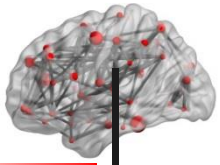
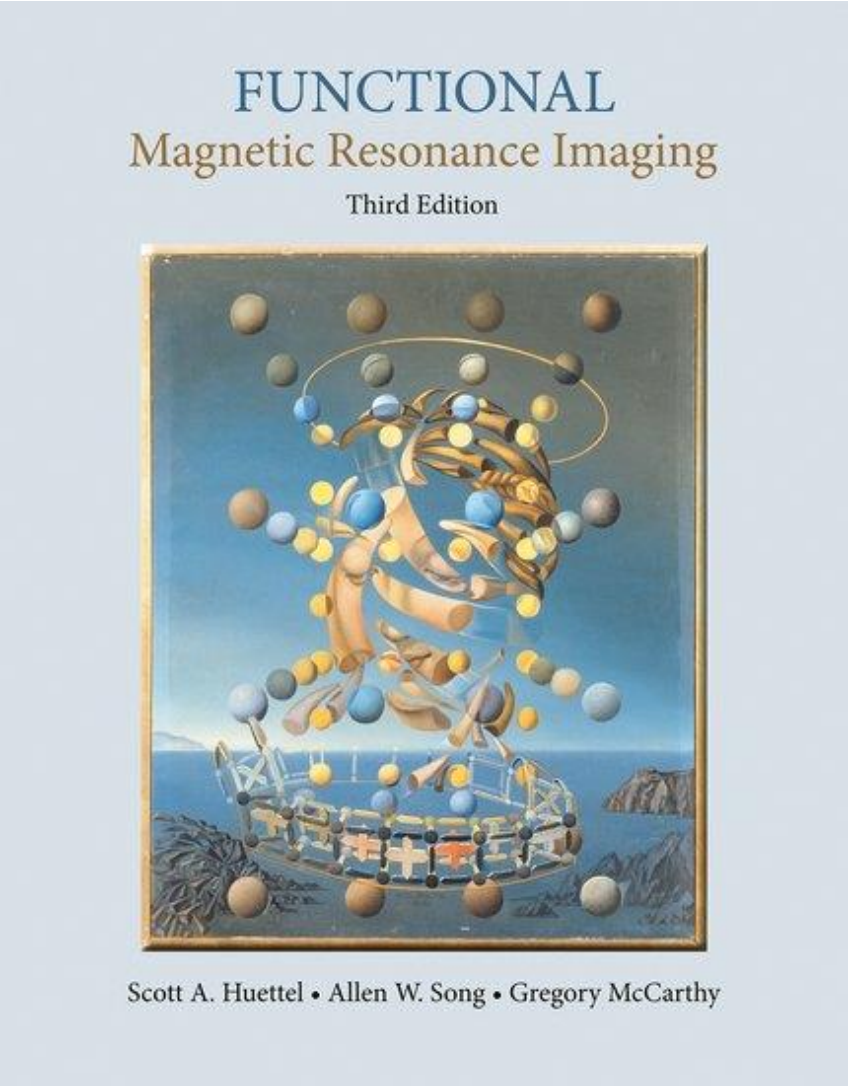


如何實際進行fMRI研究？

從問題發想、實驗設計到最新研究

國立臺灣大學醫學院 職能治療學系
國立臺灣大學醫學院 腦與心智科學研究所
吳建德

Main reference source



What types of research questions are appropriate?

- Questions per se are the most important!!!

- Understanding about the underlying neuromechanisms can help advance the field
  - knowledge
  - clinical implication

Example 1:
Is face processing domain specific or domain general?

associative visual agnosia
vs.
prosopegnosia

Example 1:
Is face processing domain specific or domain general?

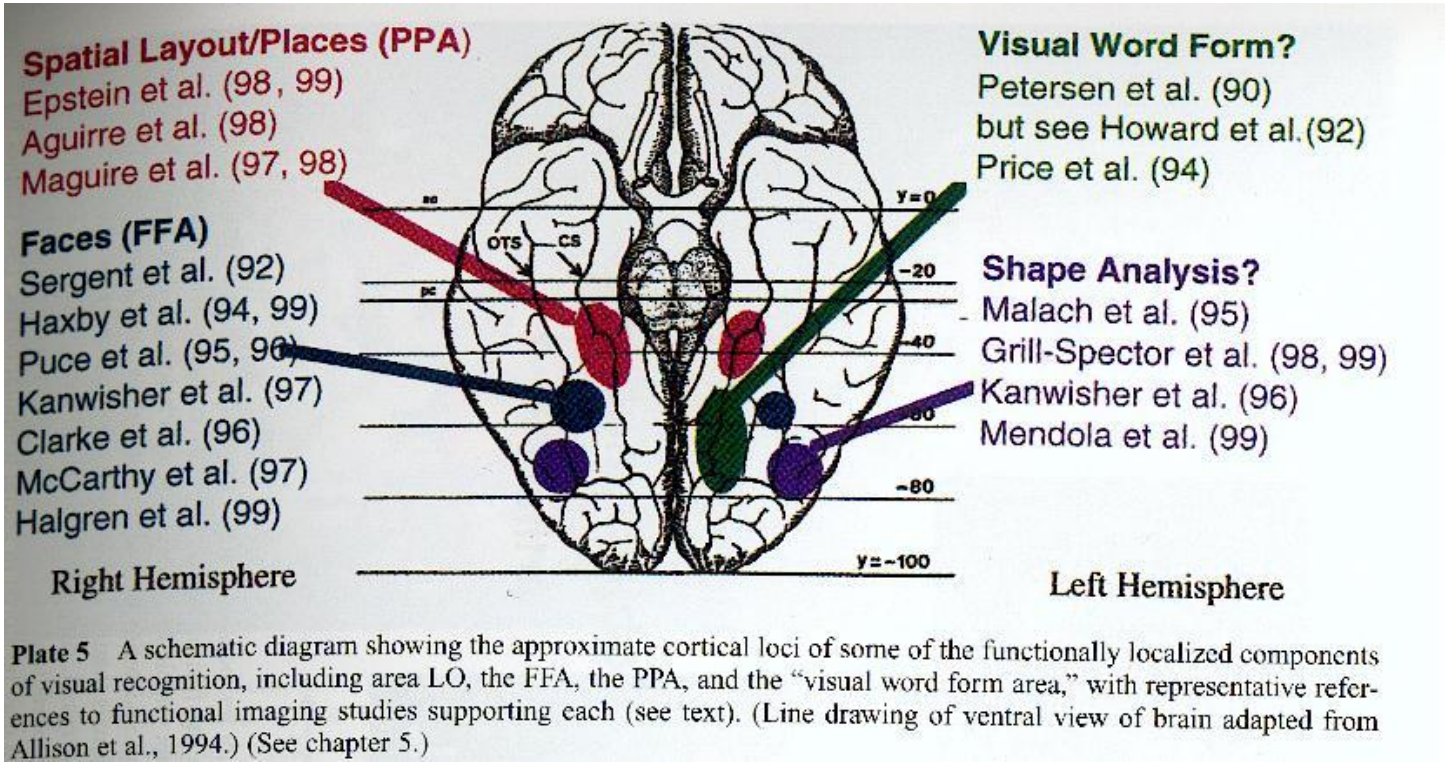
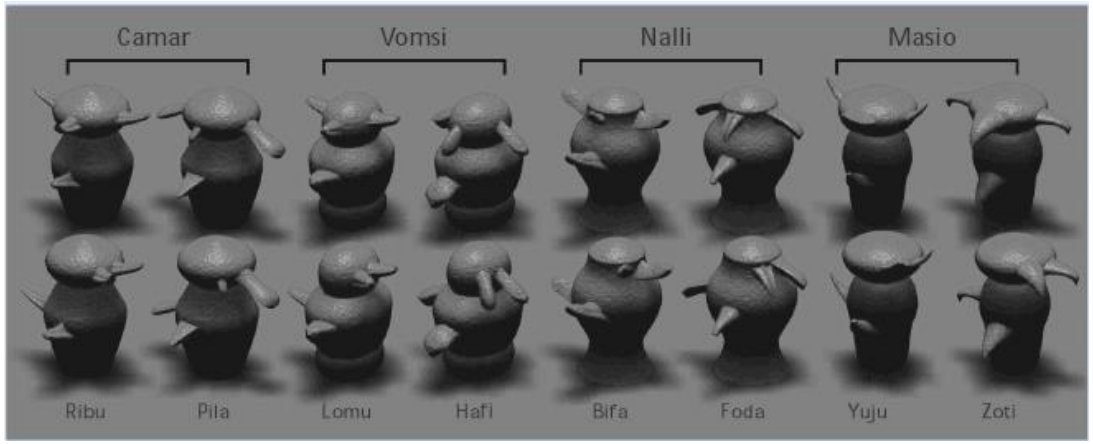
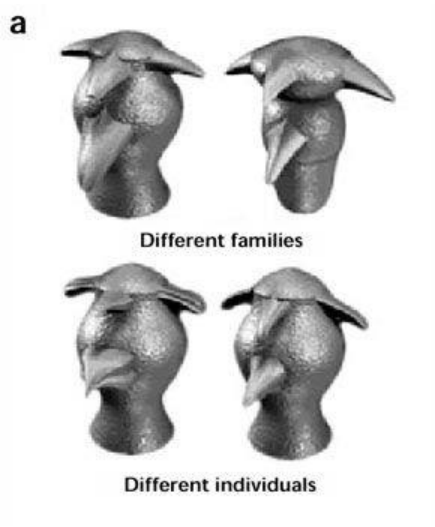


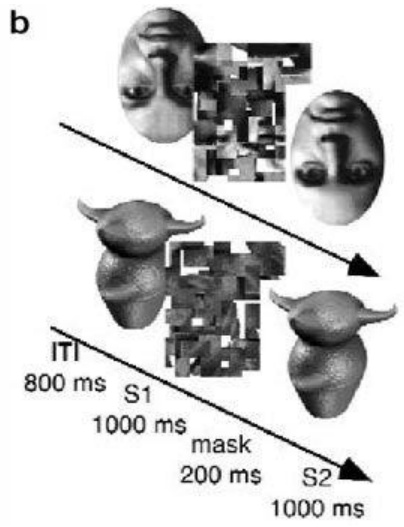
Plate 5 A schematic diagram showing the approximate cortical loci of some of the functionally localized components of visual recognition, including area LO, the FFA, the PPA, and the "visual word form area," with representative references to functional imaging studies supporting each (see text). (Line drawing of ventral view of brain adapted from Allison et al., 1994.) (See chapter 5.)

