Cognitive (Neuro) Psychology

Introduction

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July 2016

So far ...

- Introduction to Neurobiology
- Sensory Physiology
- Programming

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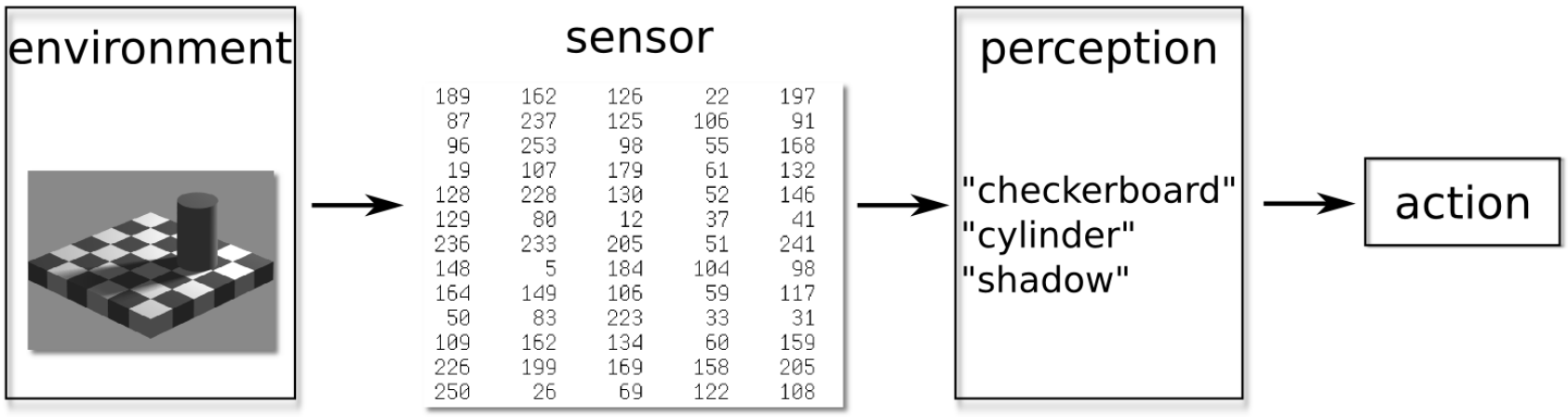
- Sensory Physiology
- Programming
- Cognitive (Neuro)Psychology

What do you expect?

Human cognition



Human cognition

Internal processes involved in making sense of the environment and deciding what action might be appropriate.
These processes include:

- attention
- perception
- learning
- memory
- language
- problem solving
- reasoning
- thinking

Thinking

You cannot observe atoms directly. We still think they exist. Why? We cannot observe thoughts in other people directly. We still think they exist. Why?

Approaches to Human Cognition

1. Cognitive Psychology
2. Cognitive Neuropsychology
3. Cognitive Neuroscience
4. Computational Cognitive Science

What is Cognitive Psychology?

Scientific attempt to understand human cognition by observing the behavior of people performing various cognitive tasks.

What is Cognitive Psychology?

- Miller (1956) - magical number 7 ± 2
- Bruner, Goodnow, & Austin (1956) - a study of thinking
- Broadbent (1958) - filter theory
- Newell & Simon (1972) - a general problem solver
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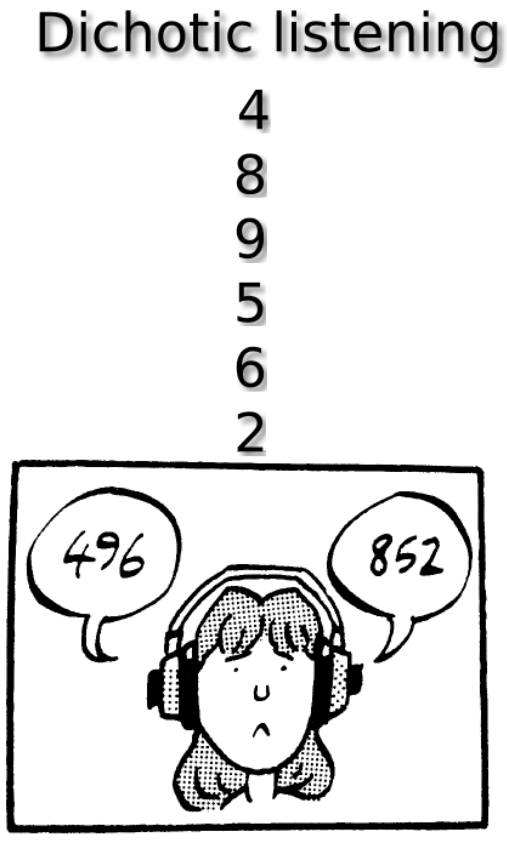

