

Kognitionspsychologie II: Session 1

Introduction

Rui Mata, FS 2021

Rui Mata: Education and Main Academic Positions



Cognitive and Decision Sciences

Aktuell Studium Forschung Weiterbildung **Fakultät**

 Fakultät > Abteilungen > Cognitive and Decision Sciences 

Research	Teaching	Applied Decision Science
Events	BSc Project	MSc Project
Team	 <p>Cognitive and Decision Sciences Meet the Team of 2021</p>	

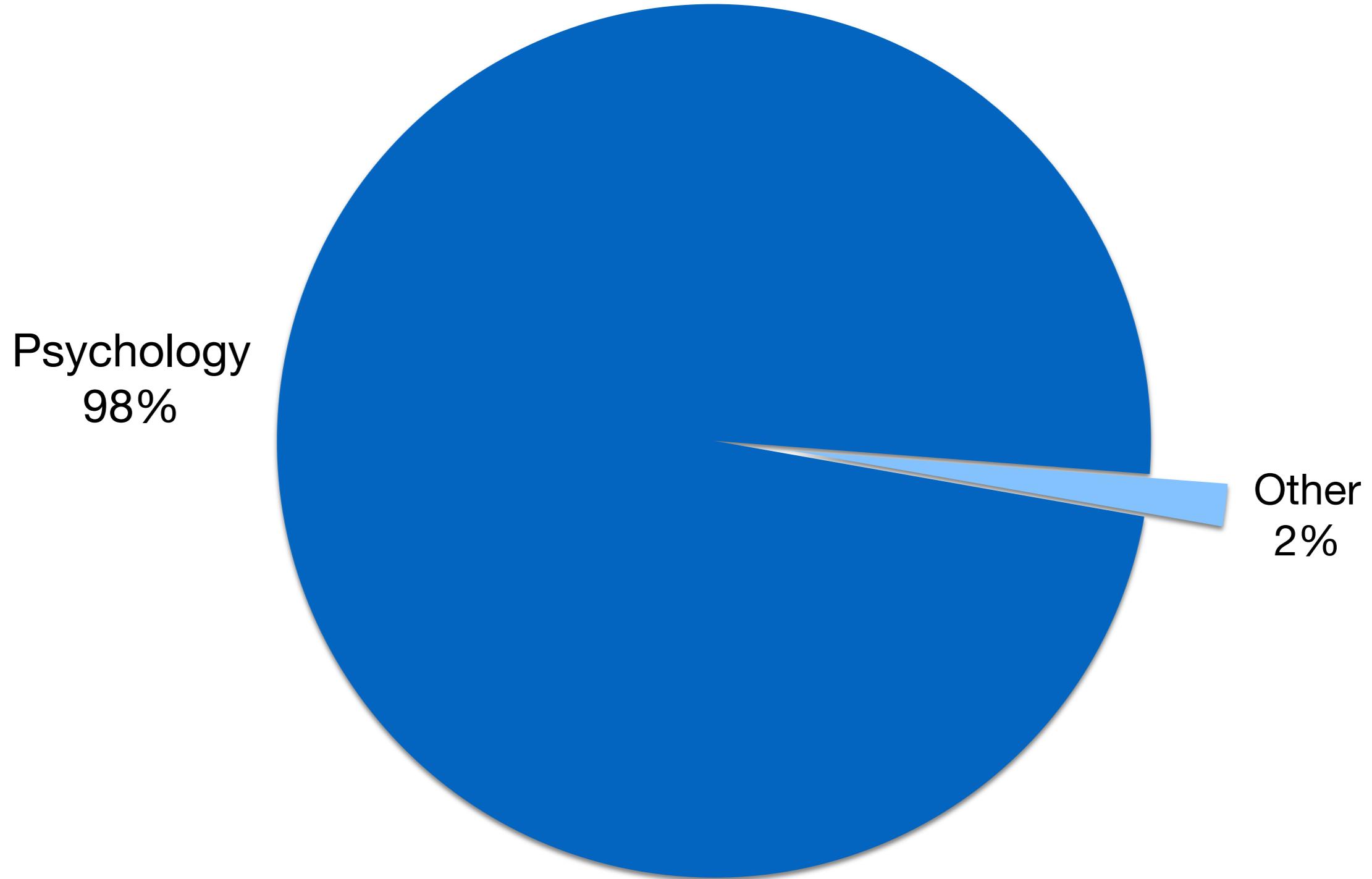
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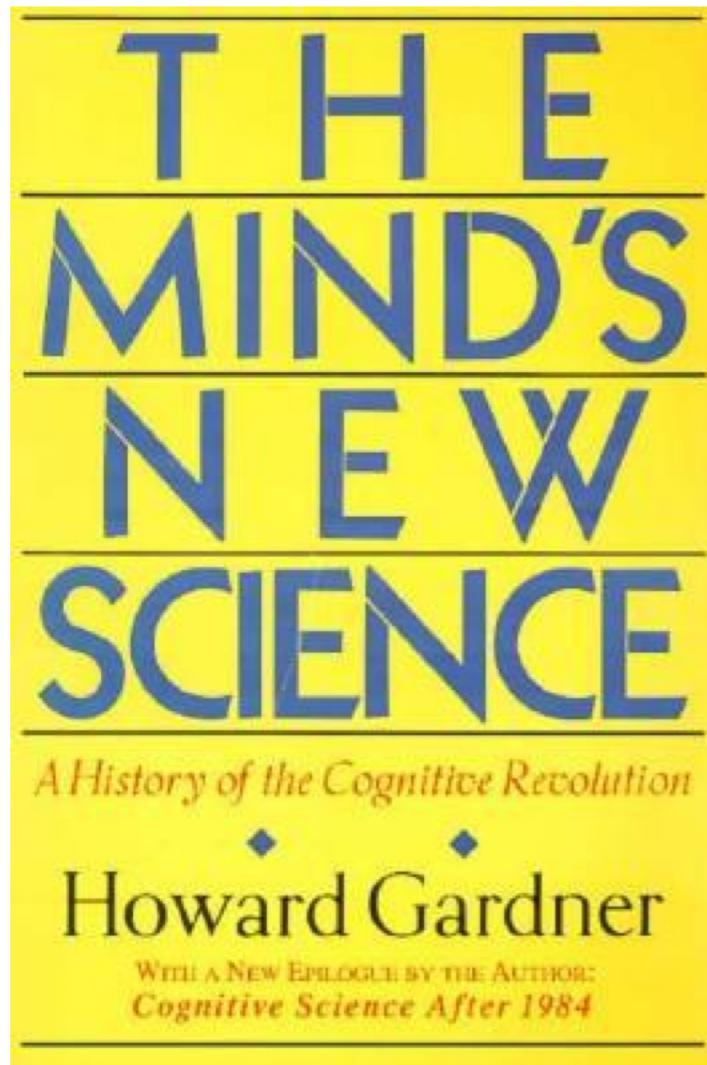
Cognitive and Decision Sciences