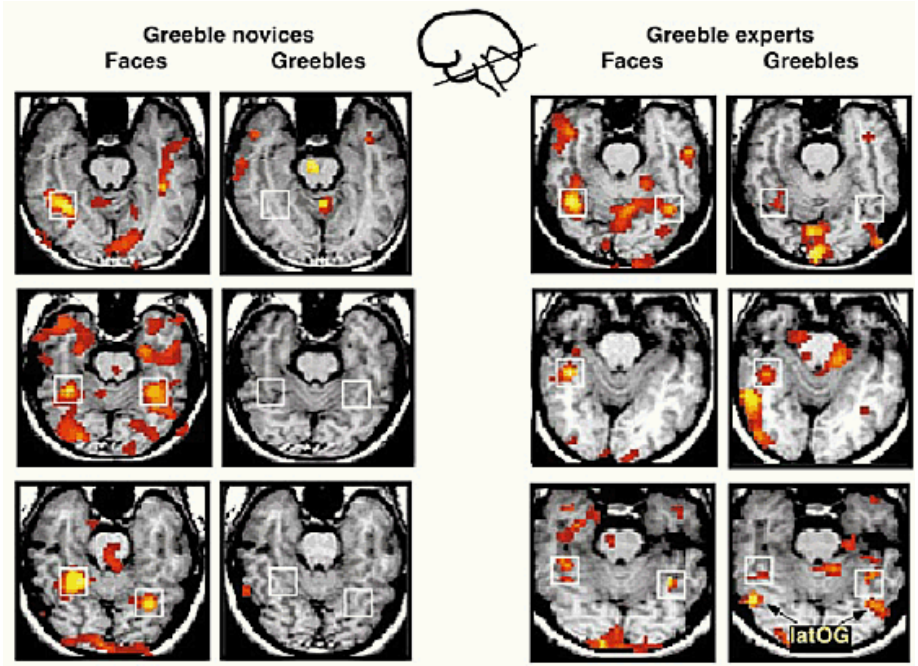
(Kanwisher, Downing, Epstein & Kourtzi (2001). In Handbook of Funcitonal Neuroimaging of Cognition. MIT Press

Example 1:
Is face processing domain specific or domain general?



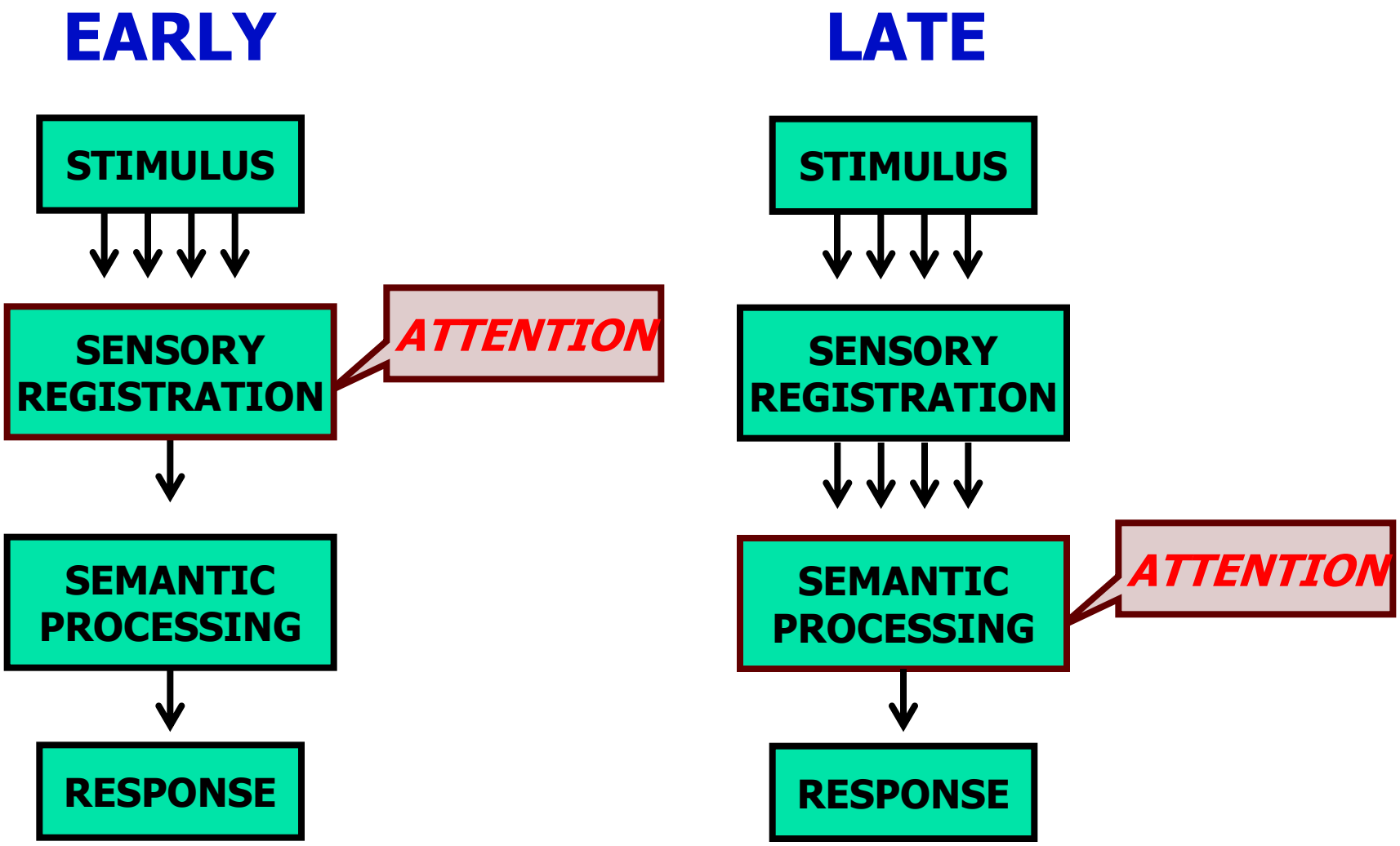






Gauthier et al., 1999, Nature Neuroscience

Example 2:
Is attentional selection early or late?