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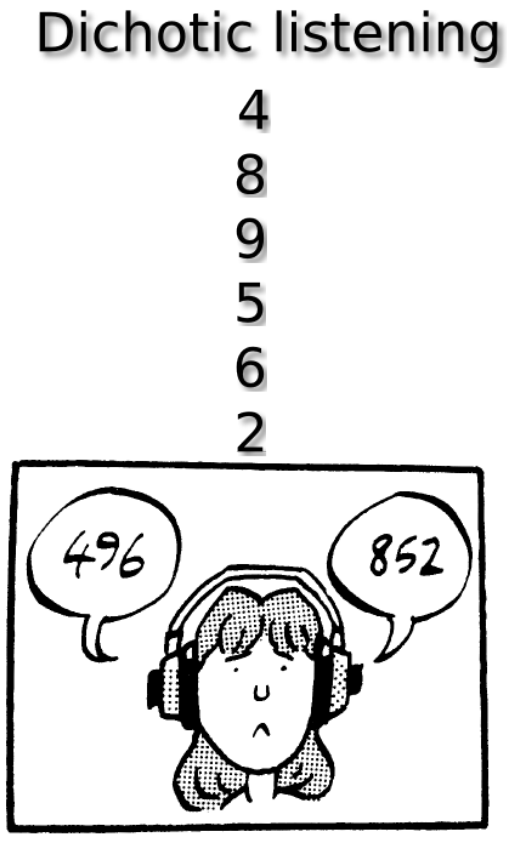
$\Rightarrow$ capacity limits



The computer metaphor

Cognition as information processing approach

bottom-up $\longleftrightarrow$ top-down processing

Thinking

In what way is your brain like a digital computer? What are the differences? Do they matter for the computer metaphor?

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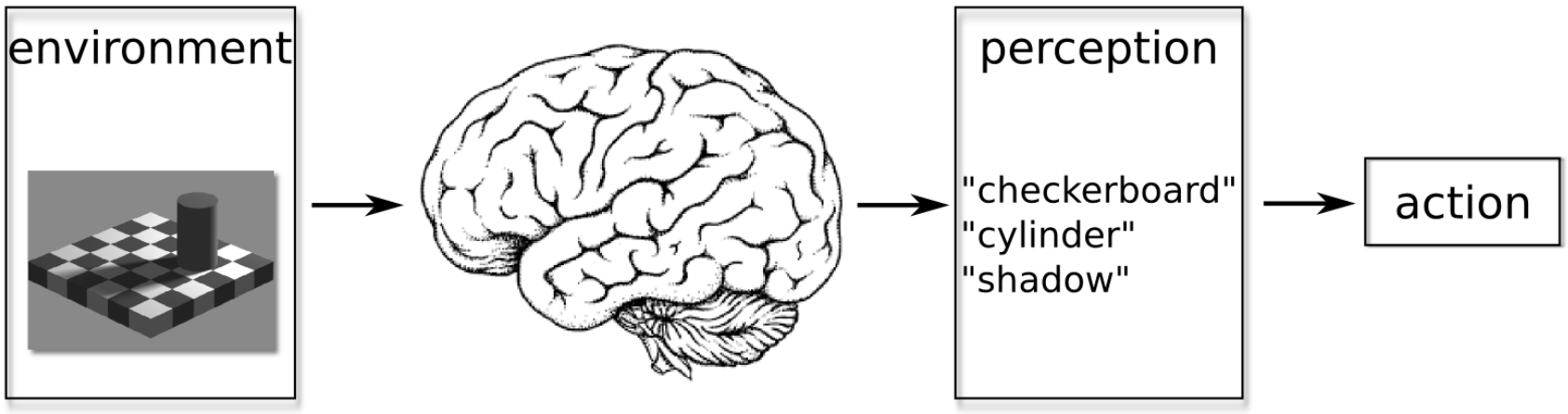
- Cognitive Science - Cognitive Systems - Artificial Intelligence