The Center for Cognitive and Decision Sciences (CDS) investigates how people of all ages make decisions. Our goal is to understand the psychological mechanisms underlying decision making to ultimately help individuals make better choices in everyday life.

«Our Mission: Understanding and improving human decision-making through the use and development of evidence-based practices»

You!





„The safest general characterization of the European philosophical tradition is that it consists of a series of footnotes to Plato“

Alfred North Whitehead

Gardner, H. (1985). *The mind's new science: A history of the cognitive revolution*. New York: Basic Books.

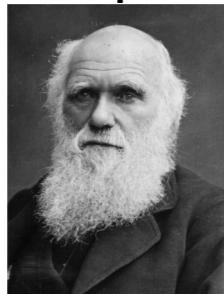
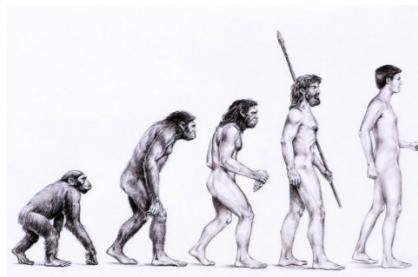
Is there nothing new under the sun?

Example

Person

Discipline

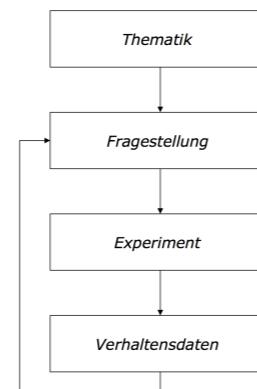
Evolution



Charles Darwin

Biology

Empirical Method

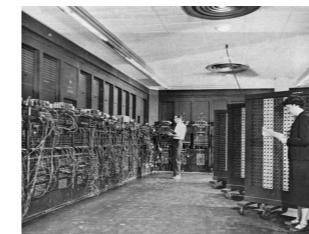


Wilhelm Wundt

Psychology

Information Theory

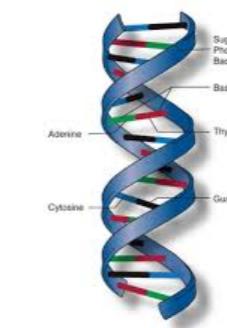
ENIAC: Electronic Numerical Integrator And Computer



Claude Shannon

Computer Science

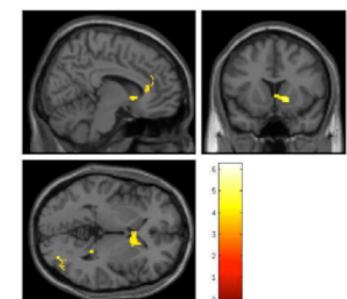
DNA Structure



James Watson
Francis Crick

Genetics

fMRI



Seiji Ogawa

Medicine

1838

1879

1948

1953

1992

Learning Objectives for the Semester

You should be able to...

- learn about central theories and models in key areas of psychology
- become familiarized with common methods used in the psychological sciences
- learn about examples of applications of psychological science to real-world contexts
- reflect about the need for pluralistic explanations of human behavior

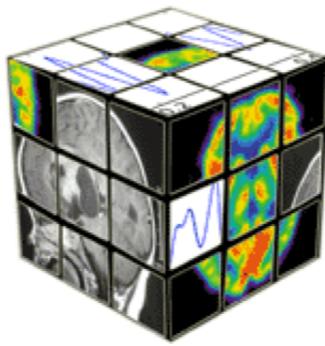
Learning Objectives for Today

- Place psychology within the Cognitive/Neuro/Affective Sciences
- Discuss pluralistic explanations: Aristotle, Tinbergen, Marr
- Discuss the role of evolutionary explanations in psychology
- Learn about the syllabus

Psychology and the other sciences...



