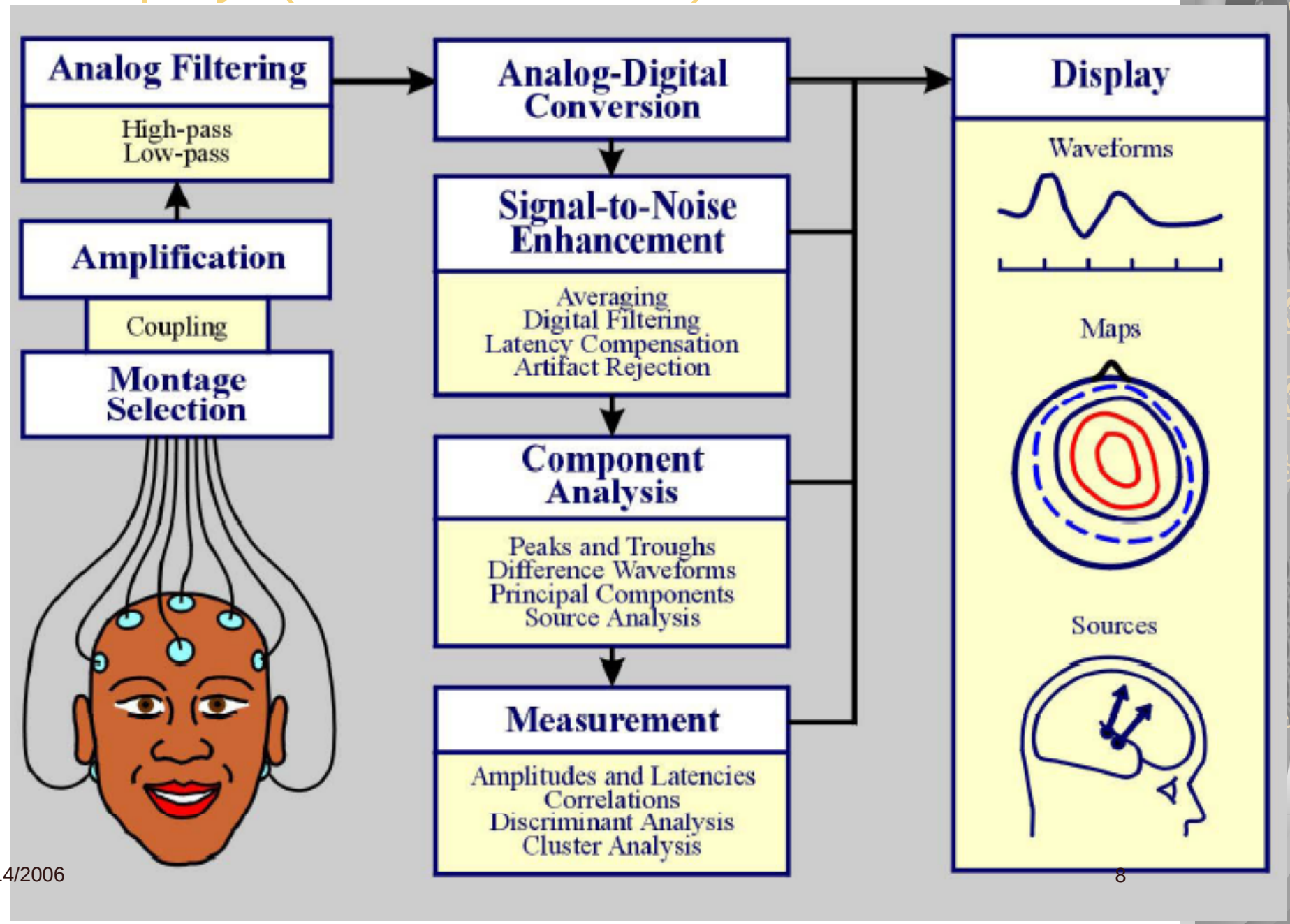
Overview: EEG

Electroencephalography (EEG) provides a direct measurement of the neuroelectric wave-form activity.

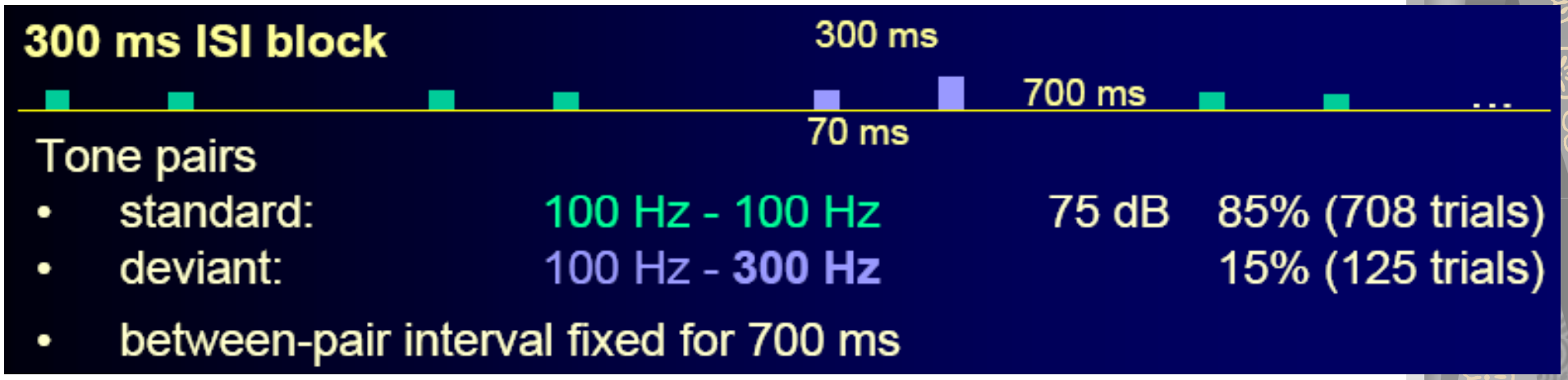
- **Equipment for EEG recording: amplifier unit, electrode cap, conductive jelly, injection, and aid for disinfection.**