Human cognition



Cognitive Neuropsychology

Idea: look at patterns of cognitive performance (intact and impaired) shown by brain-damaged patients

! the principle aim is not to learn about the brain, but to elucidate the functional architecture of cognition

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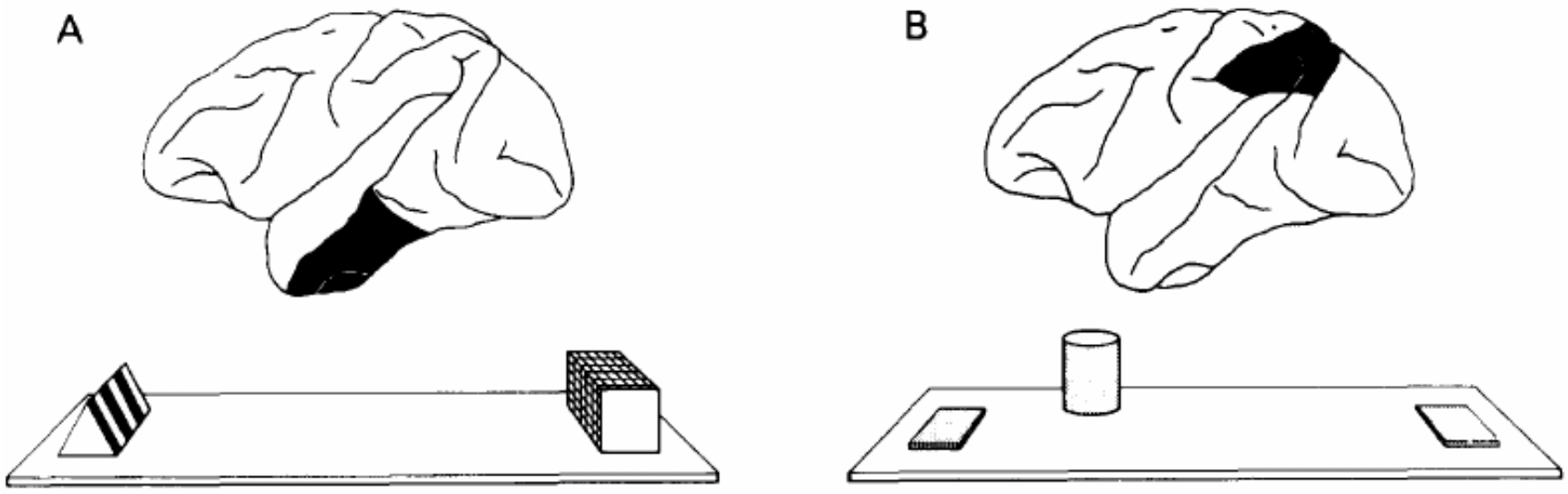
Assumptions:

- Modular organization: functional & anatomical
- Subtractivity: brain damage impairs modules does not add them