<http://cognitivesciencesociety.org/>
(1979)



Cognitive
Neuroscience
Society

<http://www.cogneurosociety.org>
(1994)



<http://www.society-for-affective-science.org>
(2012)

The formation of societies can be seen as a symptom of attempts to place psychology in contact with a larger set of ideas and research agendas across the last few decades; from a focus on explanations of cognition as representation and computation (Cognitive Science), the role of biological implementation for behavior (Cognitive Neuroscience), and the affective and motivational bases of human behavior (Affective Science).

Emphasis on *computation/processes*

cognitive sciences Research Main Field specific

A large word cloud centered around the word "science". Other prominent words include "study", "intelligence", "cognition", "language", "research", "models", "processes", "information", "behavior", "brain", "memory", "edit", "systems", and "process". The words are in various sizes and colors, with a large orange arrow pointing from the top left towards the word "mind".

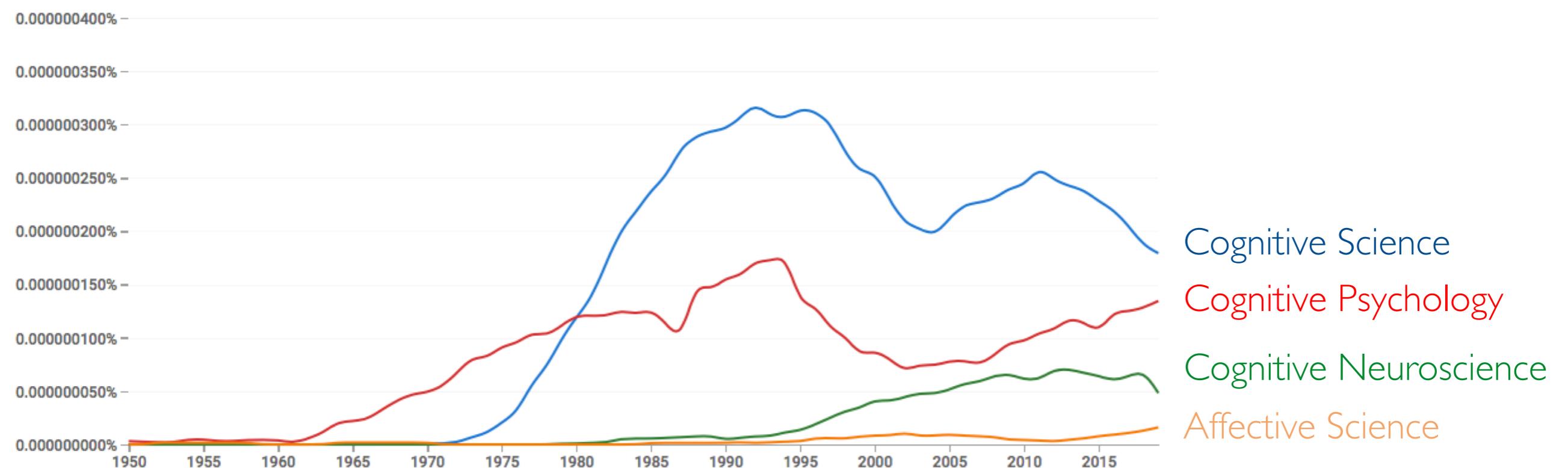
http://en.wikipedia.org/wiki/Cognitive_science

Emphasis on *emotion*

http://en.wikipedia.org/wiki/Affective_science

Emphasis on *neural implementation*

http://en.wikipedia.org/wiki/Cognitive_neuroscience



Google books Ngram Viewer

Frequency of use of the terms **Cognitive Science**, **Cognitive Psychology**, **Cognitive Neuroscience**, and **Affective Science** in the last ca. 70 years

