F5

Cognitive Systems

2020 edition

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cognitio

PSI 3560 – COGNITIVE SYSTEMS

class F5

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COGNITIVE NEUROSCIENCE

The neural basis of cognitive processes and information representation and processing.

Session F5

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Summary

  - Second session (remote)
- The neural basis of cognitive processes and information representation and processing
  - The mind-body problem, reduction, and representation
  - Information representation and processing in the brain

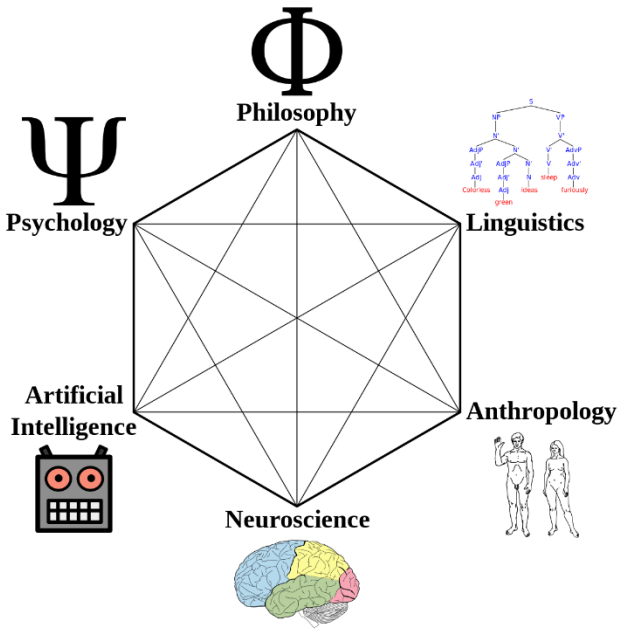
What is cognition

- Concept of cognition – class F2
  - Commonsense concept of cognition
    - Most people take cognition as thinking
    - Thinking → succession of mental states
      - **Mental state** → an expression of a consideration about something
        - » **Consideration** → a belief, desire, intention, expectation, attitude…
      - Propositional attitude
        - » believe that p, desire that p, intend that p, expect that p
    - Thinking is the mental process that expresses a propositional attitude
      - Mental process → something that happens in the mind
        - » in the brain

What is cognition

- Concept of cognition (commonsense)
  - Propositional attitude
    - Is a relation to a proposition
    - Is a declarative sentence → has meaning, has content
      - The meaning is derived from a composition of elementary meanings
        - » Compositionality → Syntactic prescriptions
          - Production rules → Generative grammar
          - Alphabet + Vocabulary + Grammar → Language
            - Language → *the language of thought*
- Model of mind → language of thought