Double dissociation

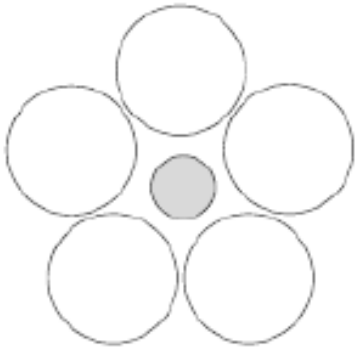


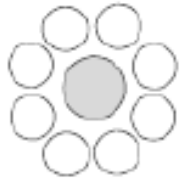
Mishkin, 1983

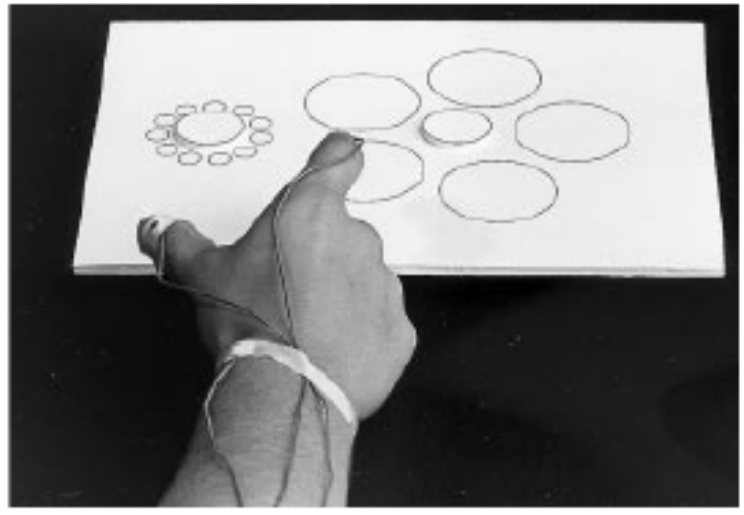
A lesions in ventral stream impair object identification, but not localization