Pluralistic Explanations

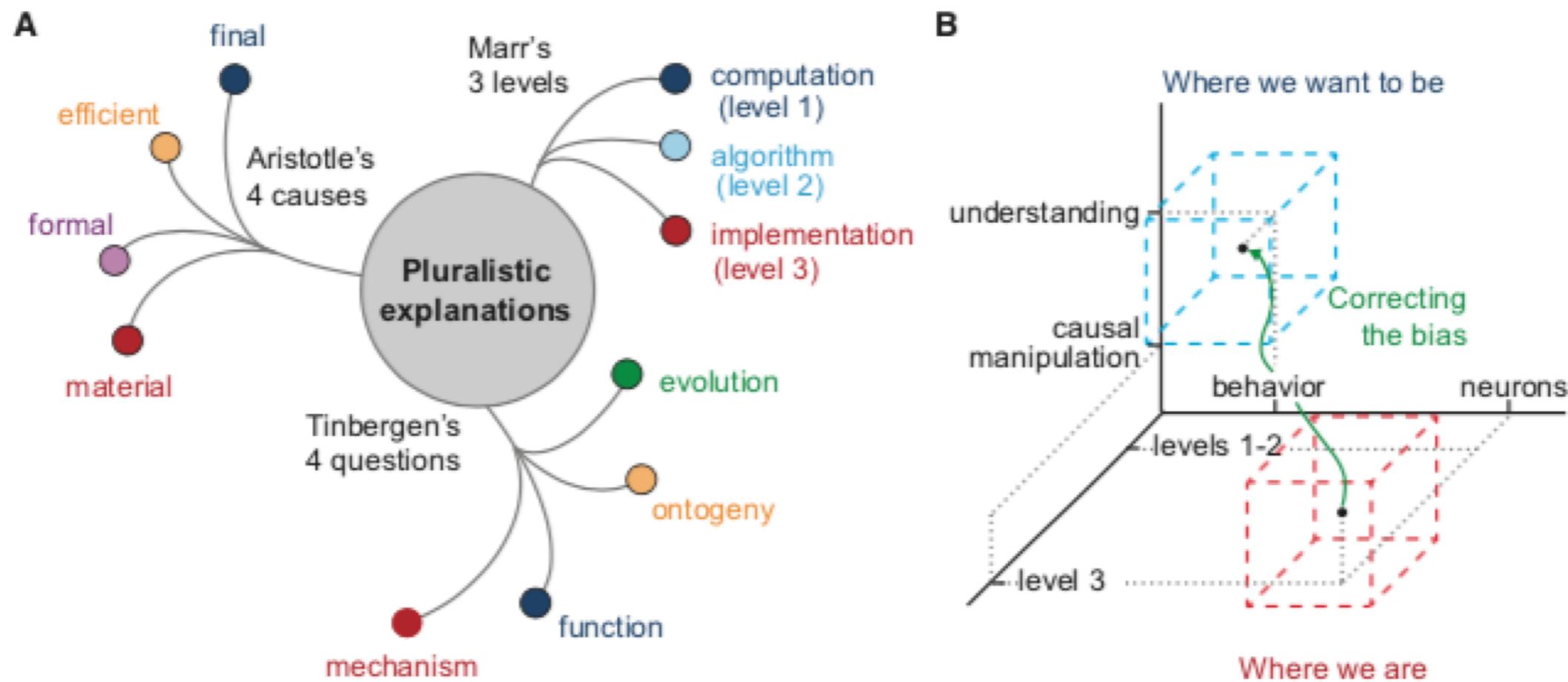


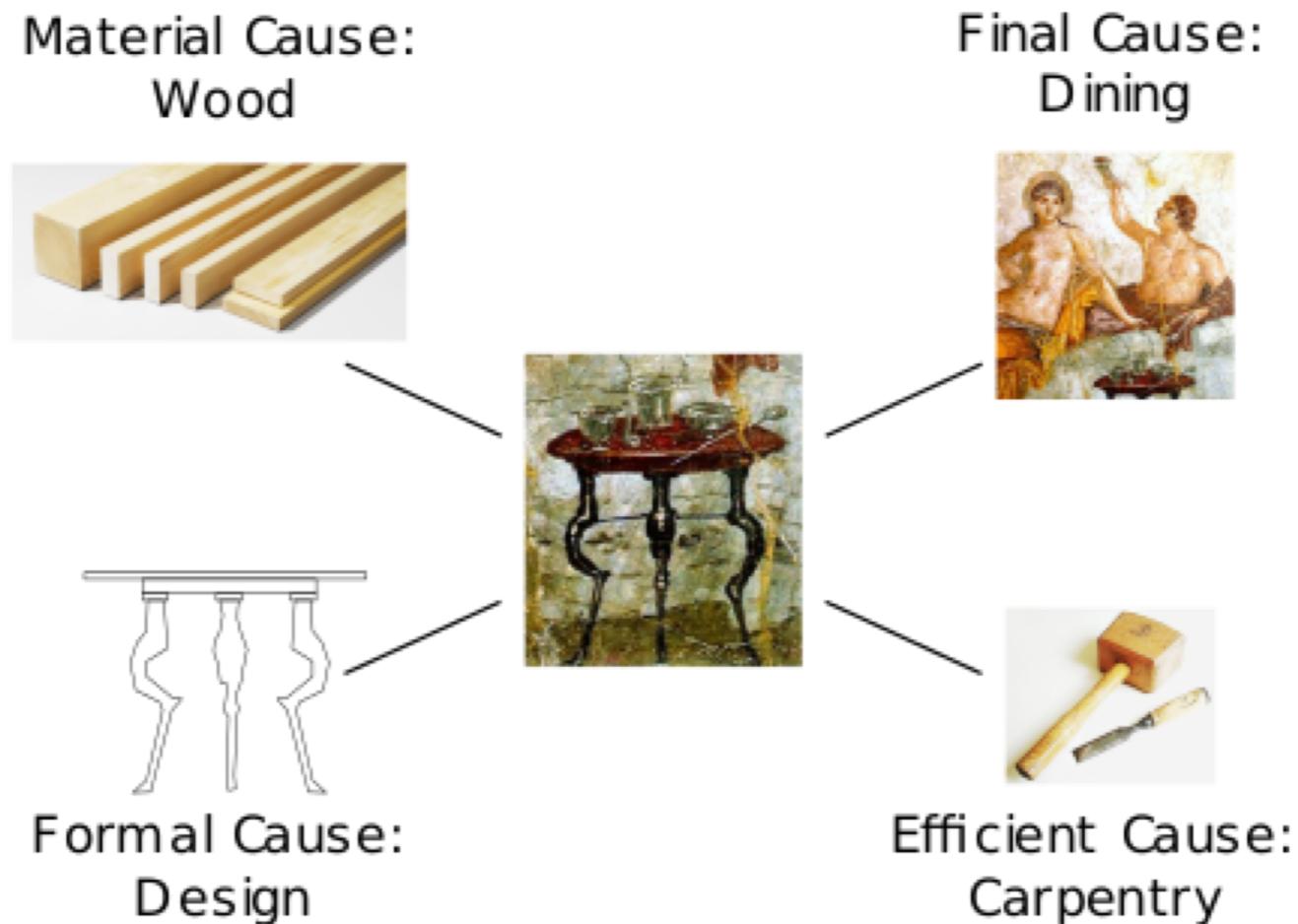
Figure 4. The Future History of Pluralistic Explanation

(A) That understanding of a phenomenon is multidimensional has long been appreciated. Aristotle posited four kinds of explanation: to explain "why" something changes, a polyhedral notion of causality is necessary; one that includes not only the material cause (what it is made out of), but also the other three "whys": formal (what it is to be), efficient (what produces it), and final (what it is for). Tinbergen also devised four questions about behavior: to go beyond its proximate causation (mechanism) to also considering its evolution, development, and real-world function. Marr's three levels are also shown.

