

# Consciousness in Unified Theories of Minds

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# Consciousness in Unified Theories<sup>2</sup> of Minds

- ① Unified Theories of Minds
- ② Necessary and sufficient conditions for Intelligence
- ③ On the Nature of Consciousness

1

# Unified Theories of Minds

# What Unified ToM are

- Theories of Mind that cut across all levels of organisation of an Intelligent System.

# Definition of Level (for *Systemic Description*)

A level consists of a

**Medium** that is to be processed,

**Components** that provide primitive processing,

**Laws of composition** that permit components to be assembled into *systems*, and

**Laws of behavior** that determine how system behavior depends on the component behavior and the structure of the system.

*Unified Theories of Cognition.*  
*(Newell, 1990 and earlier).*

## **Knowledge-level systems**

**Medium: Knowledge**

**Laws: Principle of rationality**

## **Program-level systems**

**Medium: Data structures, programs**

**Laws: Sequential interpretation of programs**

## **Register-transfer systems**

**Medium: Bit vectors**

**Laws: Parallel logic**

## **Logic circuits**

**Medium: Bits**

**Laws: Boolean algebra**

## **Electrical circuits**

**Medium: Voltage/current**

**Laws: Ohm's law, Kirchhoff's law**

## **Electronic devices**

**Medium: Electrons**

**Laws: Electron physics**

*Unified Theories of Cognition.  
(Newell, 1990).*

# The Nature of Knowledge

**Whatever can be ascribed to an agent, such that its behavior can be computed according to the principle of rationality.**