B lesions in dorsal stream impair object localization, but not identification

Dissociation

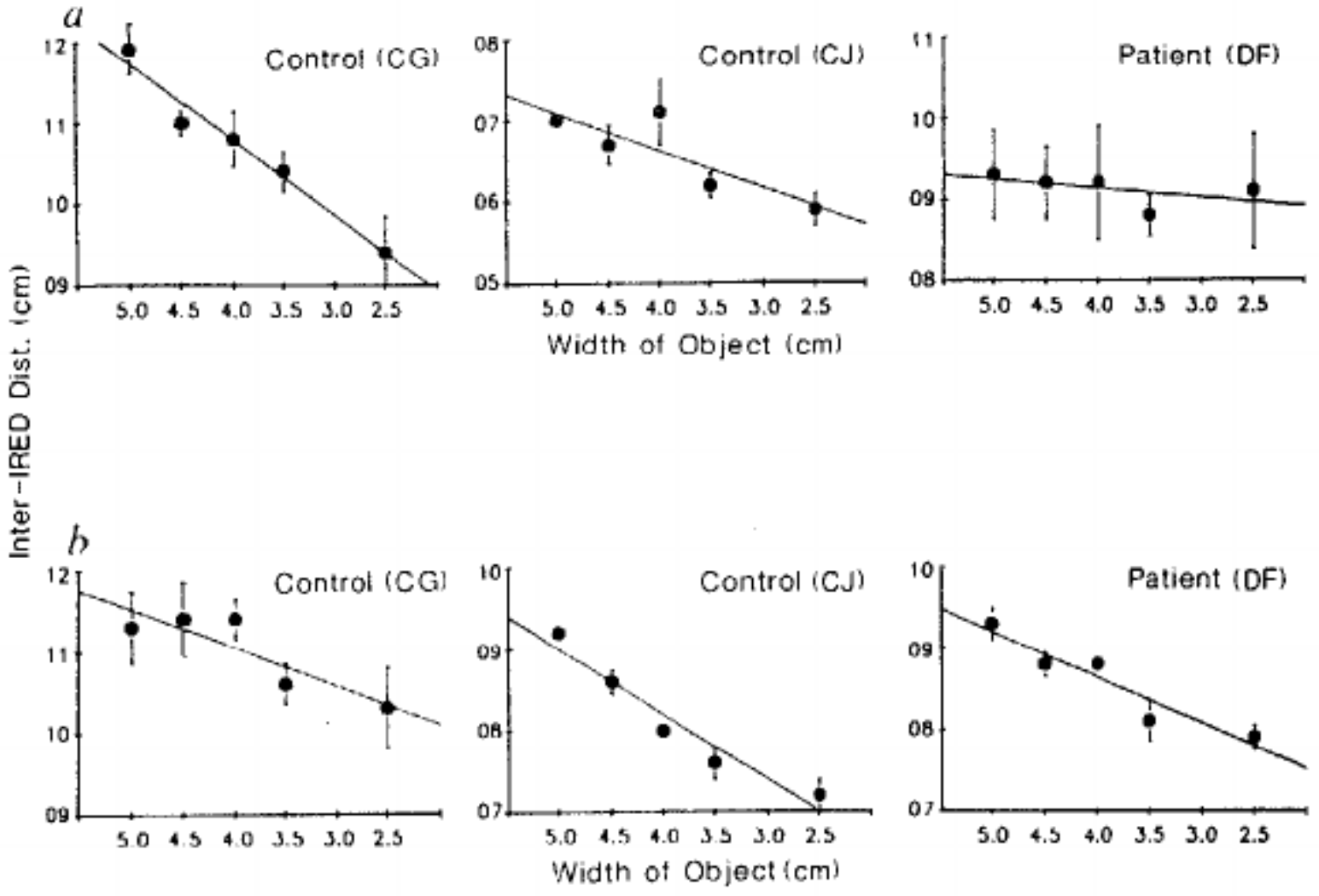






- damage ventrally in lateral occipital region

Dissociation



Goodale et al., 1991

Cognitive Neuropsychology - A critical evaluation

- different patients have different and diffuse lesions
- patients often impaired in more than one function, secondary effects
- interruption of a function by a lesion does not mean that the function is localized in the respective area
- strongest evidence comes from double dissociations but is not fool-proof
- functions may still be distributed over the brain and not localized in one area - why?