(B) Three-dimensional space with axes of understanding-manipulation, behavior-neurons, and Marr's levels. The red box is where we are and the blue is where we should be.

Krakauer, J. W., Ghazanfar, A. A., Gomez-Marin, A., MacIver, M. A., & Poeppel, D. (2017). Neuroscience needs behavior: Correcting a reductionist bias. *Neuron*, 93(3), 480–490.
<http://doi.org/10.1016/j.neuron.2016.12.041>

Aristotle's four causes



Tinbergen's four questions

Tinbergen argued that there are complementary categories of explanations, involving different kinds and objects of explanation.

FOUR AREAS OF BIOLOGY: FOUR QUESTIONS		Two objects of explanation	
Two kinds of explanations	Proximate	Developmental/historical	Single form
	Explains how organisms work by describing their mechanisms and their ontogeny	A sequence that results in the trait	The trait at one slice in time
Evolutionary	Ontogeny	Mechanism	<p>Q: How does the trait develop in individuals?</p> <p>A: Description of the trait's forms at sequential life stages, and the mechanisms that control development.</p>
	Phylogeny	Adaptive significance	<p>Q: What is the phylogenetic history of the trait?</p> <p>A: Description of the history of the trait as reconstructed from its phenotype and genotype precursors</p> <p>Q: How have variations in the trait interacted with environments to influence fitness in ways that help to explain the trait's form?</p> <p>A: Description of how variations in the trait have influenced fitness</p>



Nikolaas Tinbergen (1907-1988)

Ethologist, received the Nobel Prize for Medicine in 1973 for “discoveries concerning organization and elicitation of individual and social behaviour patterns”. Tinbergen had a large impact on the field of ethology (i.e., the science of animal behavior) with his book *The Study of Instinct* (1951), in which he proposed to investigate innate behaviour that is not acquired or changed by learning.

Nesse, R. (2013), Tinbergen's four questions, organized: A response to Bateson and Laland. *Trends in Ecology and Evolution*, 28(12), 681-682.

Tinbergen, N. (1963) On aims and methods of ethology. *Z. Tierpsychol*, 20, 410–433.

Language

Ontogeny	Mechanism
Phylogeny	Adaptive Significance

Language

Ontogeny

Age of Arrival	Mean Score
Native	~270
3-7	~270
8-10	~255
11-15	~235
17-39	~210

Mechanism

a

b

Phylogeny

Adaptive Significance

Marr's levels

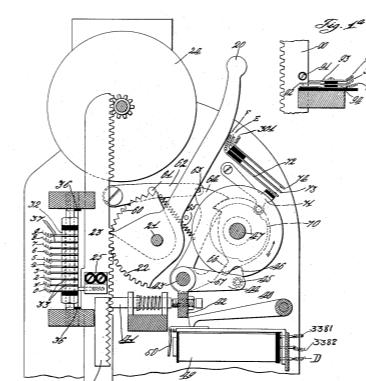
- **Computational level:** What is the goal of a given process/computation?
- **Algorithmic level:** How can a goal be achieved using a particular set of inputs/outputs, which algorithm describes the required transformations?
- **Implementational level:** How is an algorithm physically implemented (e.g., neural activity)?



Addition
 $S_T = Z_1 + \dots + Z_N$

A diagram illustrating the addition algorithm for $58 + 36 = 94$. It shows two columns of numbers. The left column has a bracket under the tens column with arrows pointing to 'Record the 1 ten.' and 'Record the 4.'. The right column has a bracket under the tens column with arrows pointing to 'Add the tens. $1 + 5 + 3 = 9$ ' and 'Record the 9 tens.'