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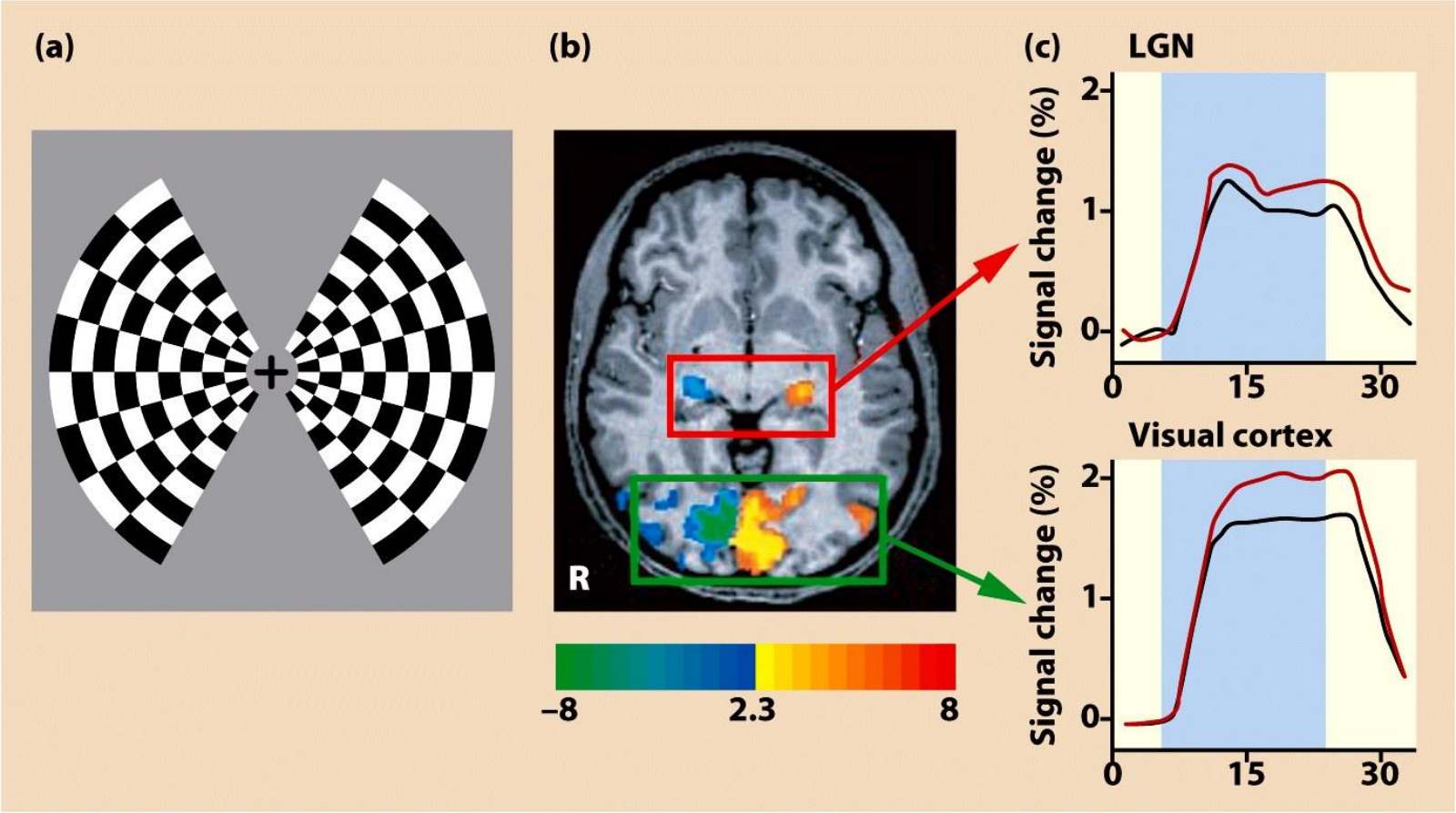
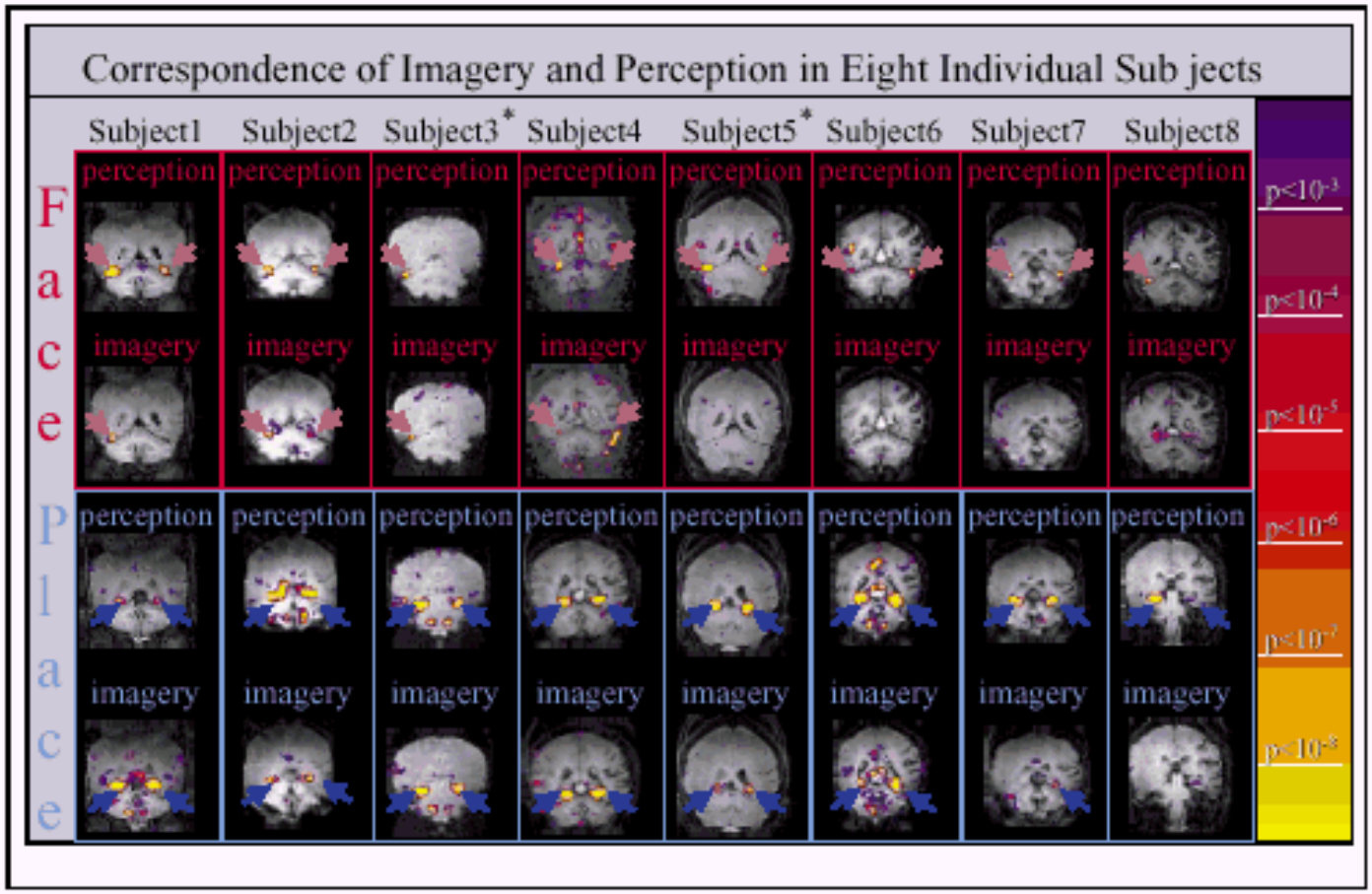
Is attentional selection early or late?



O'Connor et al., 2002, Nature Neuroscience

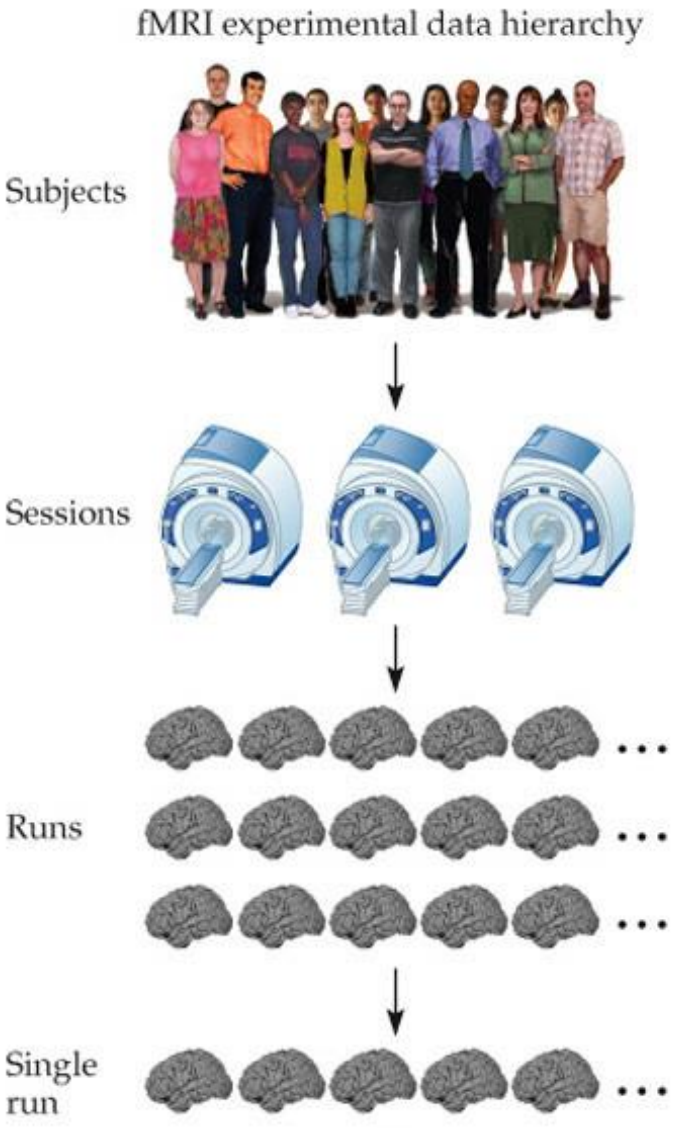
Example 3:
Is visual imagery like 'perception'?

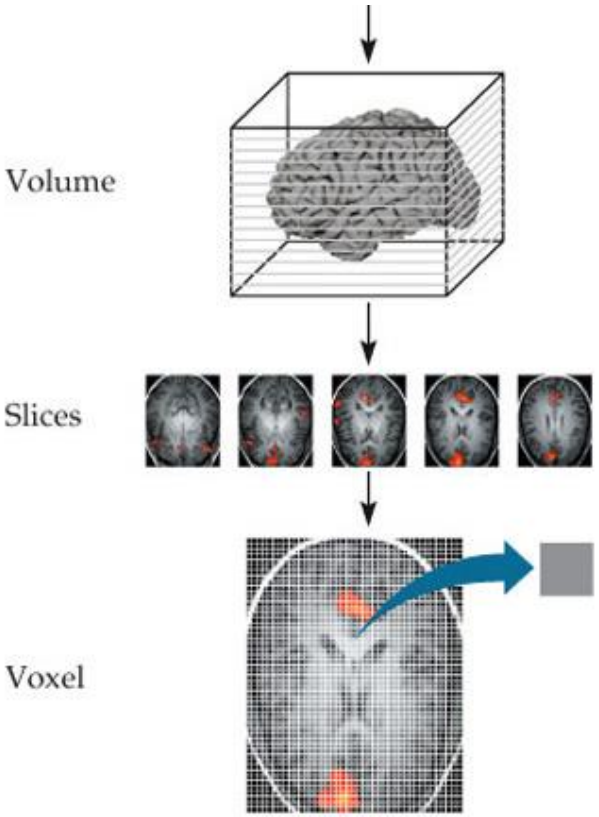
Zenon Pylyshyn's propositional theory
vs.
Stephen Kosslyn's spatial representation theory of imagery processing



Example 4:
Is vegetative state = unconsciousness?