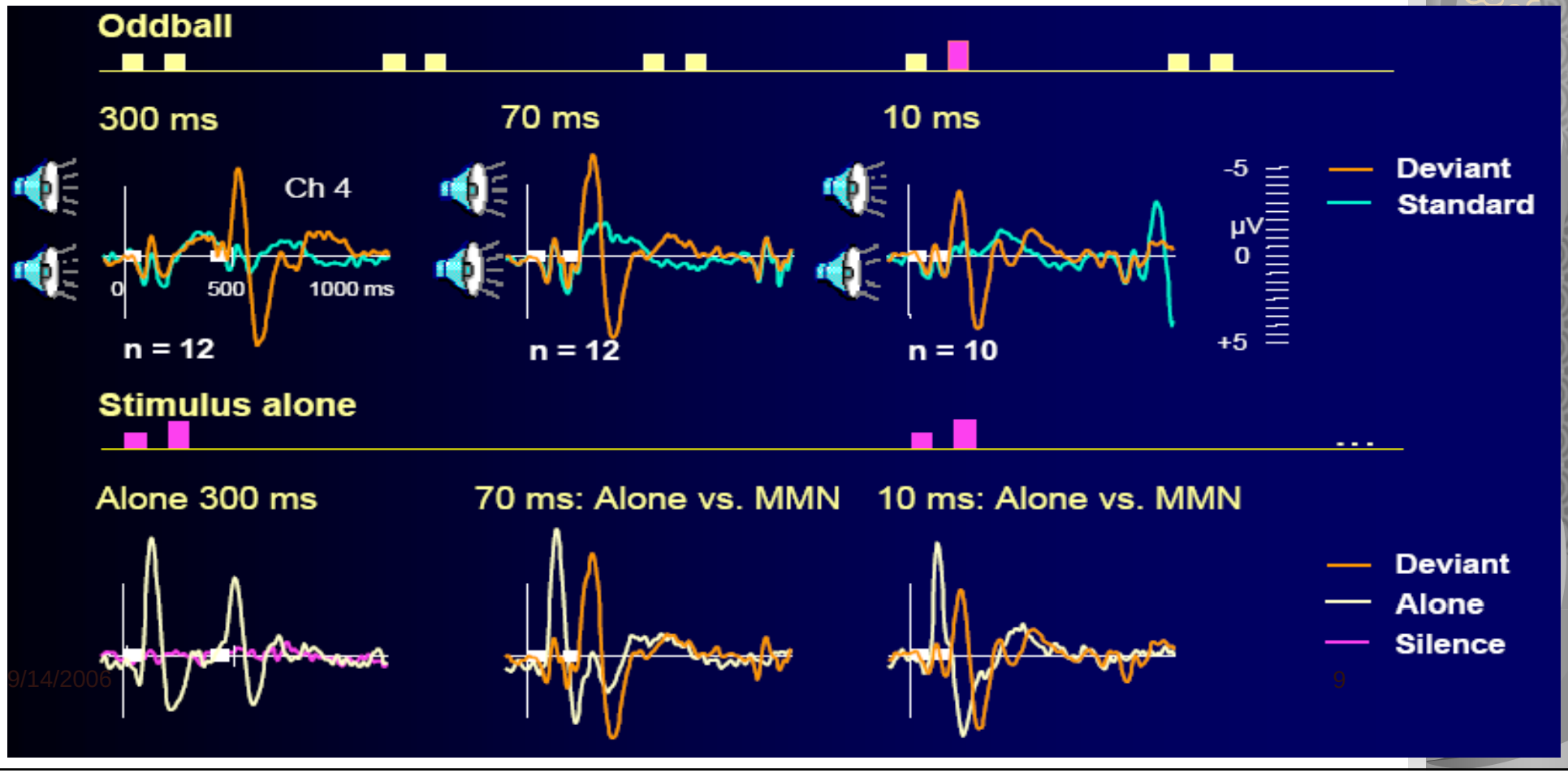


Overview: ERP Amplification, Analysis, and Display (source: internet)