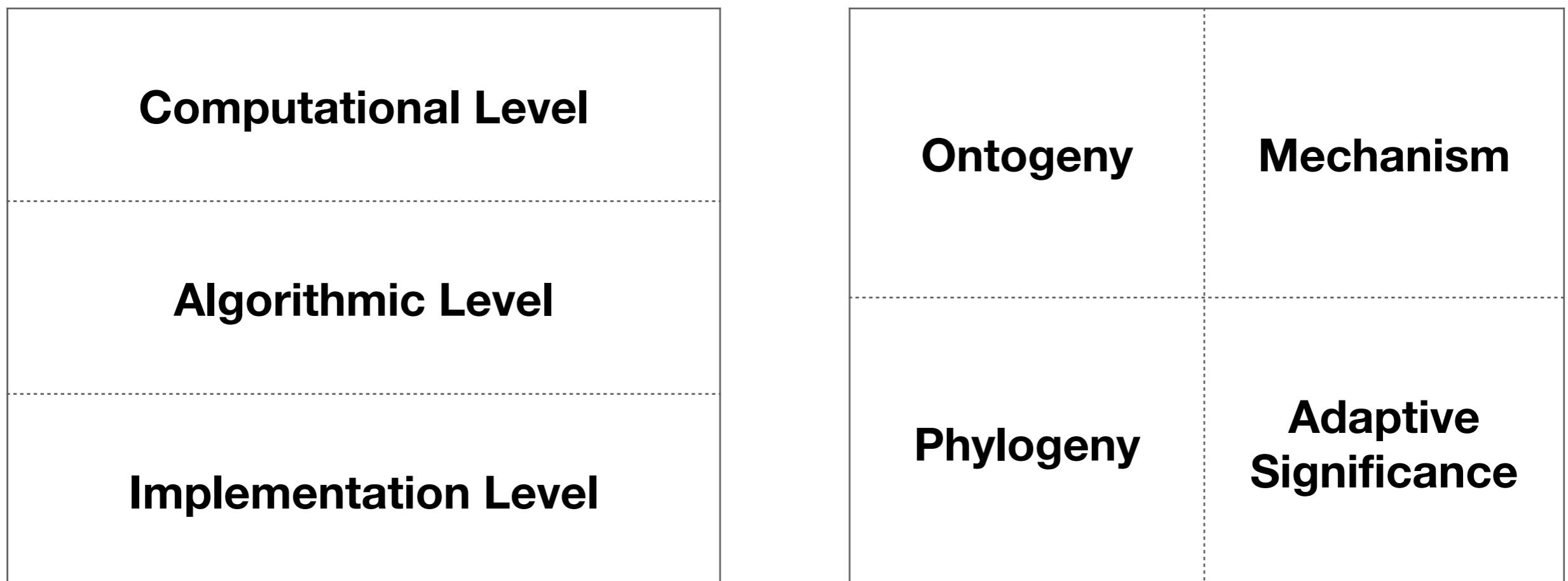
$$\begin{array}{r} 58 \\ + 36 \\ \hline 94 \end{array}$$



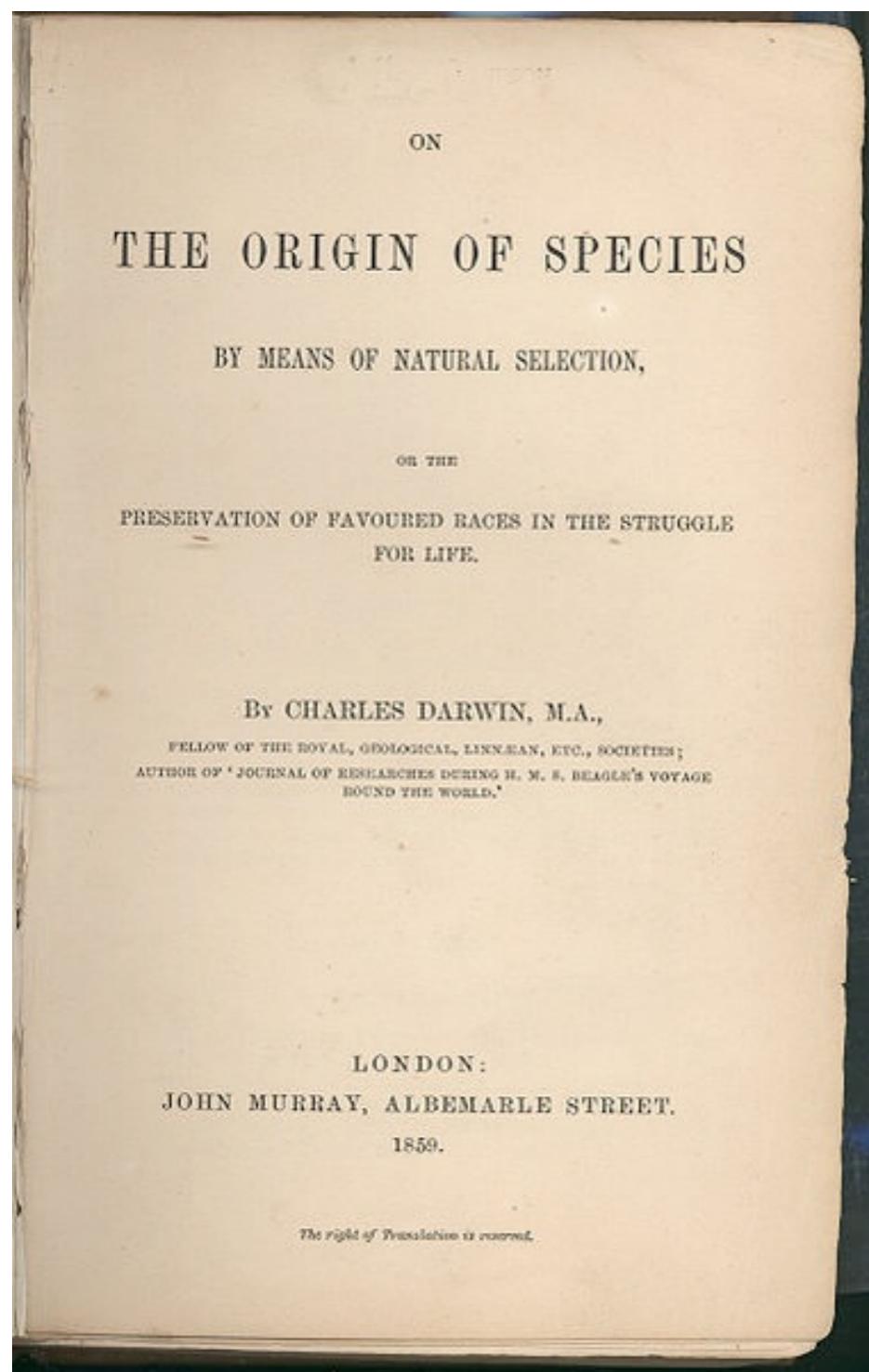
David Marr (1945-1980)

Studied mathematics and physiology but later worked as a professor of Psychology at MIT. He integrated results from psychology, artificial intelligence, and neurophysiology to produce a new model of vision. He is particularly famous for proposing a three level view of how to understand information processing systems (see left).