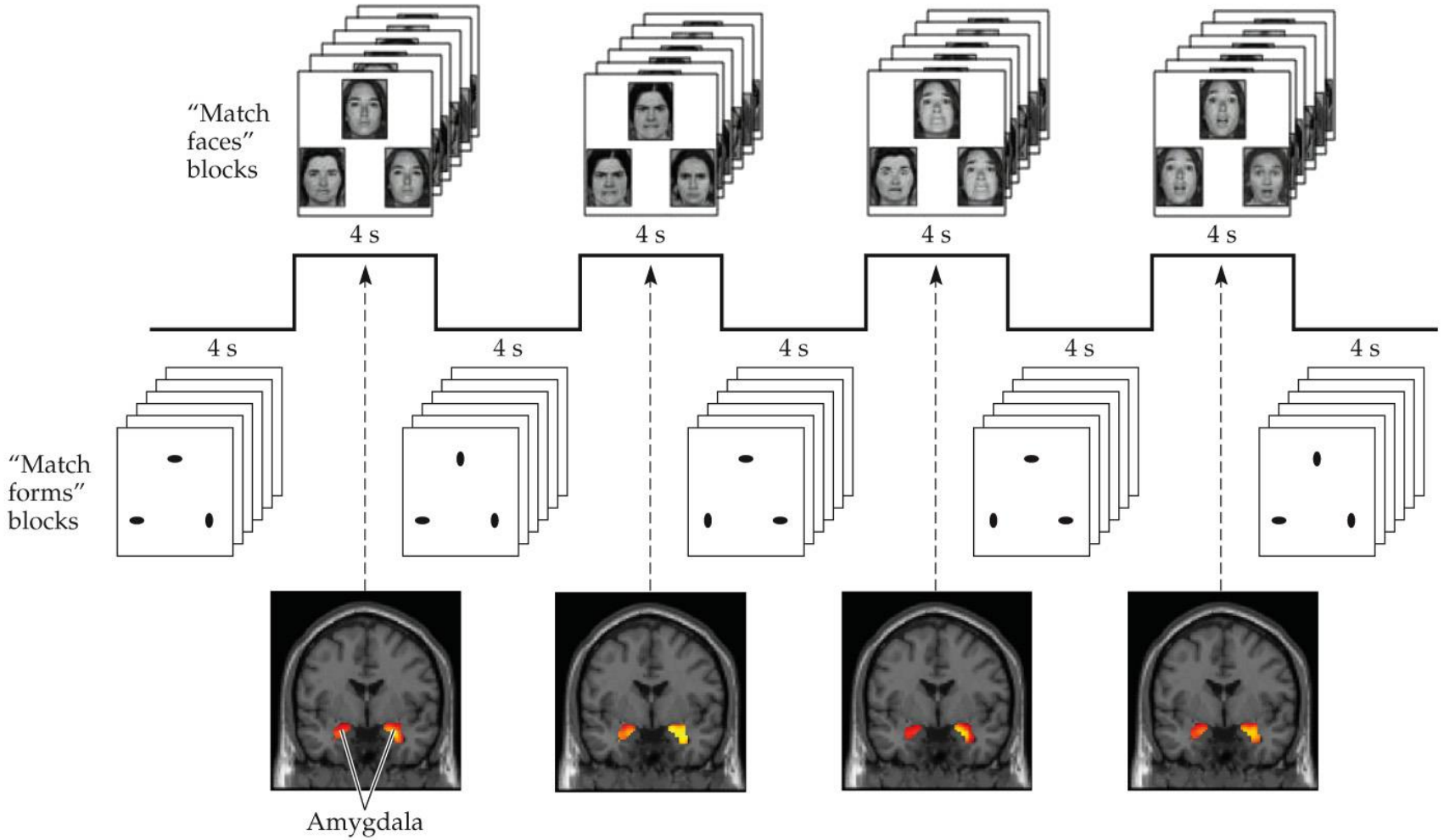
The data structure of typical fMRI





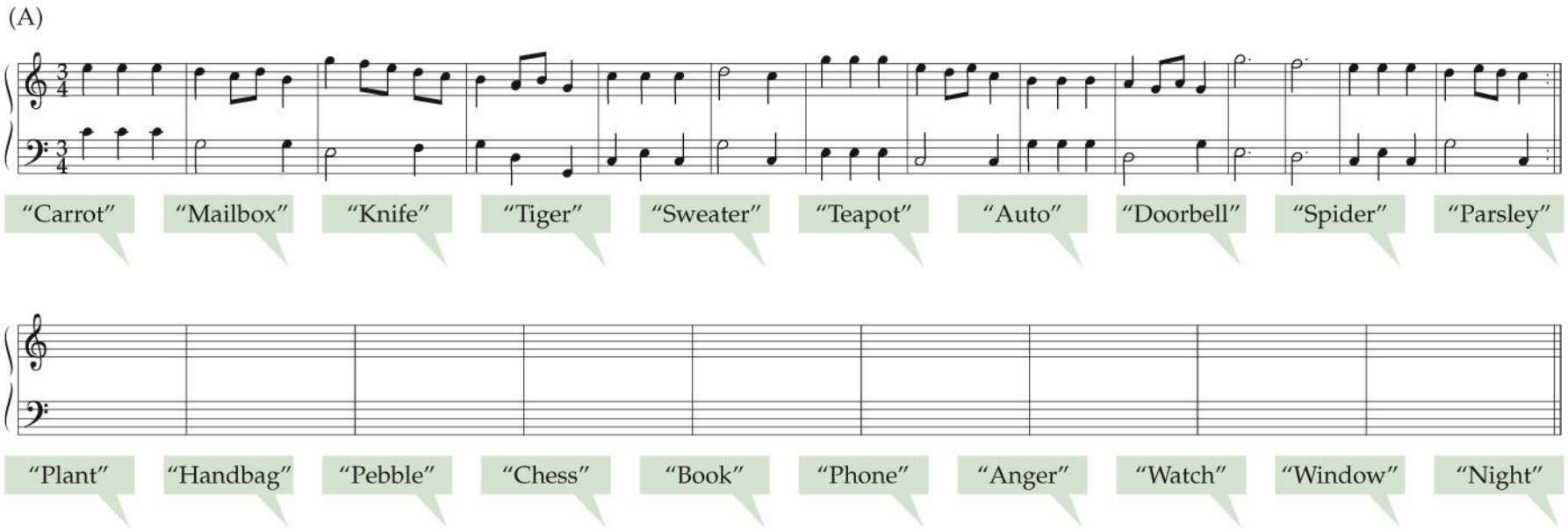
FUNCTIONAL MAGNETIC RESONANCE IMAGING 3e, Box 8.1 Figure 1

Blocked Design



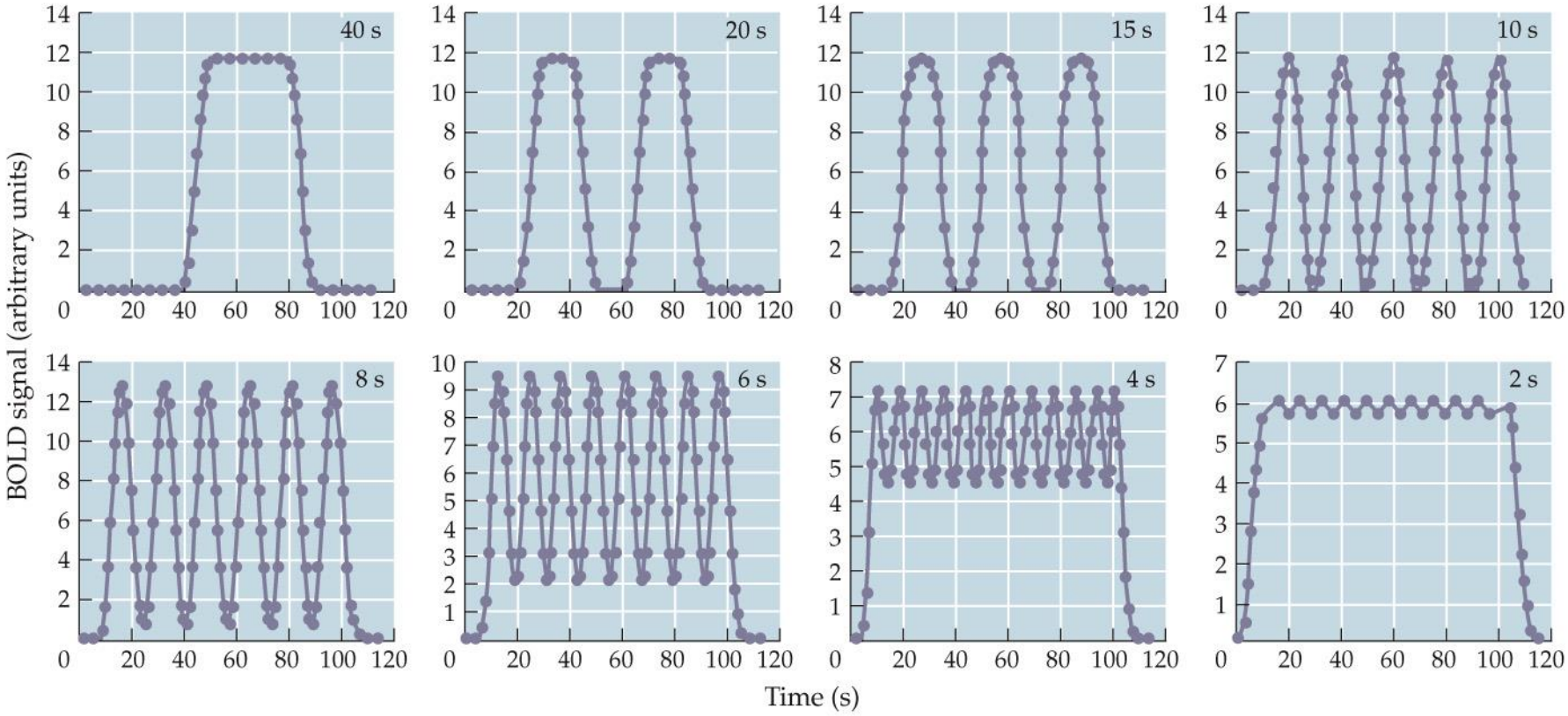
FUNCTIONAL MAGNETIC RESONANCE IMAGING 3e, Figure 9.8