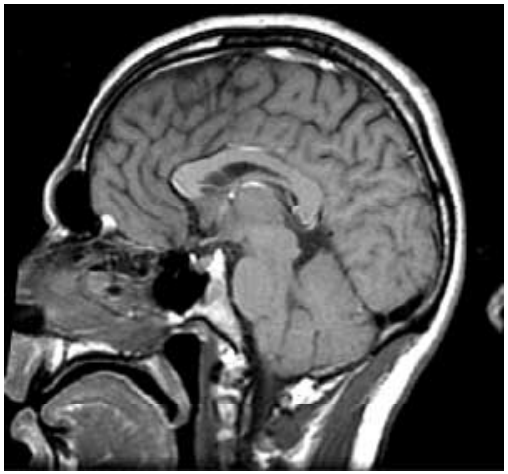
ERP experimental design (source internet)



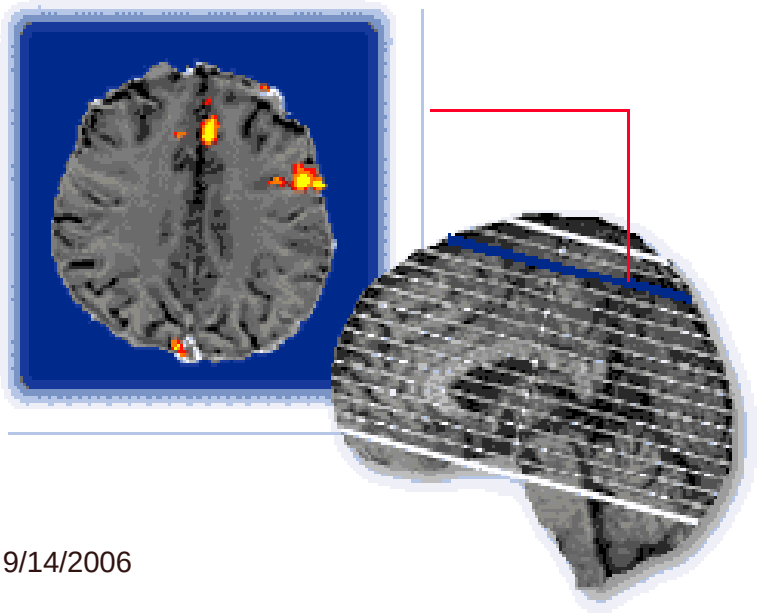


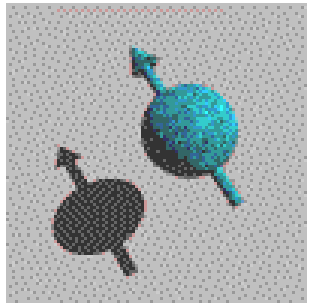
Magnetoencephalograghy (MEG)

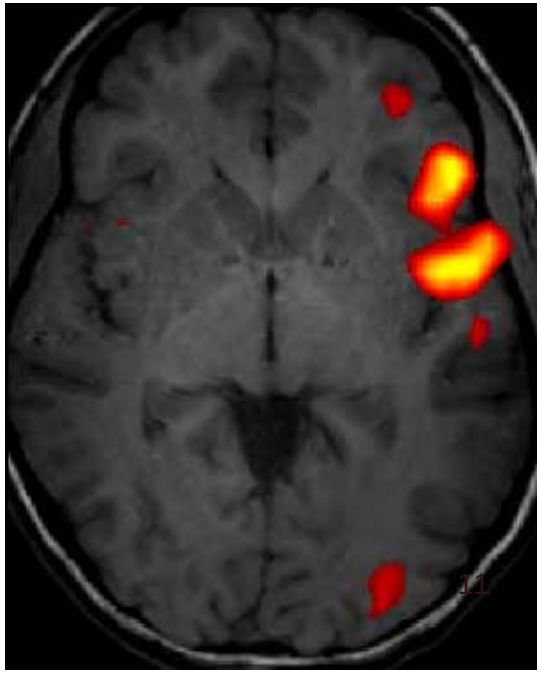
Overview: The MRI technology



Functional Neuroimaging shows locations of brain activated by cognitive tasks

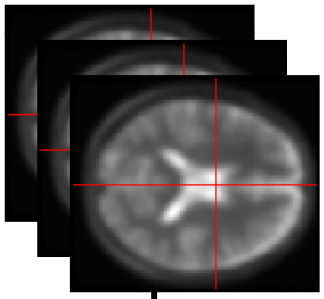




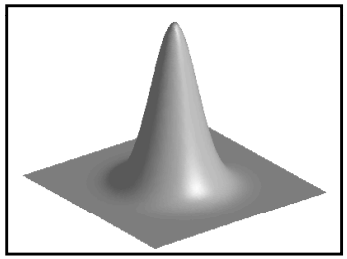


Overview: fMRI process (From SPM group)

