

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



علوم شناختی

جلسه ۷ (الف)

سیستم‌های شناختی به‌عنوان سیستم‌های کارکردی

Cognitive Systems As Functional Systems

کاظم فولادی قلعه
دانشکده مهندسی، دانشکدگان فارابی
دانشگاه تهران

<http://courses.fouladi.ir/cogsci>

PART 1: HISTORICAL LANDMARKS



Chapter 3: The Turn to the Brain



Chapter 3.1: Cognitive systems as functional systems



Functional approach to cognition

- Cognitive science has long been dominated by a **functional approach** to cognitive systems
- This focuses on **what different cognitive systems do and how they do it**, rather than on physical details
 - E.g., the function of vision is to transform information from the retina into a representation of discrete visual objects

Functional approach to cognition

- The **brain** can be thought of as **hardware** that runs a wide variety of programs (software), like a computer
- Cognitive scientists can study different **cognitive processes** (the **software**) without focusing on how they are implemented in the **brain** (the **hardware**)

Multiple realizability

- Cognitive functions can be “realized” by different **neural structures**
 - Studying individual neural structures would not necessarily tell us anything about the function
- By analogy, the function of blood circulation can be realized by different types of hearts
 - e.g., human beings and hummingbirds have differently structured hearts that still perform the same basic function

Turning away from functions

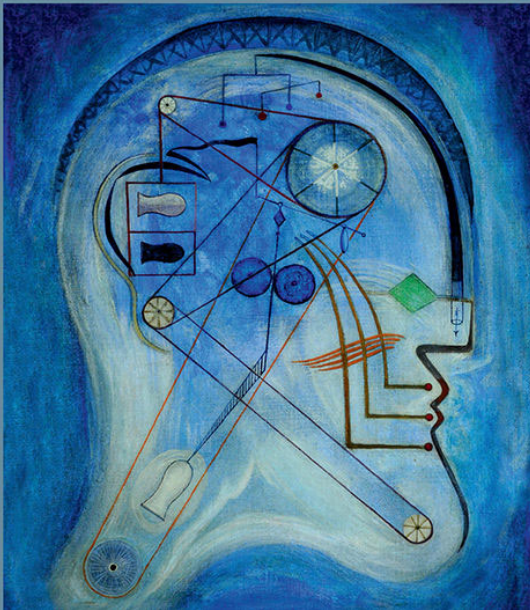
Recently, cognitive scientists have begun to focus more on how cognitive systems are **implemented in brains and nervous systems**

José Luis Bermúdez

Cognitive Science

An Introduction to the Science of the Mind

Third Edition



José Luis Bermúdez,
Cognitive Science:
An Introduction to the Science of the Mind,
 3rd ed., Cambridge University Press, 2020.
Chapter 3 (Section 3.1)

CHAPTER THREE

The Turn to the Brain

OVERVIEW 65

3.1 Cognitive Systems as Functional Systems? 66**3.2 The Anatomy of the Brain and the Primary Visual Pathway** 68
The Two Visual Systems Hypothesis: Ungerleider and Mishkin, "Two Cortical Visual Systems" (1982) 70**3.3 Extending Computational Modeling to the Brain** 76

A New Set of Algorithms: Rumelhart, McClelland, and the PDP Research Group, *Parallel Distributed Processing: Explorations in the Microstructure of Cognition* (1986) 77
 Pattern Recognition in Neural Networks: Gorman and Sejnowski, "Analysis of Hidden Units in a Layered Network Trained to Identify Sonar Targets" (1998) 78

3.4 Mapping the Stages of Lexical Processing 80

Functional Neuroimaging with PET 81
 Petersen, Fox, Posner, and Mintun, "Positron Emission Tomographic Studies of the Cortical Anatomy of Single-Word Processing" (1988) 81

3.5 Studying Memory for Visual Events 84
Functional Neuroimaging with fMRI 86
Brewer, Zhao, Desmond, Glover, and Gabrieli, "Making Memories: Brain Activity That Predicts How Well Visual Experience Will Be Remembered" (1998) 87**3.6 The Neural Correlates of the BOLD Signal** 90
Logothetis, "The Underpinnings of the BOLD Functional Magnetic Resonance Imaging Signal" (2001) 91

Overview

A striking feature of contemporary cognitive science, as compared with the 1970s for example, is the increasing centrality of the brain. This chapter reviews some landmarks in cognitive science's turn to the brain. There are several different strands here. One is the emergence of different techniques for studying the brain. These include brain studies and functional neuroimaging techniques. And then, distinct from these but no doubt related, is the development of neurally inspired computational models.

For both theoretical and practical reasons, neuroscience was fairly peripheral to cognitive sciences until the 1980s. We begin in Section 3.1 by looking at some of the theoretical reasons, particularly the influential idea that cognitive systems are functional systems, and so need to be studied in terms of their function – what they do and how they do it. Many cognitive scientists hold