Blocked Design



FUNCTIONAL MAGNETIC RESONANCE IMAGING 3e, Figure 9.6

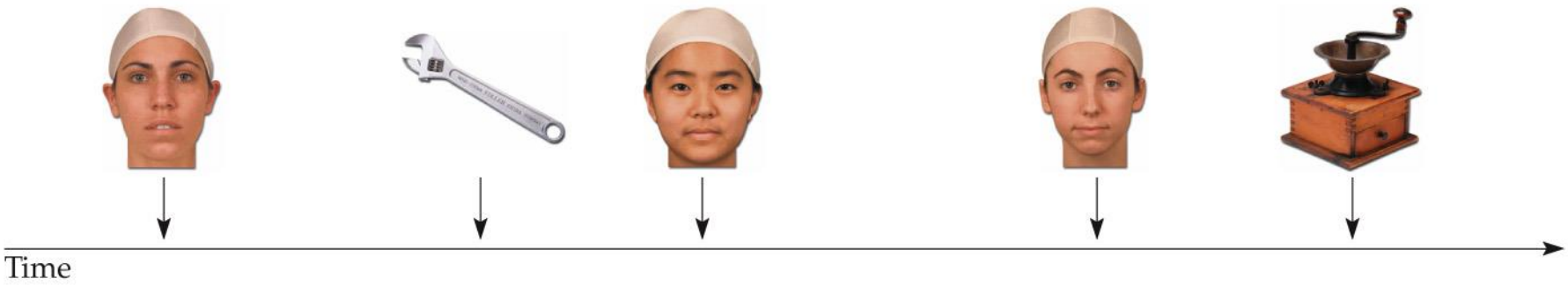
Blocked Design



FUNCTIONAL MAGNETIC RESONANCE IMAGING 3e, Figure 9.9

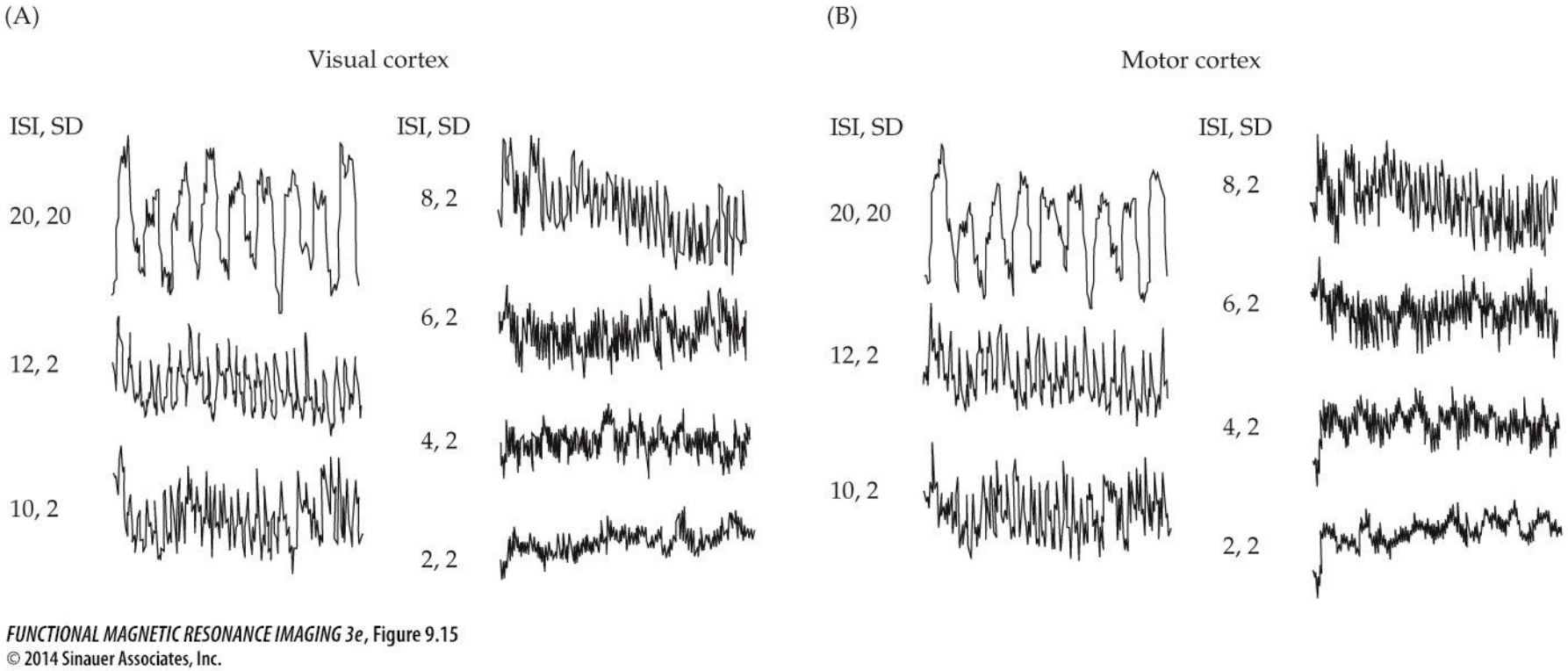
Effects of block interval on the fMRI hemodynamic response (BOLD signal)