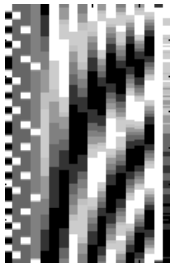
fMRI time-series



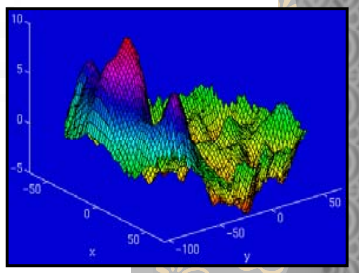
kernel



Design matrix



Statistical Parametric Map

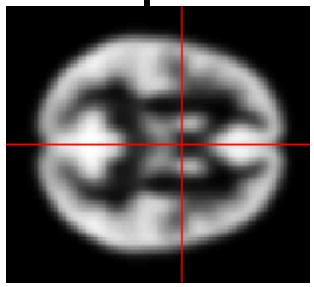


Motion correction

Smoothing

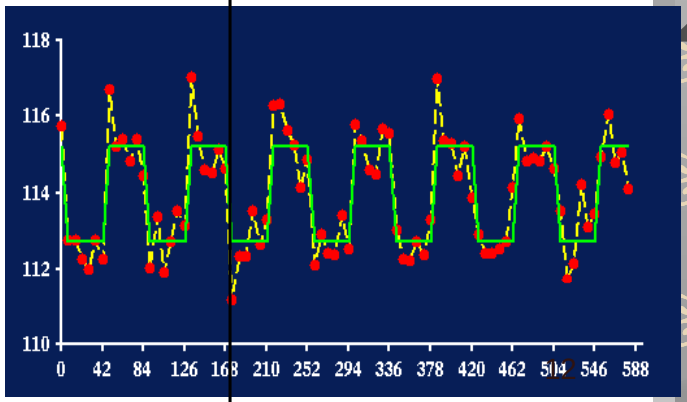
General Linear Model

Spatial normalisation

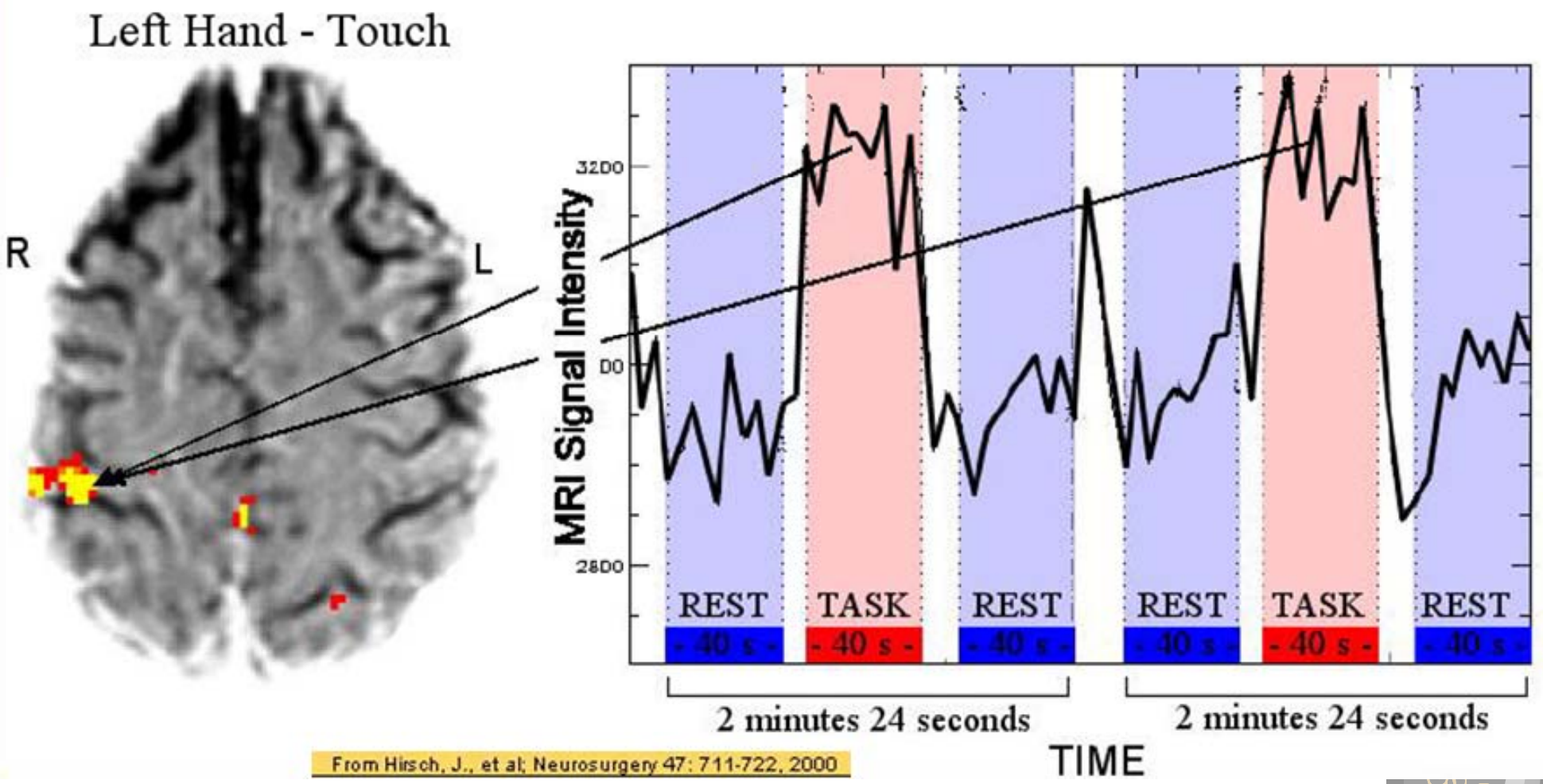


Standard template

Parameter Estimates

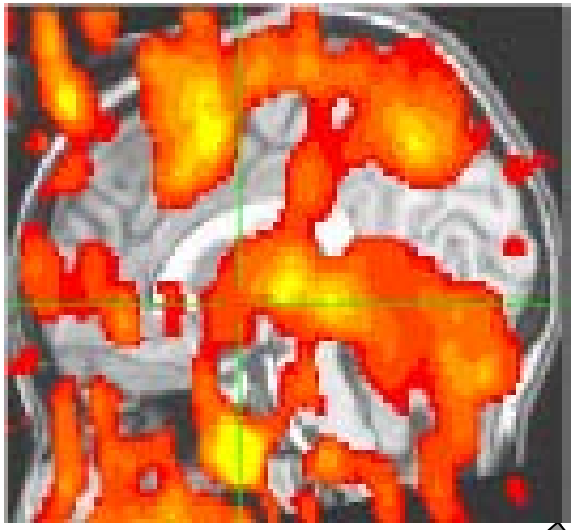


Magnetic Resonance Signals to Location of Function



From Hirsch, J., et al; Neurosurgery 47: 711-722, 2000

FUNCTIONAL Magnetic Resonance Imaging



Phrenology

Neuroimaging has been used for almost all functions:

face processing

word recognition

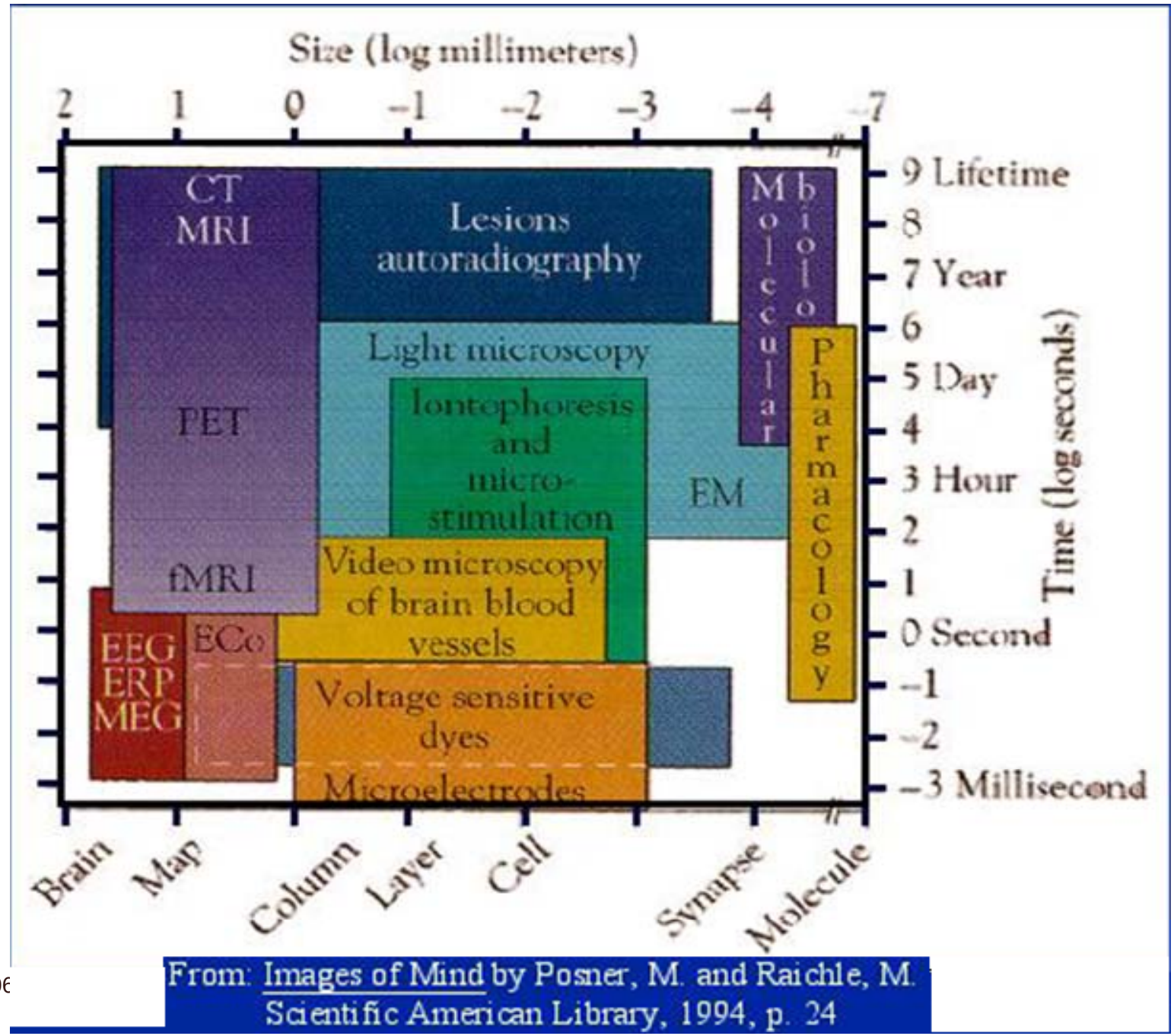
gum-chewing

tickling

meditation

religion

Tradeoff in using different techniques



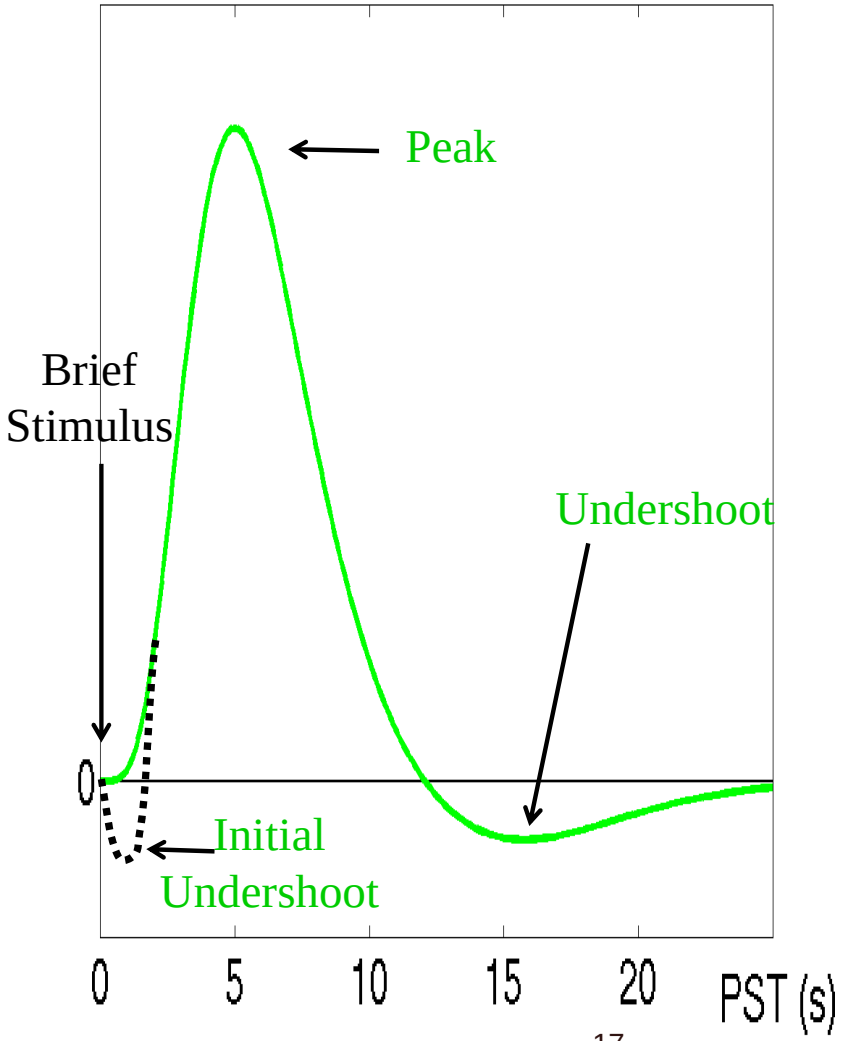
From: Images of Mind by Posner, M. and Raichle, M. Scientific American Library, 1994, p. 24

The Case of attentional control (Error/Conflict monitoring)