Cognitive Neuroscience

- 1928 - 1947 Penfield stimulated brains during brain surgery

  "those fingers and my thumb gave a jump" - stimulation near central sulcus

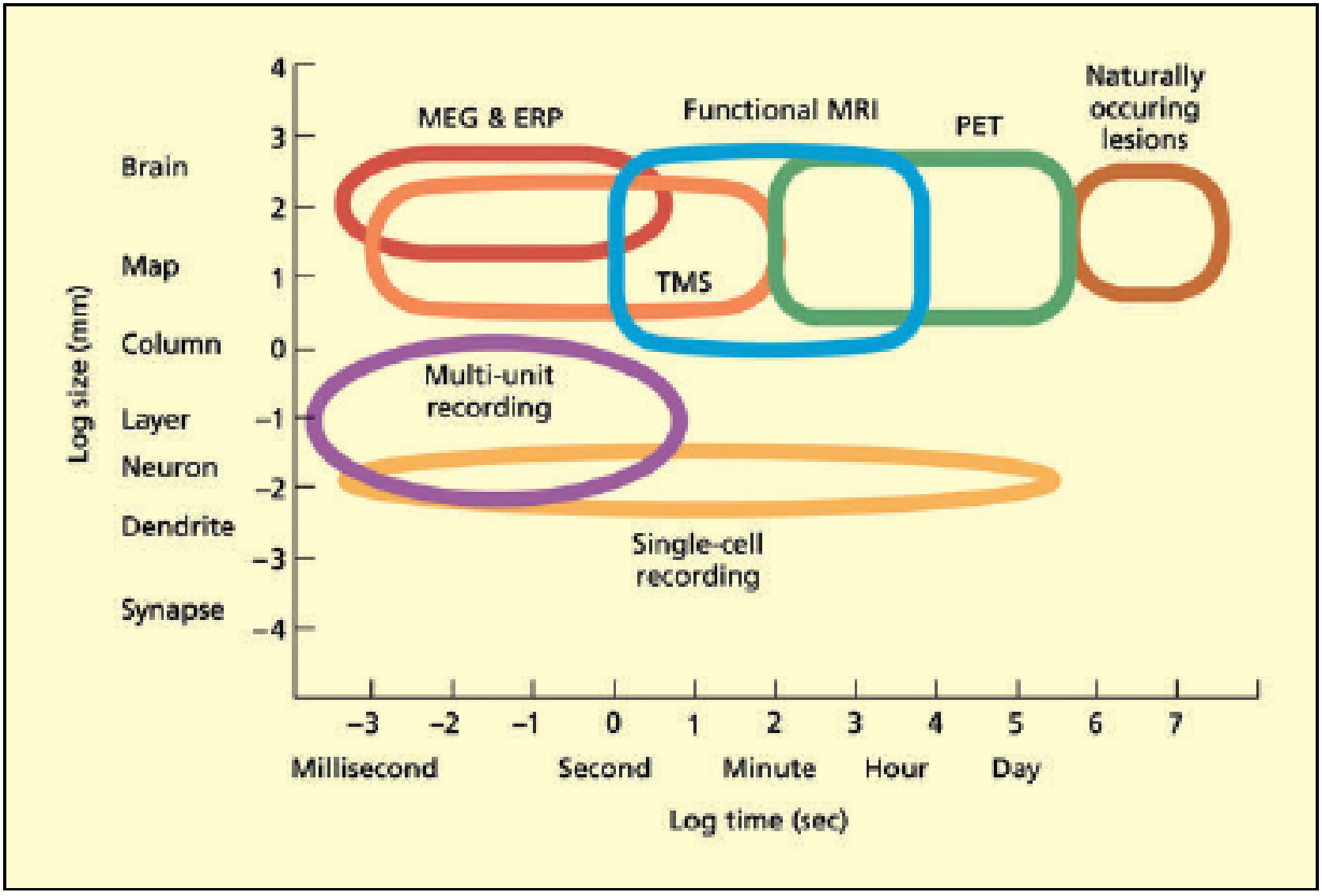
$\Rightarrow$ How are mental processes such as thoughts, memories and perceptions organized and implemented by the brain?