Event-related design



FUNCTIONAL MAGNETIC RESONANCE IMAGING 3e, Figure 9.11

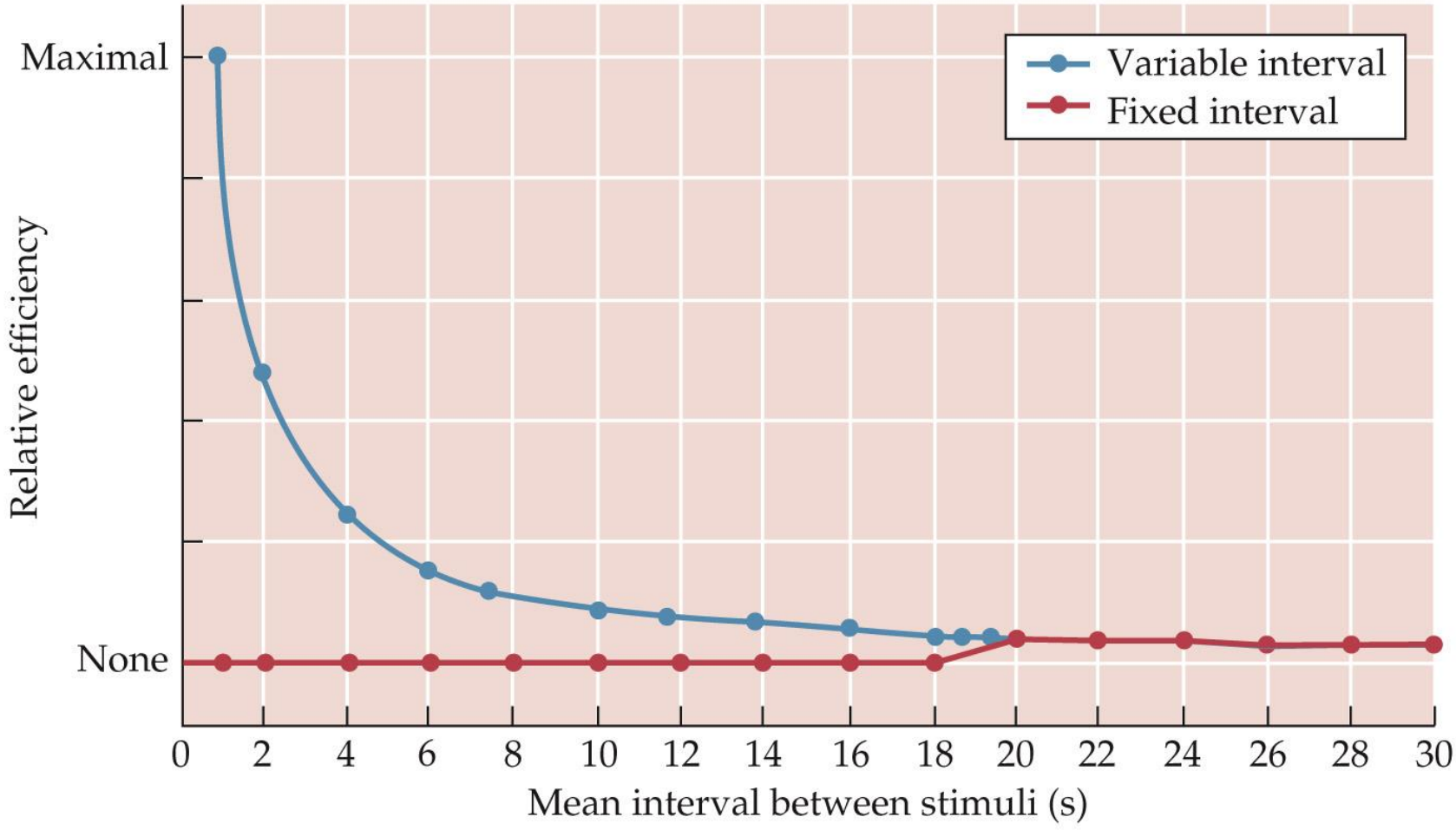
Event-related design



FUNCTIONAL MAGNETIC RESONANCE IMAGING 3e, Figure 9.15

Effects of interstimulus interval on event-related fMRI activation

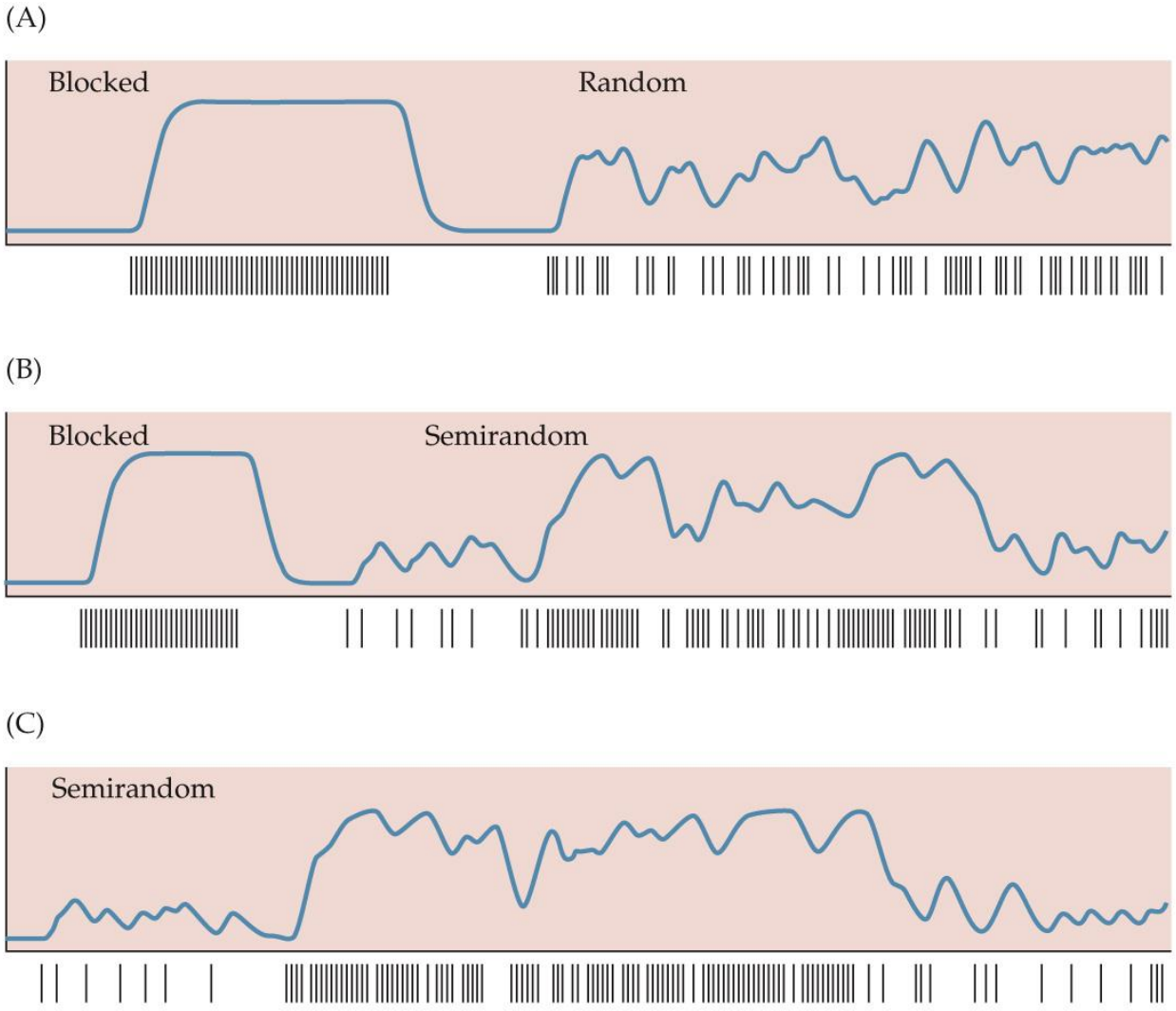
Design Efficiency and inter-stimulus interval (ISI)



FUNCTIONAL MAGNETIC RESONANCE IMAGING 3e, Box 9.2 Figure 1

Efficiency of variable-interval and fixed-interval event-related designs

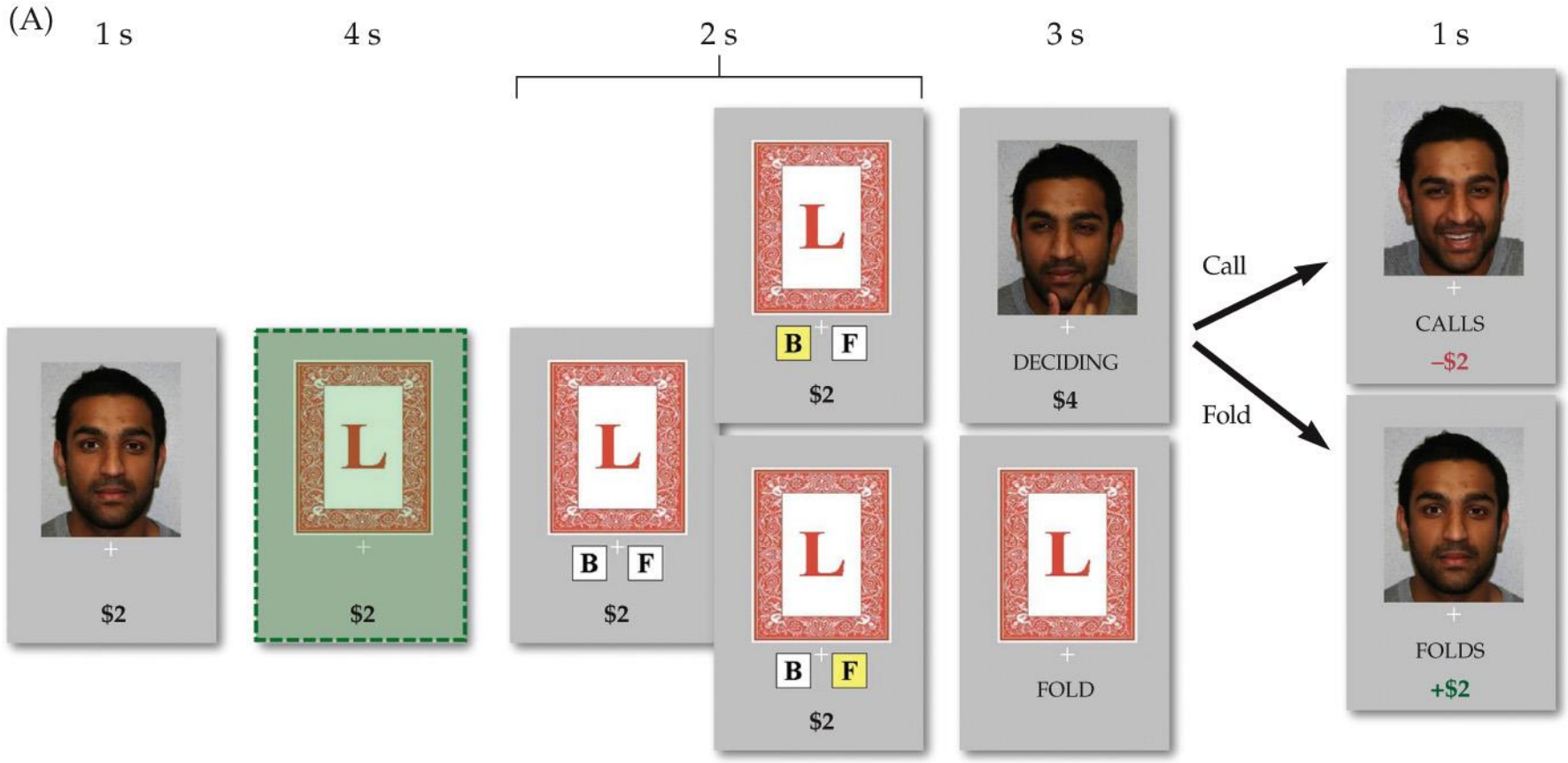
Simulated hemodynamic responses for different designs