Marr's Levels vs. Tinbergen's Questions



Evolutionary Theory and Psychology



“In the distant future I see open fields for far more important researches. Psychology will be based on a new foundation, that of the necessary acquirement of each mental power and capacity by gradation. Light will be thrown on the origin of man and his history.”

Charles Darwin, *The Origin of Species*

“Our modern skulls house a stone age mind”



Thesis: A collection of adaptations (modules) that represent solutions to adaptive problems of our species, that is, reoccurring problems that had significant impact on our reproduction and survival.

- Examples: Foraging, Communication, Cooperation, etc.
- Metaphors: Swiss-army knife (Tooby & Cosmides) or Adaptive toolbox (Gerd Gigerenzer)

Barkow, J., Cosmides, L., & Tooby, J. (1992). *The Adapted Mind: Evolutionary Psychology and the Generation of Culture*. Oxford University Press.

“Our modern skulls house a stone age mind”

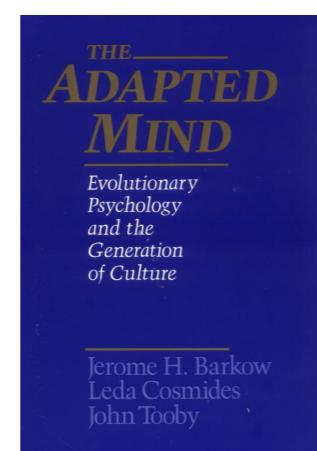
modularity: i.e., the degree to which a system's components may be separated and recombined; in cognitive science, the thesis of modularity of mind holds that the mind is composed of (at least some) independent, domain-specific processing modules.

strong modularity

Our cognitive architecture consists of a confederation of hundreds or thousands of domain-specific (function specific) modules designed to solve adaptive problems from our evolution as a species of hunter-gatherers.

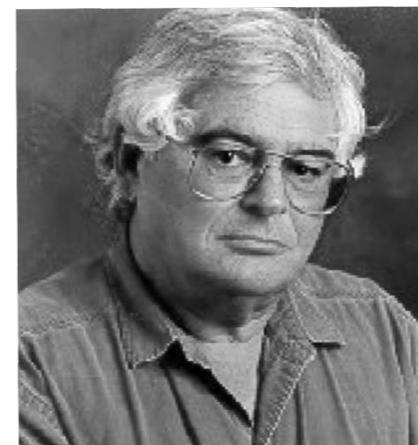


John Tooby (1952-)
Leda Cosmides (1957-) 1992

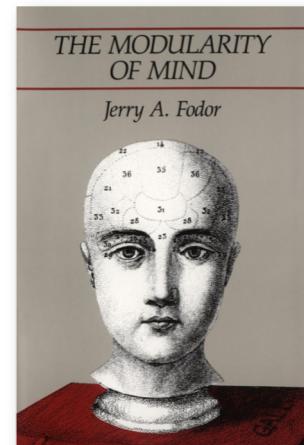


weak modularity

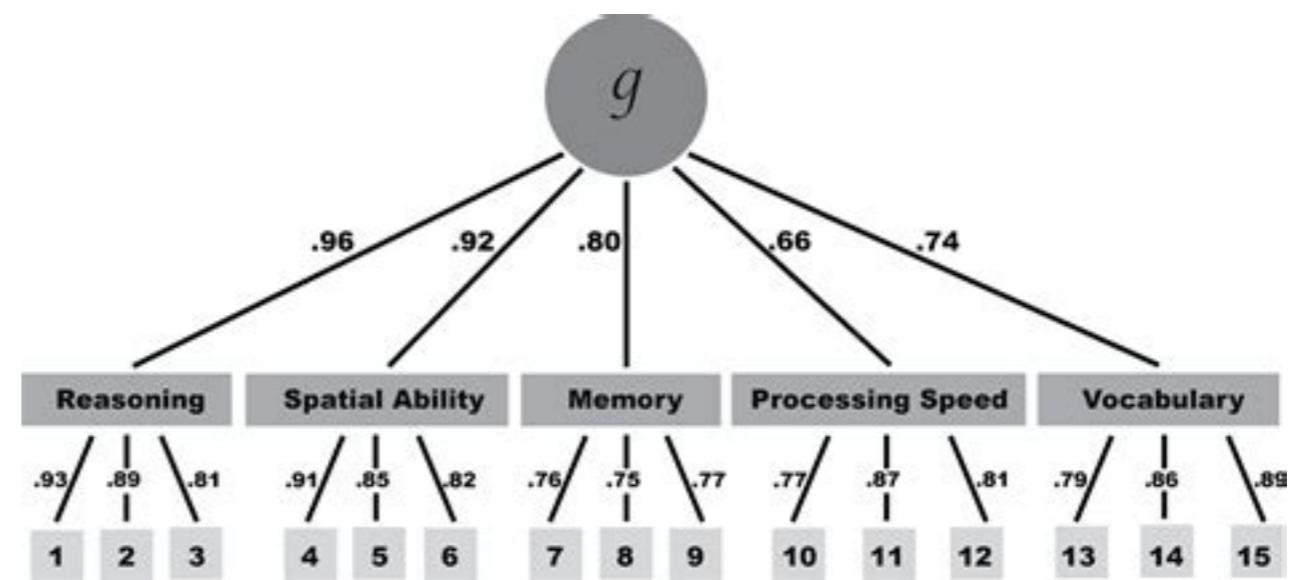
Modularity is only applied to perceptual modules, which are informationally encapsulated and provide input to higher-order systems.