The neural basis of cognitive processes

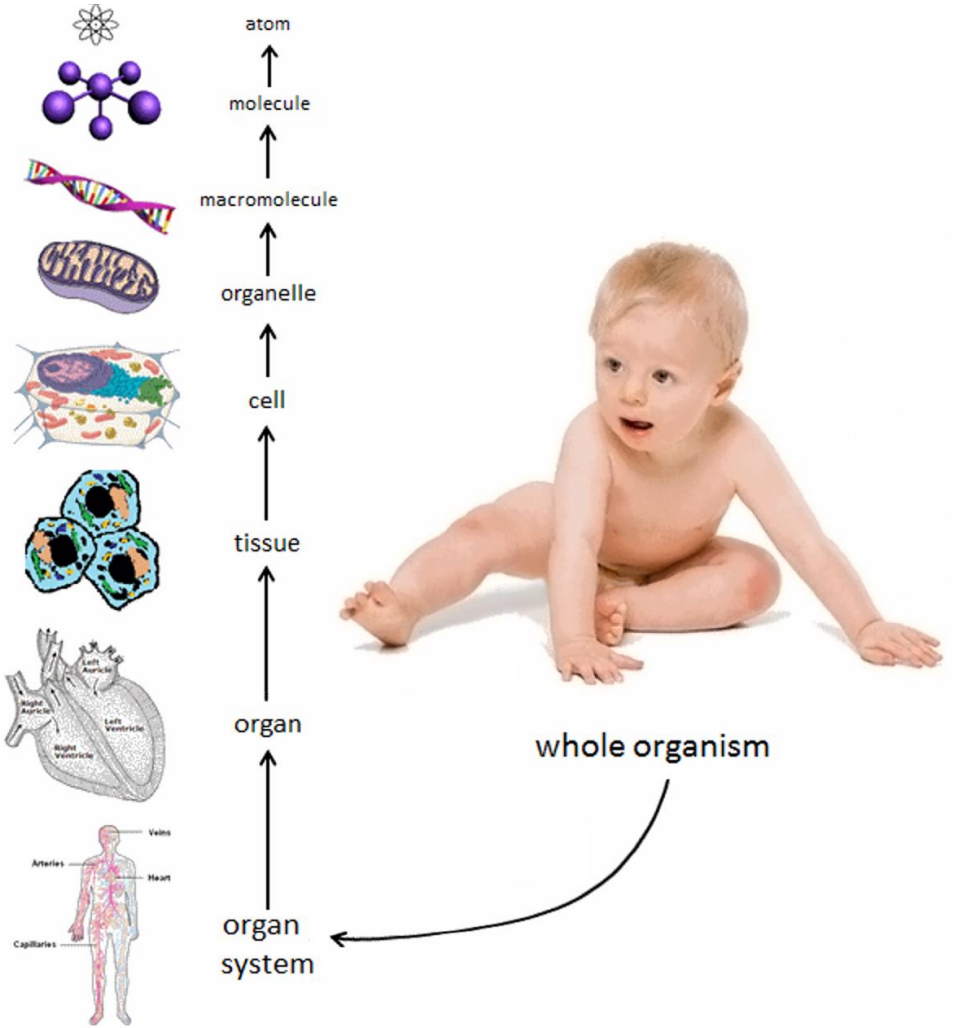


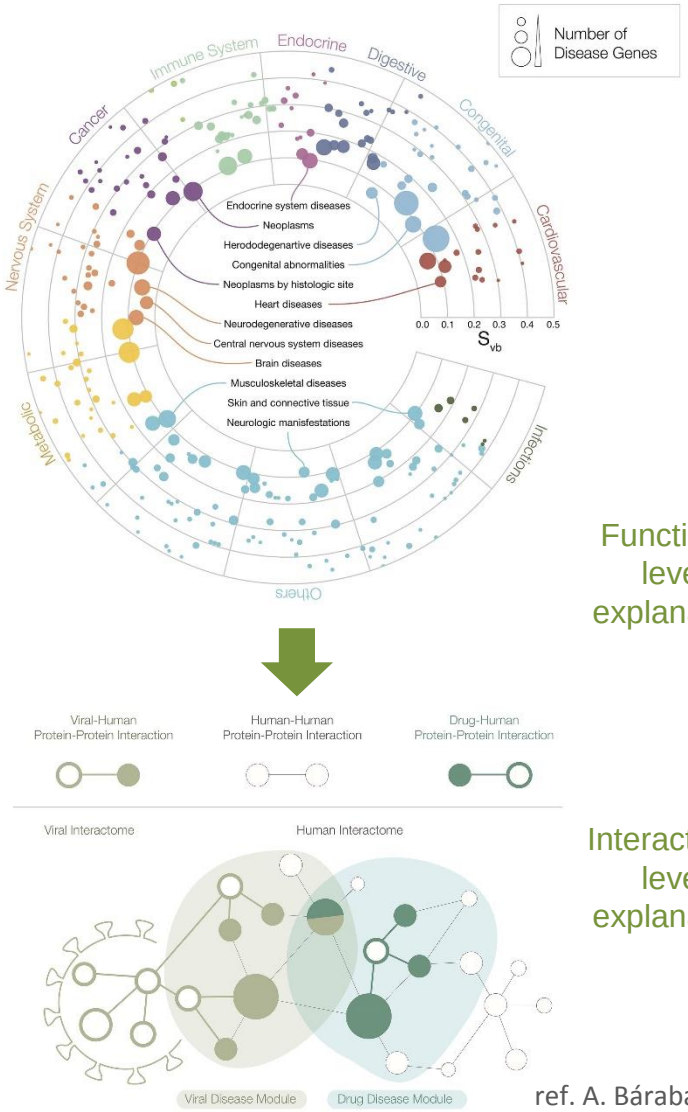
- The explanatory gap
  - How should we understand the relation between psychological states and physical states ?
    - The **Mind-Body problem**

The neural basis of cognitive processes

- Mind-body problem
  - Can mental states be reduced to brain states ?
  - Can psychological explanations be reduced to biological explanations ?
- Reductionism
  - Ontological reduction
    - Complex objects, composed substances, complex relations → reduces to → simpler objects, substances and relations
  - Theoretical reduction
    - Explanations in a theory → reduces to → explanations in another theory with simpler principles