FUNCTIONAL MAGNETIC RESONANCE IMAGING 3e, Box 9.2 Figure 2

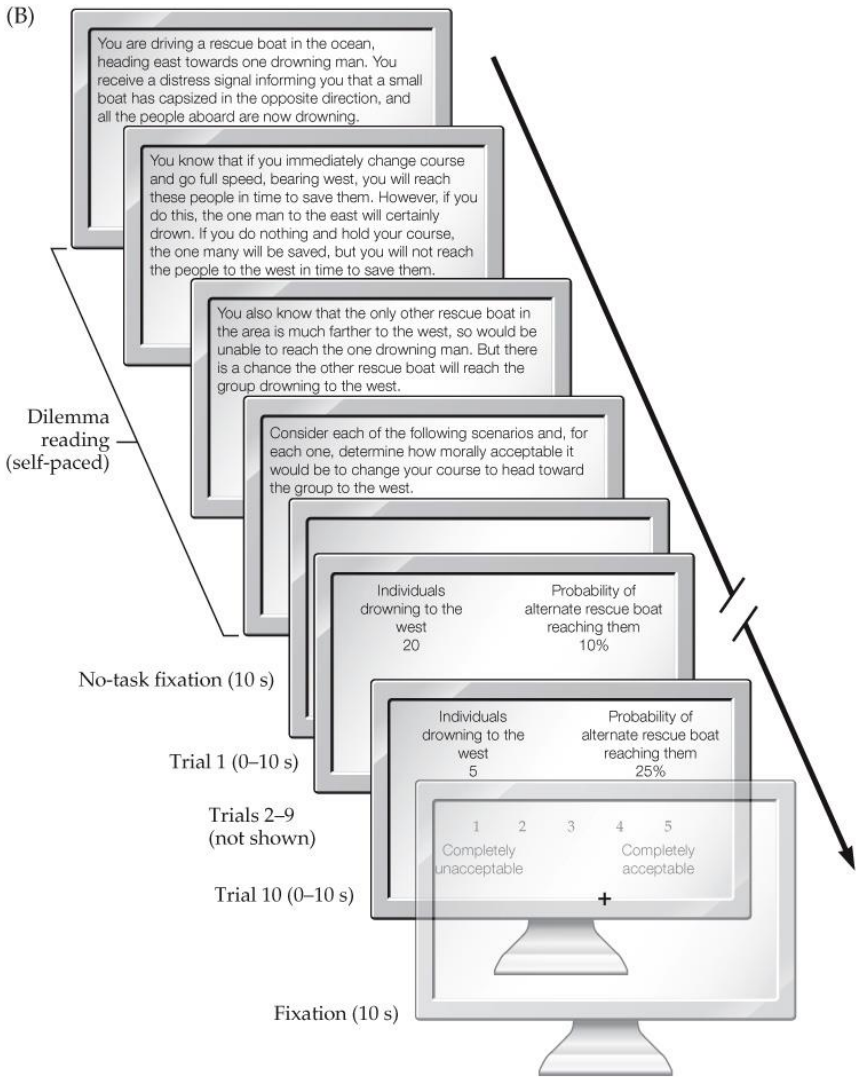
Semirandom designs combine features of blocked and event-related designs

Example 1 for event-related design



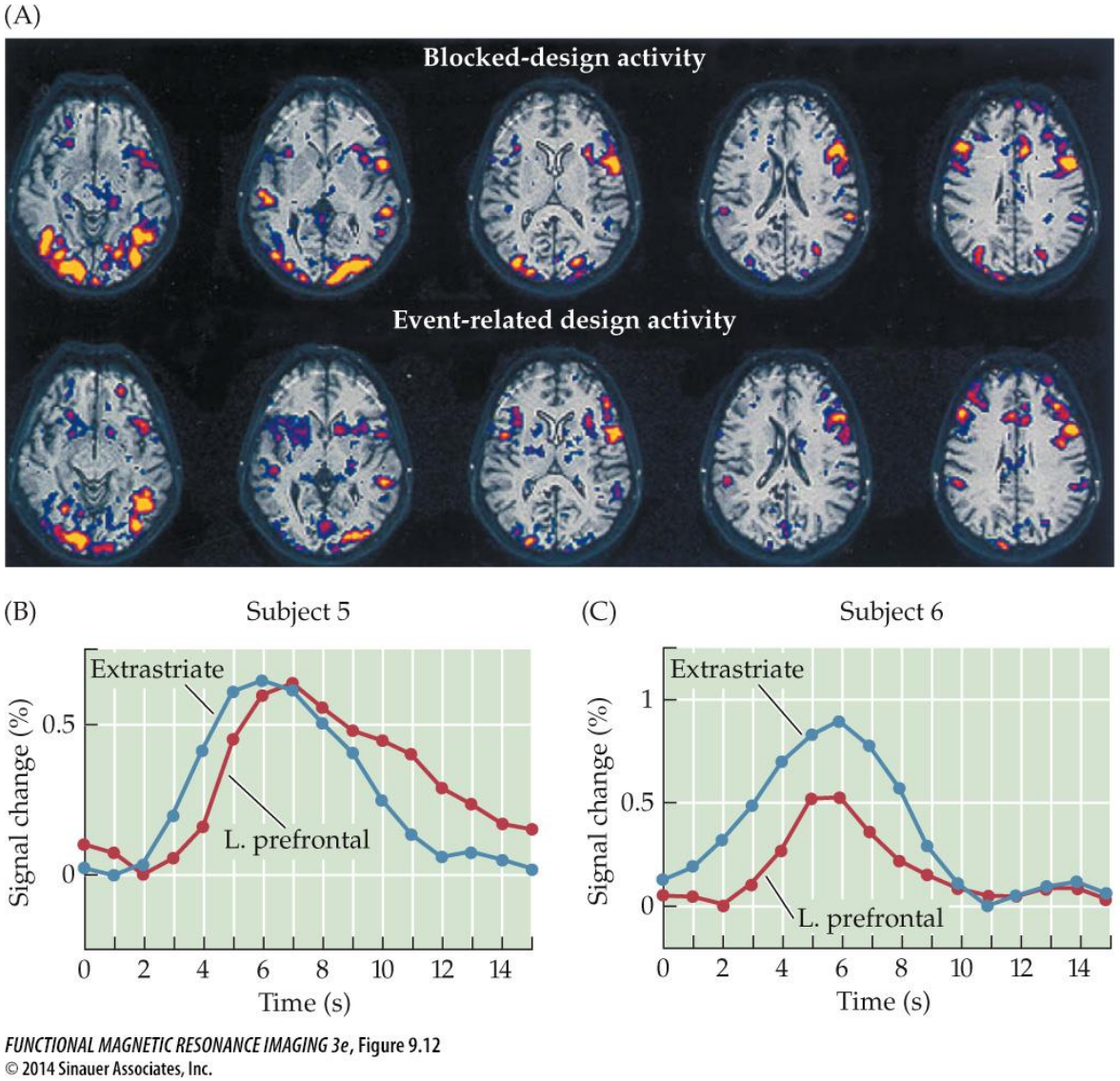
FUNCTIONAL MAGNETIC RESONANCE IMAGING 3e, Figure 9.16 (Part 1)

Example 2 for event-related design



FUNCTIONAL MAGNETIC RESONANCE IMAGING 3e, Figure 9.16 (Part 2)