Jerry Fodor (1935-2017)



Next week



Summary

- **Psychology and the sciences:** historically, psychology has had different goals; since the “cognitive revolution” there has been a focus on understanding cognition and behaviour resorting to concepts of representation and computation; more recently, there has been increased focus on biological implementation and understanding both cognition and affect/motivation.
- **Pluralistic explanations:** philosophy (Aristotle) and other sciences (Tinbergen, Marr) have accepted that there are different aspects of phenomena and that one can pose different questions regarding these.
- **Tinbergen's questions:** ontogeny, mechanism, phylogeny, adaptive significance
- **Marr's levels:** computational, algorithmic, implementation
- **Evolution:** evolutionary principles may be helpful to understand human behaviour and psychology - but the nature-nurture debate continues in psychology...
- **Modularity of mind:** there are different views concerning the degree to which the cognitive system is composed of somewhat independent modules and what their characteristics are.

Course website



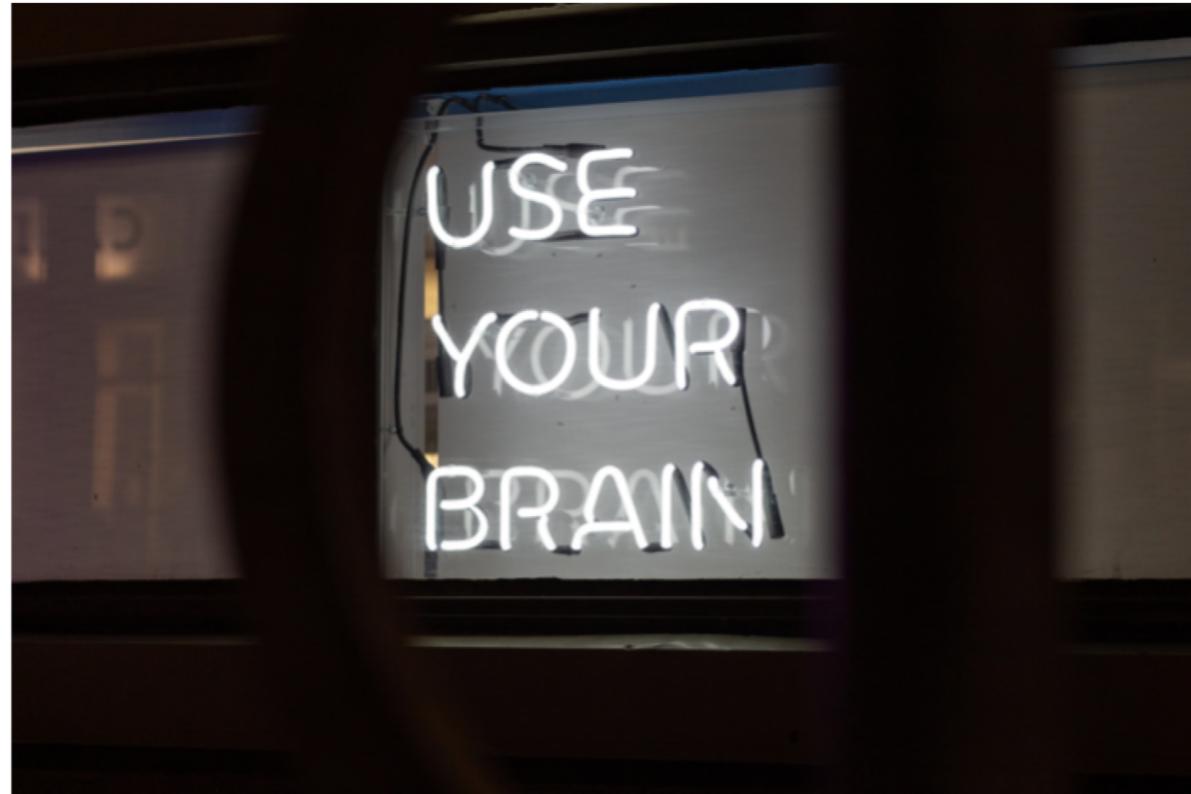
KOGPSY

Welcome to the website for *Kognitionspsychologie II* FS21 ([23263-02](#))

Instructor: [Rui Mata](#), University of Basel

Contents

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- [What is this course about?](#)
- [What can you expect to learn?](#)
- [How should you use this website?](#)
- [Video recordings and SWITCHtube](#)



Thinking, feeling, willing are simply words we use to describe different ways of using one's brain! Photo by [Jesse Martini](#) on [Unsplash](#)

<https://matarui.github.io/kogpsy/>