Cognitive Neuroscience

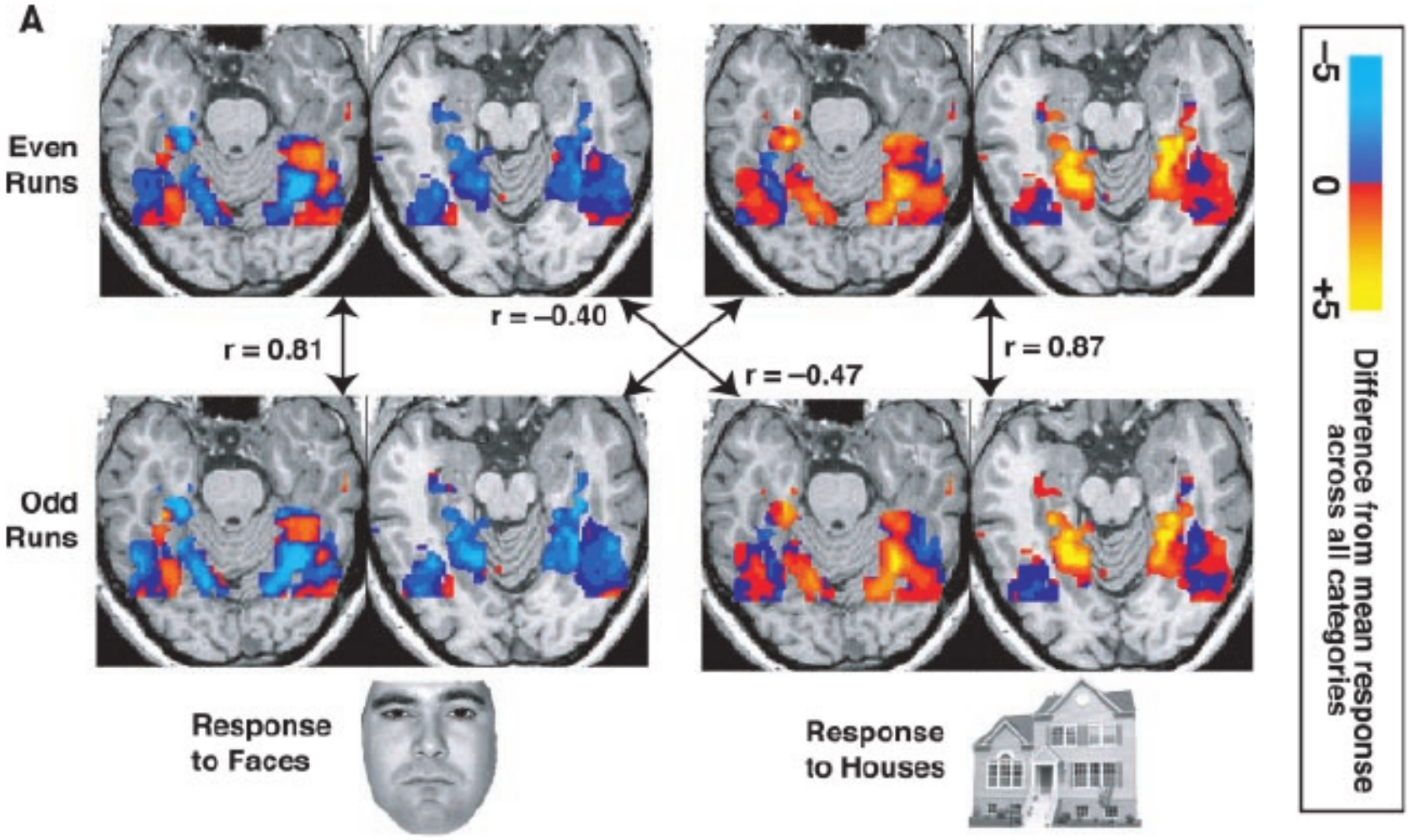
THE DIFFERENT METHODS USED IN COGNITIVE NEUROSCIENCE

Method	Method type	Invasiveness	Brain property used
EEG/ERP	Recording	Non-invasive	Electrical
Single-cell (and multi-unit) recordings	Recording	Invasive	Electrical
TMS	Stimulation	Non-invasive	Electromagnetic
tDCS	Stimulation	Non-invasive	Electrical
MEG	Recording	Non-invasive	Magnetic
PET	Recording	Invasive	Hemodynamic
fMRI	Recording	Non-invasive	Hemodynamic

Cognitive Neuroscience



fMRI - decoding



Cognitive Neuroscience - a critical evaluation

- blobology - activation in a small area is interpeted as the ’love’ area
- reverse inference - infer involvement of a cognitive process based on activation within a given brain area
- ’neuroimaging illusion’

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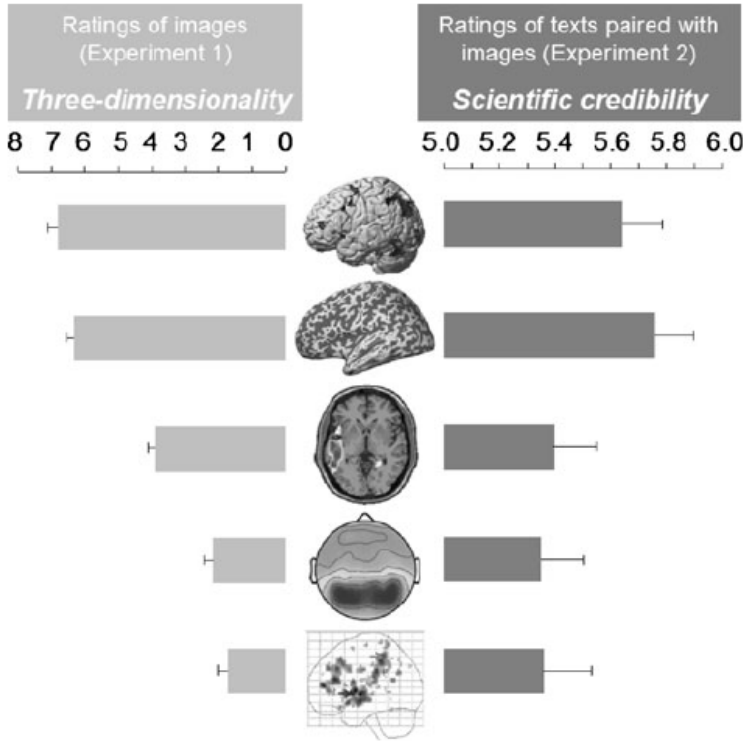