*Unified Theories of Cognition.  
(Newell, 1990 and earlier).*

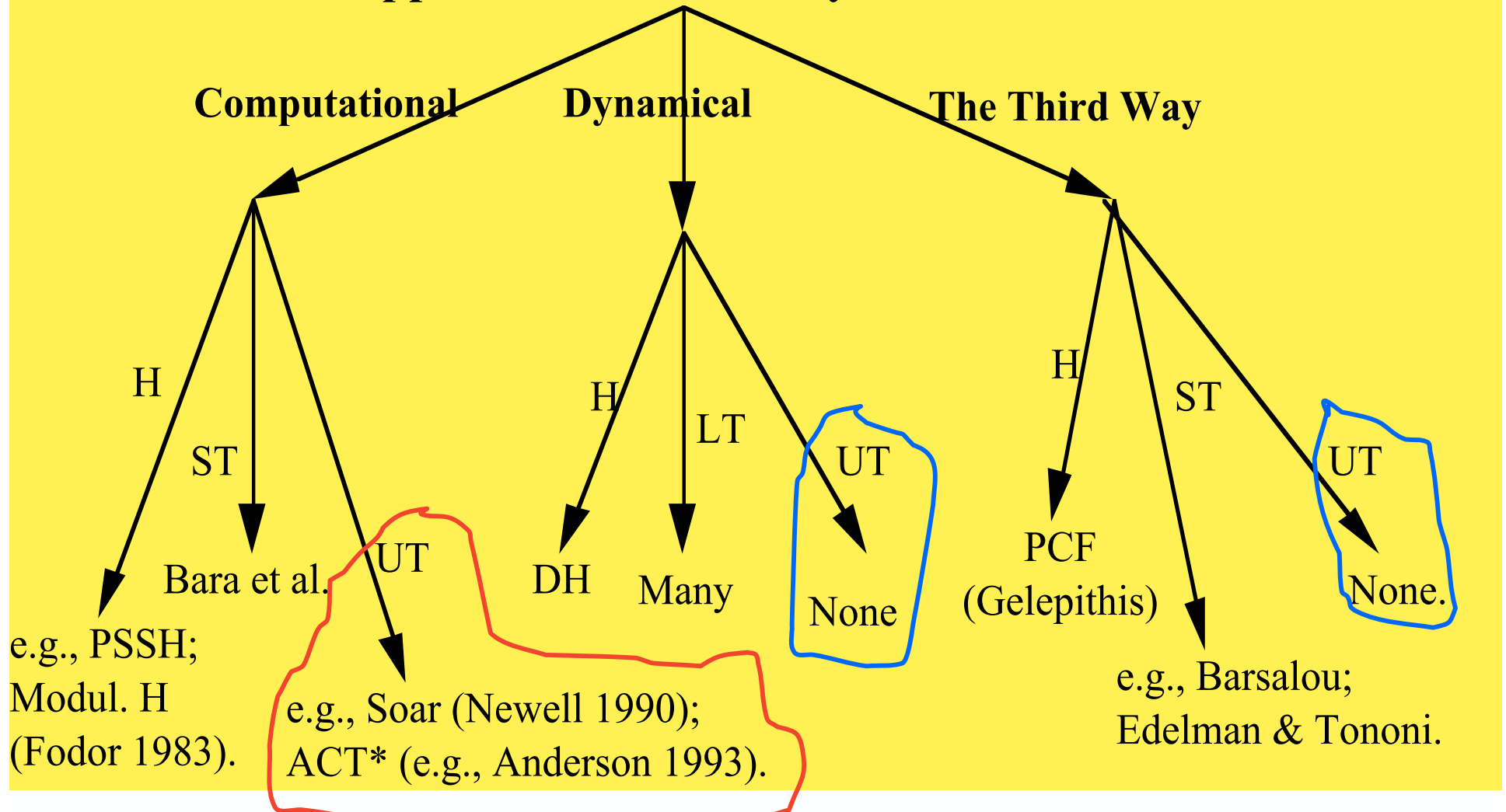
# The Principle of Rationality

**If an agent has knowledge that one of its actions will lead to one of its goals, then the agent will select that action.**

*Unified Theories of Cognition.  
(Newell, 1990 and earlier).*



# Approaches to the Study of Mind



(After Gelepithis 2002)

ST= Subject Theory    H = Hypothesis

LT= Local Theory    DH = Dynamical Hypothesis

UT= Unified Theory    PCF = Preliminary Conceptual Framework

# Domains, CSTC, and the role of Communication

10

Investigation Dom.	CSTC	Role of Comm.
Animals & Machines	Continuous S.	Fund'l. Not Analysed.
Intelligent Systems	Programming. S.	Not considered.
	Continuous S.	Not considered.
	Other Math. S.	Addr's'd, not Cntrl.
Orgs & H. Soc.	Human Language.	Cntrl; C'hnsive Th.

(Gelepithis, 2004 *Kybernetes*).

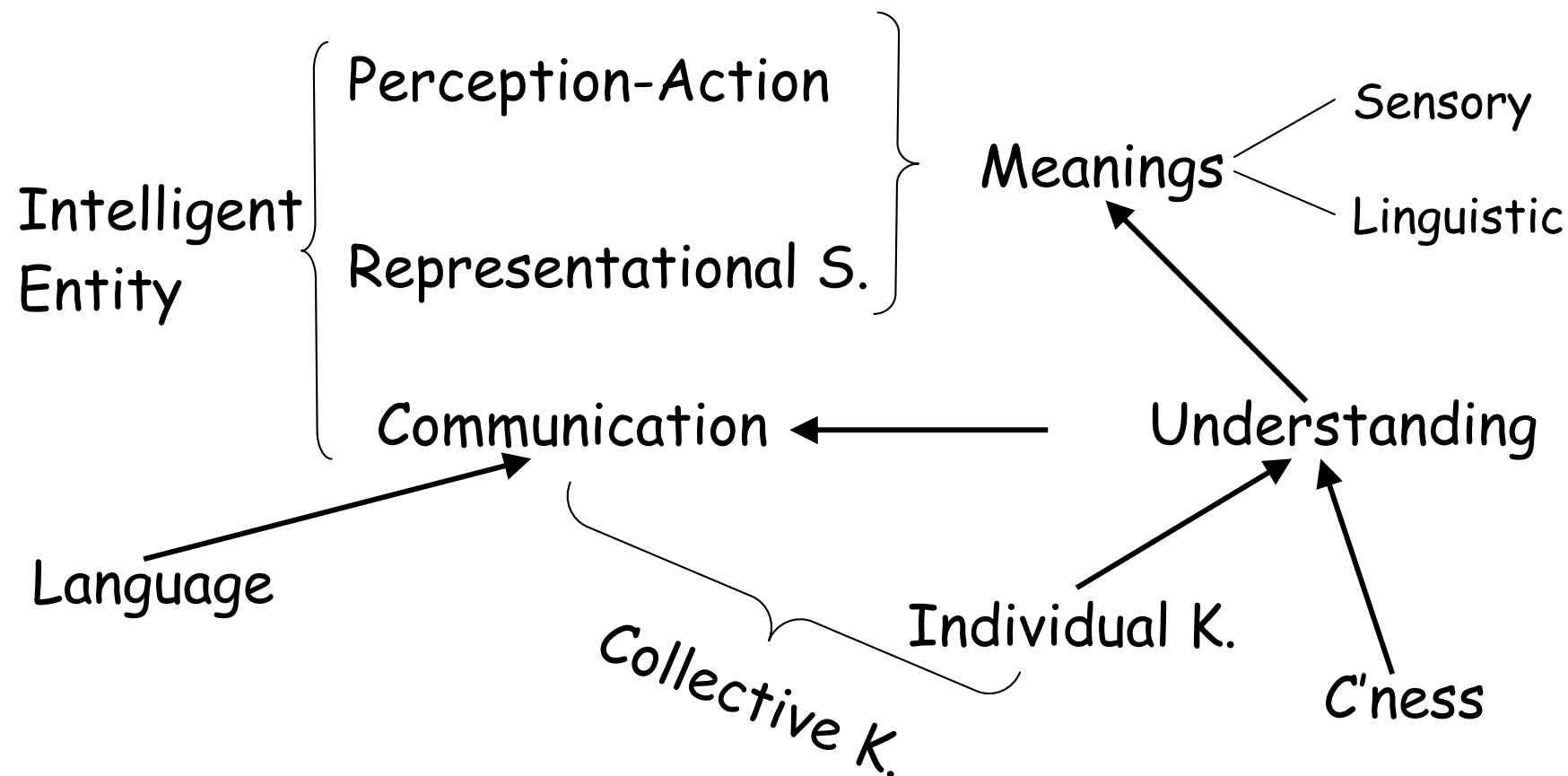
# Foundational notions of Cognitive Science