- Reductionism
  - Ontological reduction x Theoretical reduction





Functional level explanation

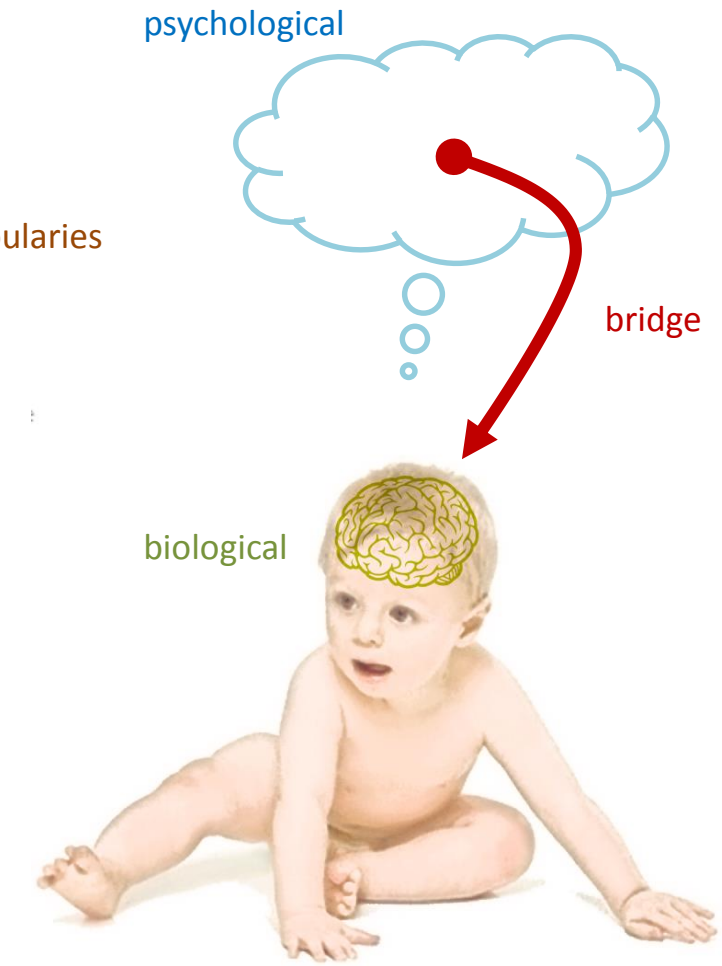
Interactional level explanation

ref. A. Bárabási, 2020

The neural basis of cognitive processes

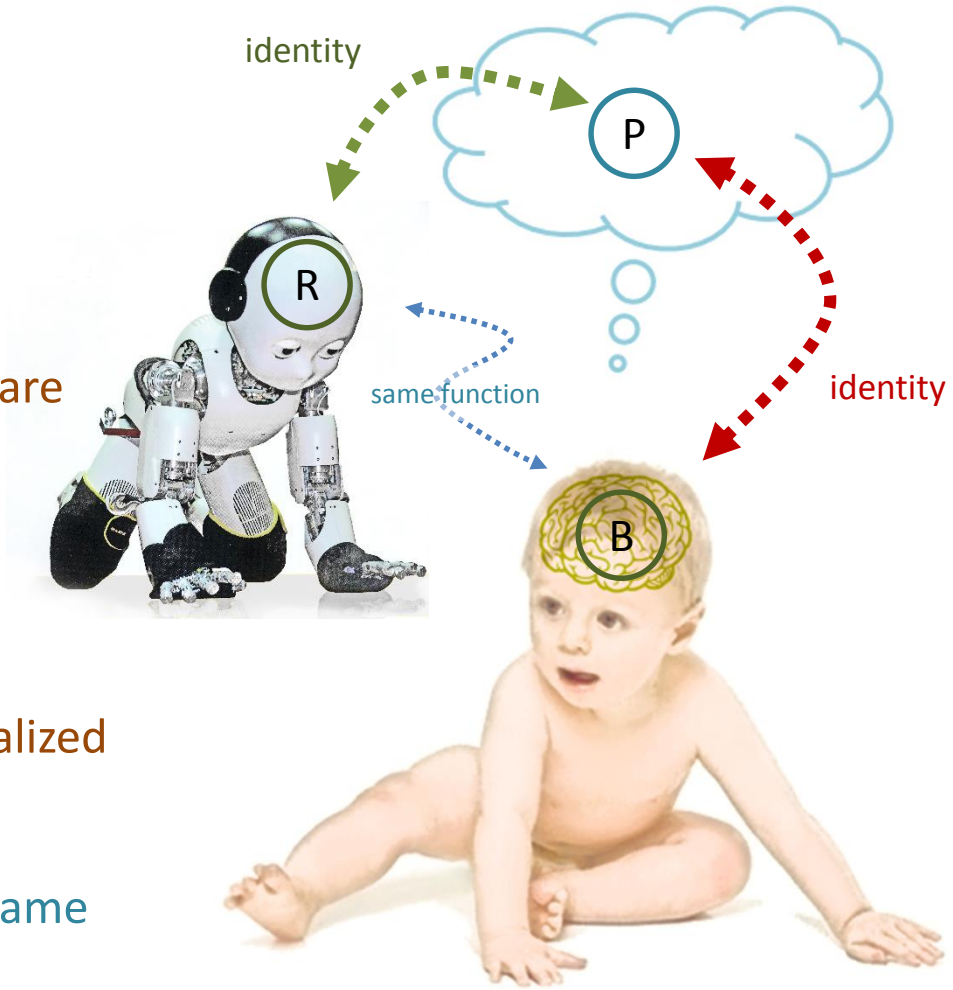
- Mind-body problem
  - Dualism
    - There are two kinds of entities, the **mental** and the **physical**
      - Substance dualism → two substances: mental and physical
      - Property dualism → one substance, but
        - » Two kinds of properties: mental and physical
  - Monism
    - Just one kind, the physical
      - Physicalism → mental properties are reducible to physical properties
      - Reductionism → identity