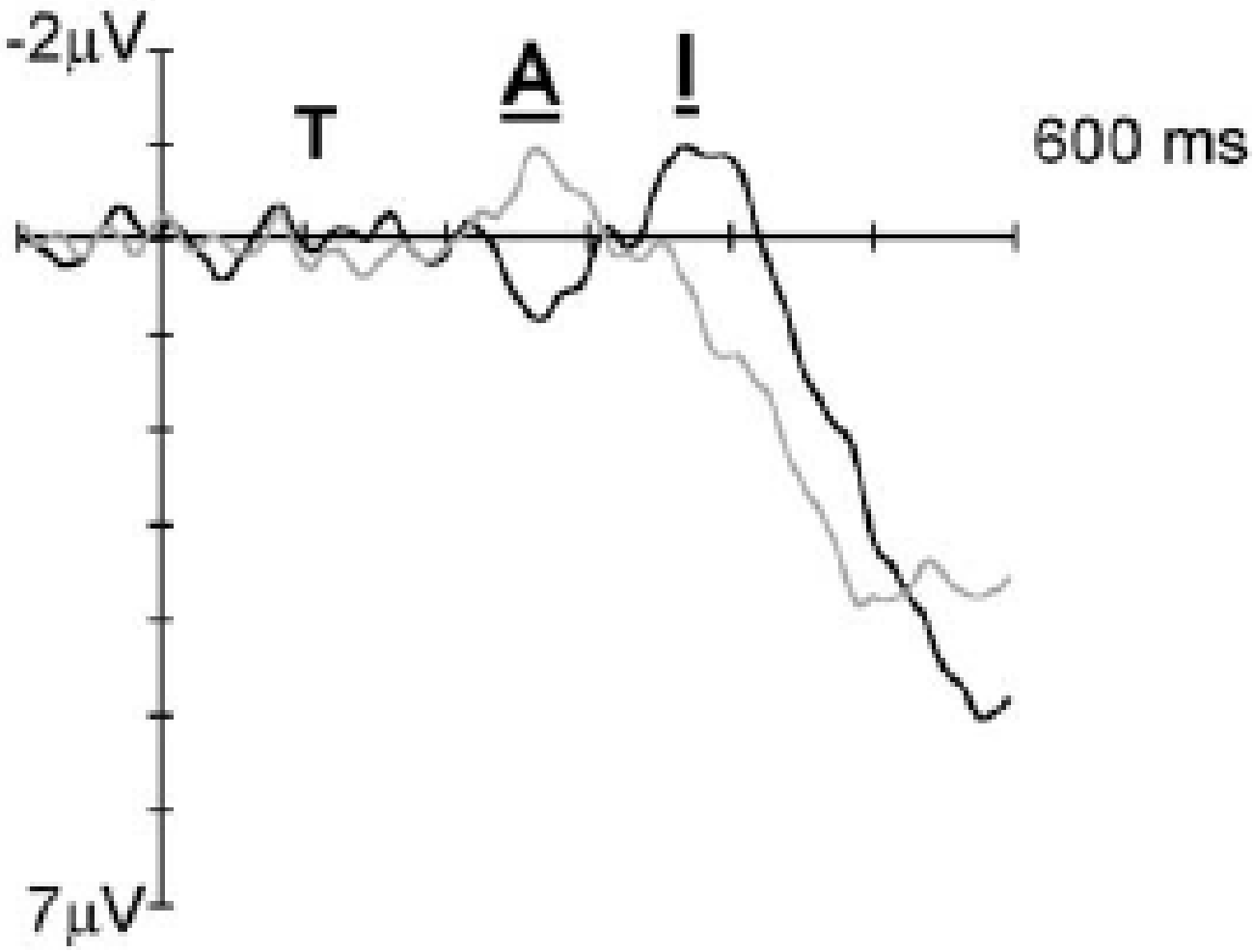
- *fMRI*
- ***ERP***
- *Modeling*
- *Philosophical*

BOLD Impulse Response

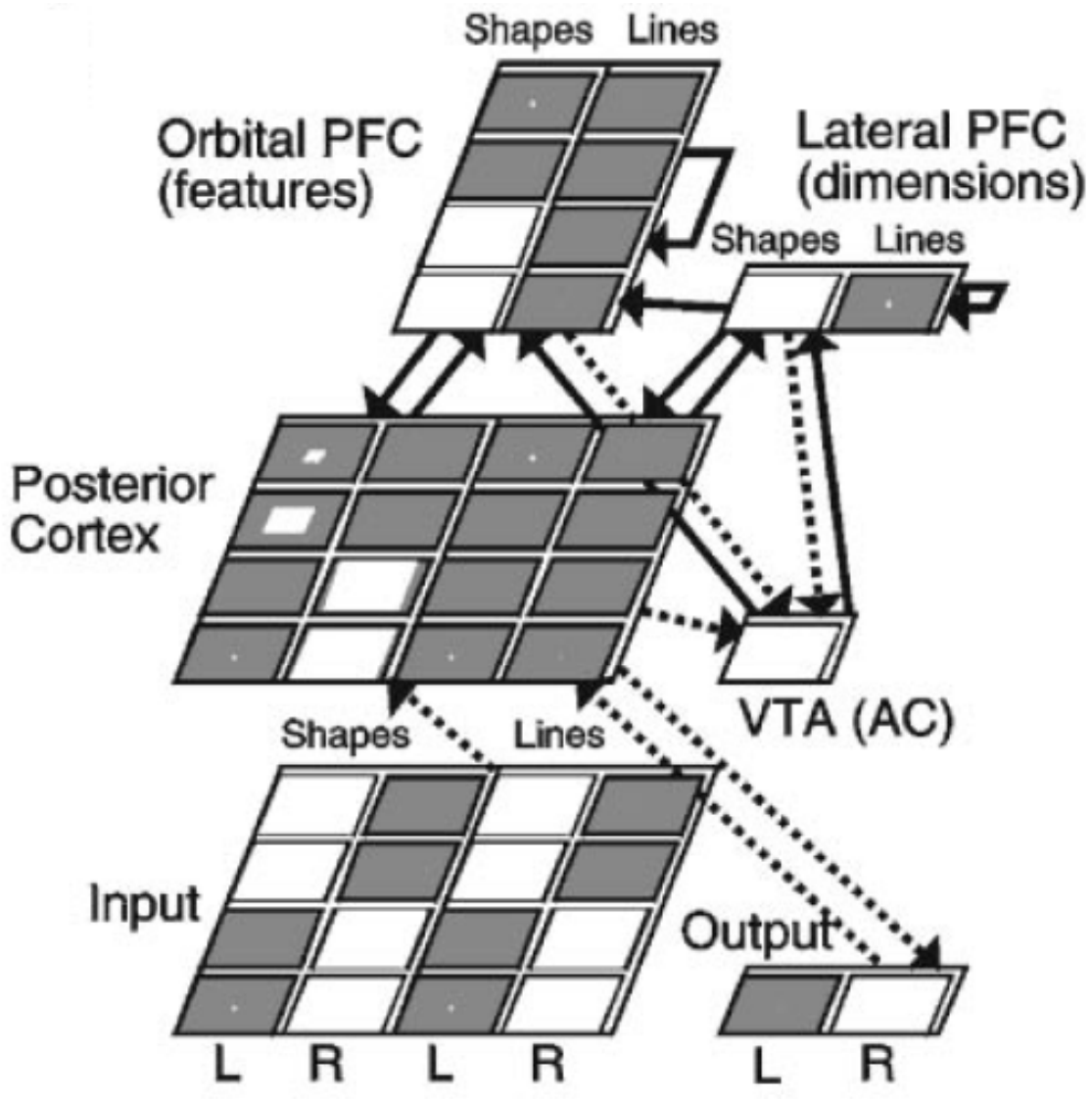
- Heamodynamic Function of BOLD, flow, volume (Buxton et al, 1998)
- Peak (max. oxygenation) 4-6s poststimulus; baseline after 20-30s
- Initial undershoot (Malonek & Grinvald, 1996)