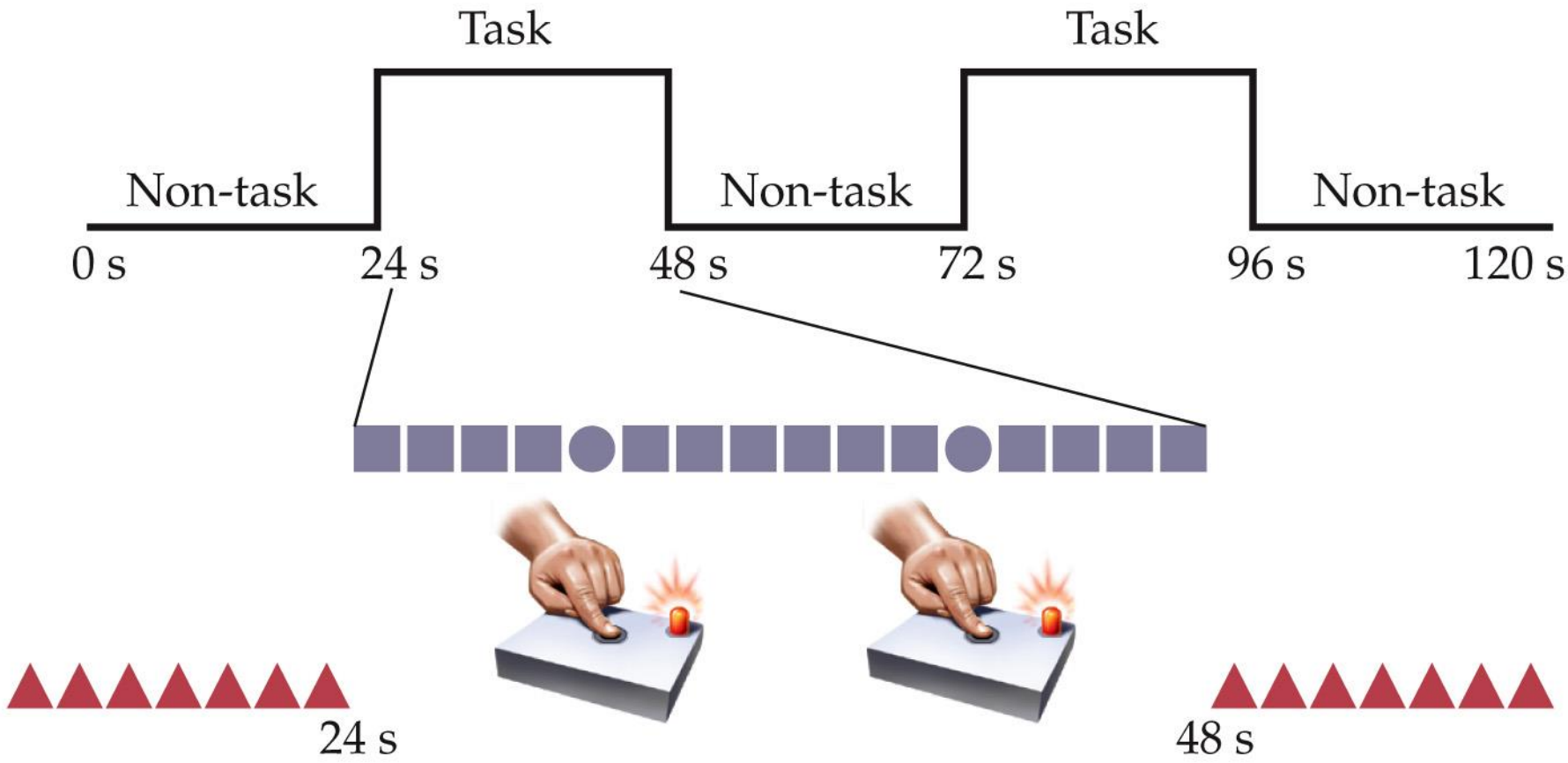
Blocked vs. event-related design



FUNCTIONAL MAGNETIC RESONANCE IMAGING 3e, Figure 9.12

Results from one of the first comparisons of blocked and event-related designs

Mixed design

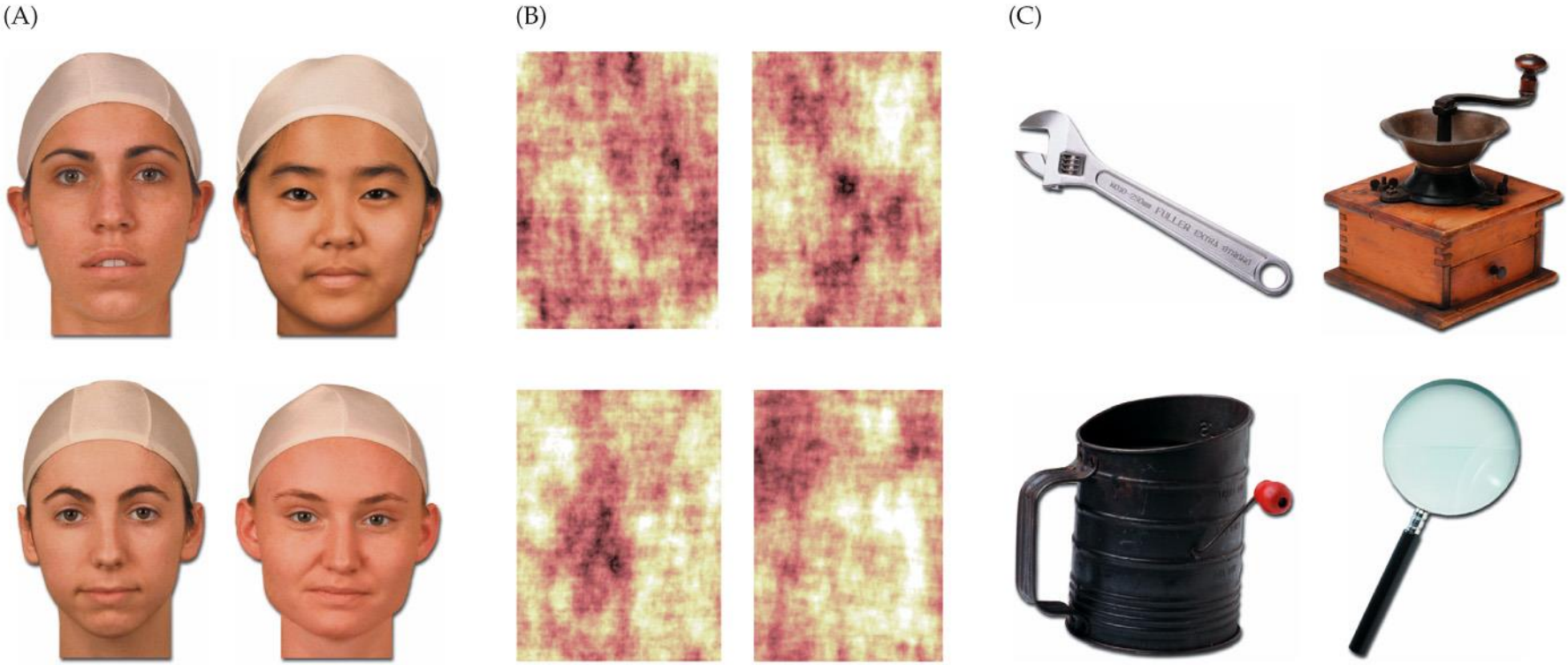


FUNCTIONAL MAGNETIC RESONANCE IMAGING 3e, Figure 9.17

An example of a mixed fMRI design

Select appropriate control condition – example 1

- Face processing

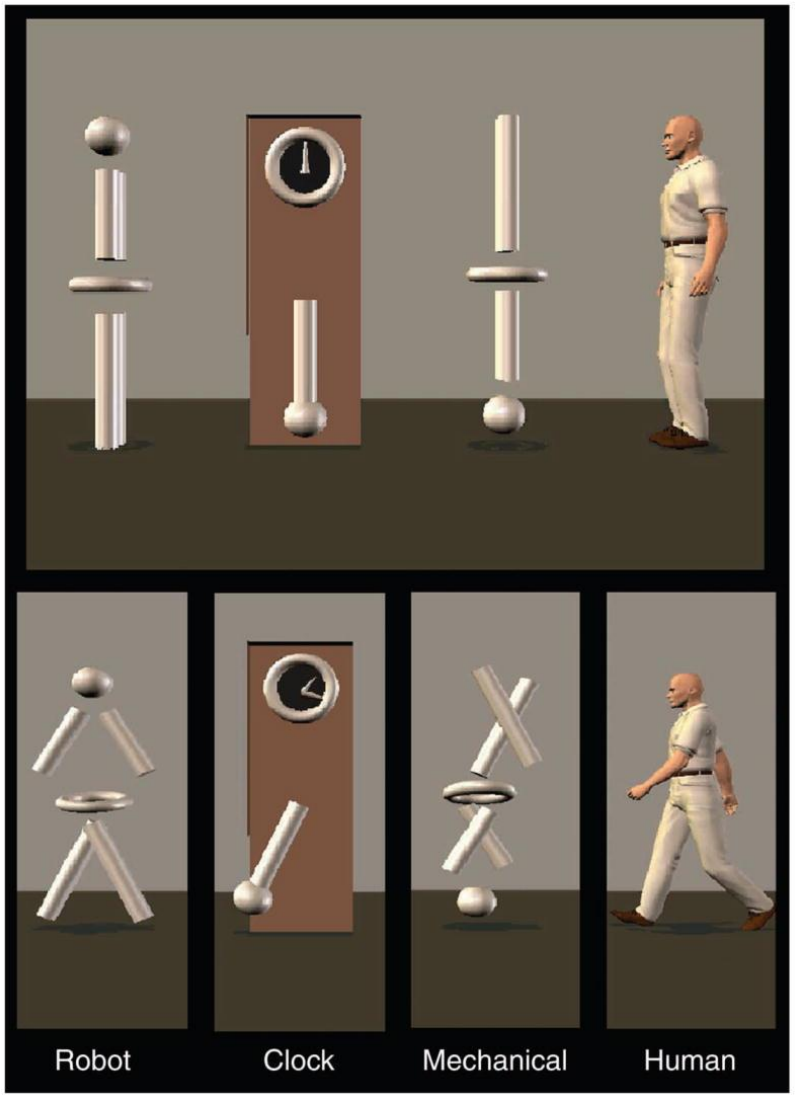


FUNCTIONAL MAGNETIC RESONANCE IMAGING 3e, Figure 9.4

Select appropriate control condition – example 2

- Biological motion

  by Pelphrey et al., 2003; Carter & Pelphrey 2006



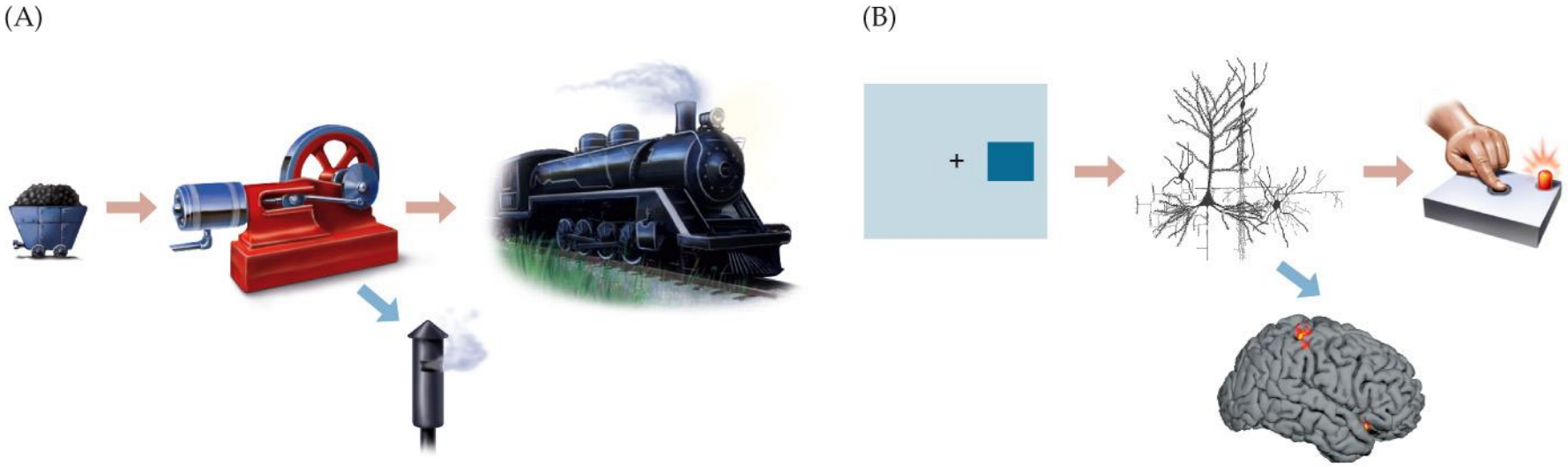
Some useful guidelines – part I

- Evoke the cognitive (or motor, perceptual, mnemonic, etc.) processes of interest.
- Collect as much data as possible from each subject
- Collect as much participants as possible

Some useful guidelines – part I

- Choose your stimulus conditions and the timing of their presentation to evoke maximal changes in the processes of interest, over time.
- Organize the timing of experimental stimuli so that the processes of interest are minimally correlated with each other, over time
- Where possible, obtain measurements of your participants' behavior (e.g., responses, RTs) that can be related to the fMRI activation

the nature of BOLD signals – causal chains or epiphenomenon?



FUNCTIONAL MAGNETIC RESONANCE IMAGING 3e, Figure 9.3