- Reductionism
  - Nagelian reduction
    - Nagel (1961)
      - Translation between two theoretical vocabularies
        - » Bridge principles or laws
      - Psychological states P1 and P2
        - » P1 → P2
      - Biological states B1 and P2
      - Bridge laws (correlations)
        - » P1 ← → B1
        - » P2 ← → B2
      - Reduction
        - » B1 → B2
  - The bridge laws lead to an *identification* between correlated states



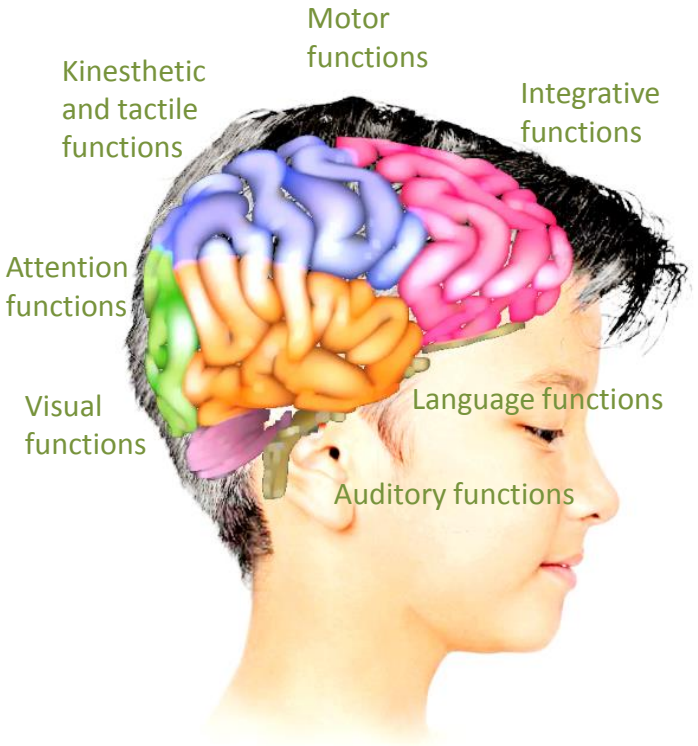
The neural basis of cognitive processes

- Identity theory
  - It's a kind of reduction
  - Mind and body are not distinct
    - **Type identity**
      - The corresponding states are the same
        - » Identical
    - **Token identity**
      - The corresponding states' *tokens* are the same
      - They can be physically realized in several ways
        - » Multiple realizability
          - Implement the same **function**



The neural basis of cognitive processes

- Functionalism
  - Fodor & Putnam (1965-67)
  - It's a token identity
    - Functions as the tokens
    - Functions can be multiply realizable
      - The physical realization is required to be sufficiently complex to carry out the function
  - It is implicit in Marr's computational theory
    - The *physical implementation* is the last aspect, preceded by the *computational model* and the *algorithmic specification*.



The neural basis of cognitive processes

- Marr's approach as a functionalist theory
  - Computational model
    - Specifies the functions
  - Algorithmic description
    - Specifies the type of representation
    - Specifies the sequence of operations and transformations
      - That are carry out on the represented data to produce the desired functions
  - Physical implementation
    - Specifies a physical realization that is suitable to the circumstances

This is all for today.