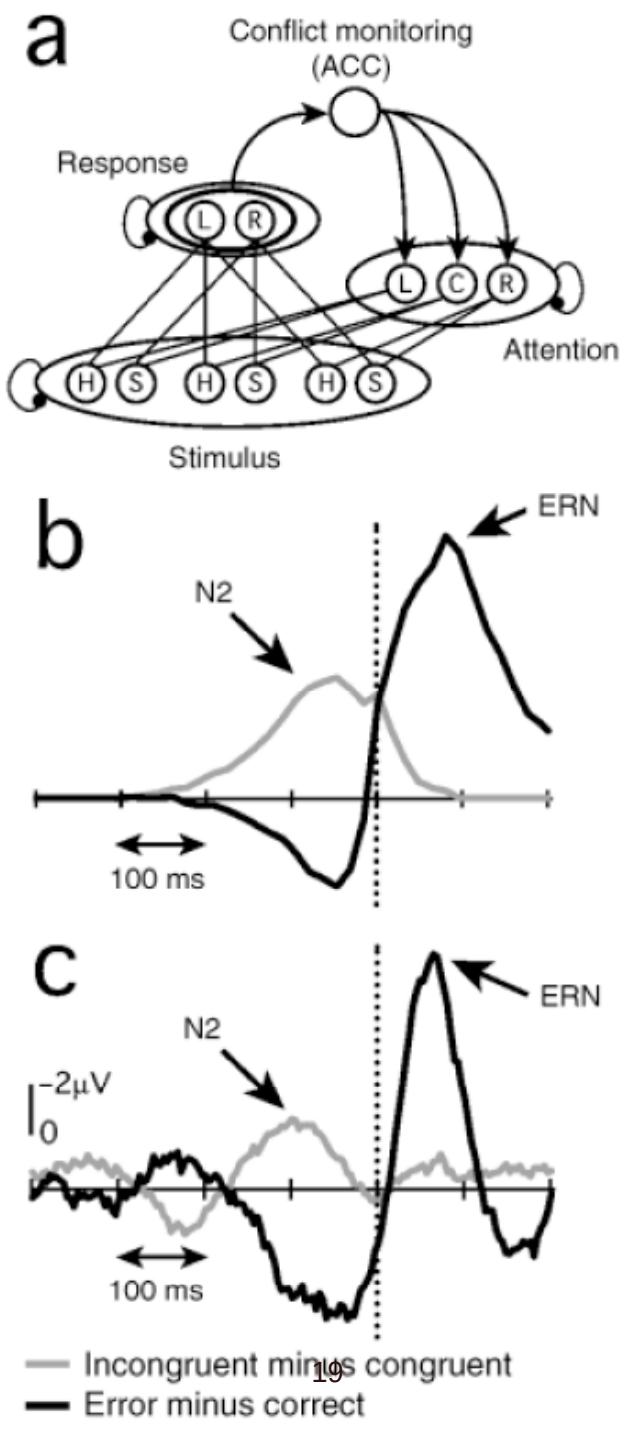


ERP



Recent computational models
O'Reily Yung Cohen





Conclusion

Behavioral:

- *Error: post error slowing Error-RT Patterns*
- *RT pattern and distribution*

Neurophysiology:

- *Direct recording: William et al*

ERP*: P3 (LC-ACC loop) N4*

fMRI *ACC 1-2 mPFC OFC 1-2*

Modeling*: Conflict*

Philosophical*: Homunculus Conflict Objective subjective*