Keehner et al., 2011

Computational Cognitive Psychology

- program computers to mimic aspects of human cognitive functioning

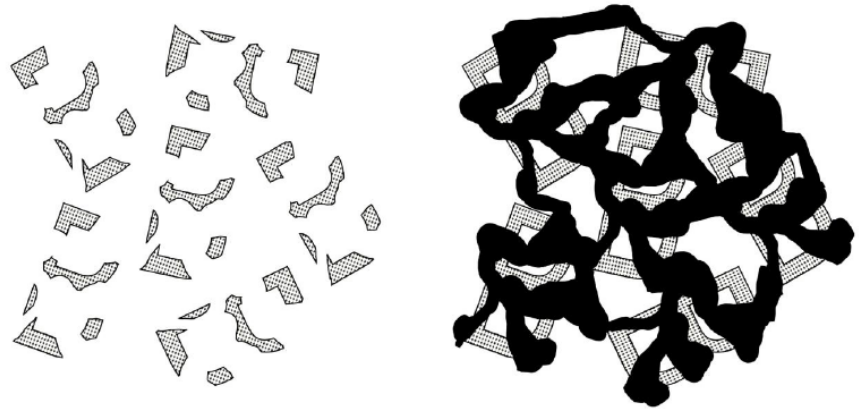
!AI construct systems that produce intelligent behavior but bear little resemblance to those used by humans e.g. deep blue

- a good computational model shows us how a given theory can be specified and allows us to predict behavior in new situations
- requires the researcher to be explicit about a theory in a way a verbal theory does not
- specific $\longleftrightarrow$ generic

Summary

- Cognitive Psychology is the experimental study of human cognition
- Cognitive Psychology combines a number of different approaches including behavioral experiments, computational modelling and the study of the brain
- Cognitive Psychology focusses on the study of human cognition and as such is a subfield of Cognitive Science which also considers other cognitive agents
- The study of Human Cognition becomes increasingly transdisciplinary recognizing the usefulness of a diverse set of different approaches

Tutorial: how to measure perception?



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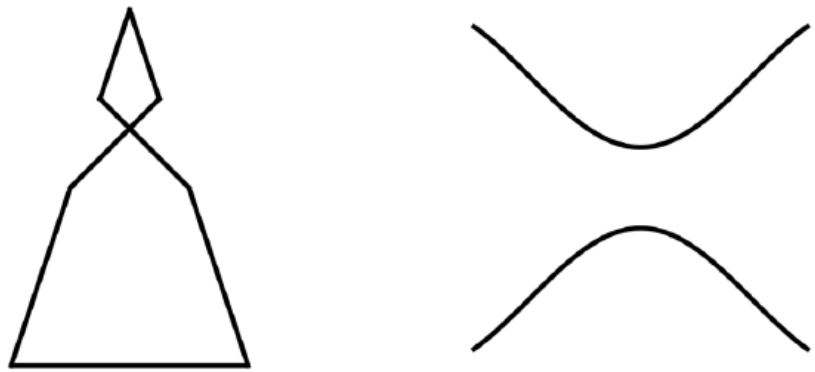

Thinking

How can you find out what's happening in someone's head? In normal life? In science?

References

- Eysenck & Keane
- Ward, J. (2010). The student's guide to cognitive neuroscience (2nd ed.). Taylor & Francis, Psychology Press: Hove and New York.