<i>According to Newell (1990)</i>	<i>According to Gelepithis (1999, 2003)</i>
1. Behaving systems,	1. Perception,
2. Knowledge,	2. Action,
3. <b>Representation</b> ,	3. Growth (e.g., self-organisation),
4. Machine* (e.g., computation),	4. Meaning,
5. Symbol,	5. Thinking (e.g., computation),
6. Architecture,	6. Understanding,
7. <b>Intelligence</b> ,	7. Communication,
8. Search,	8. <b>Representation</b> ,
9. Preparation vs. deliberation*.	9. <b>Intelligent system</b> ,
	10. Purpose,
	11. Emotion,
	12. Human language,
	13. Consciousness,
	14. Beauty.

Derived notions:  
Knowledge,  
Symbol.

**Culture,**  
**Ethical principles**

# Nexus of Foundational notions



2

# Necessary and sufficient conditions for Intelligent Systems

(After Gelepithis 1991, 2001, 2002)

# Definition of Intelligent System

A system,  $S$ , is intelligent if and only if:

- a) It possesses sensors.
- b) It is able to act on its environment.
- c) It possesses its own **Representational System**  $R_S$ , i.e.,  $R_S$  is independent of any other  $R_{S^*}$  (i.e., the representational system of  $S^*$ ).
- d) It is able to connect sensory, representational, and motor information.
- e) It is able to **Communicate** with other systems within its own class.

# Consequence

- The space of intelligent systems is extremely varied with nearly impenetrable regions of intelligence.

# Definition of a Representational System

- $R_e$  is a representational system of  $E$  if and only if  $R_e$  is a **Thought System** of  $E$  able to create **Representations**.



# Definition of Representation

- For an entity  $E$ , a representation of a situation, say,  $S_1$  is another situation, say,  $S_2$ , characterised by the properties:
  - $S_2$  simplifies  $S_1$ ; and
  - $S_2$  preserves the essential characteristics of  $S_1$ .

# Definition of Thought System

$\mathcal{T}$  is a thought system of  $E$

if and only if

$\mathcal{T}$  is a system of thoughts of entity  $E$ .

# Definition of Thought

$\square$  is a thought of  $E$

if and only if

$\square$  is an ordered  $n$ -tuple of meanings of  $E$ .

# Definition of Meaning

The meaning,  $M$ ,  
 of something  $s$ ,  
 in the context  $C_s$ ,  
 for the entity  $E$ ,  
 at time  $t$

} symbol  $M (s, C_s, E, t)$

is the *prevailed* formations of  $R^m_E$ , at  
 $t$ .

## Definition of Communication

An entity  $E_1$  communicates with  $E_2$  on a topic  $S$  if, and only if:

$E_1$  understands  $S$  -symbol:  $U(E_1, S)$ .

$E_2$  understands  $S$  -symbol:  $U(E_2, S)$ .

$U(E_1, S)$  is presentable to and understood by  $E_2$ .

$U(E_2, S)$  is presentable to and understood by  $E_1$ .

# Definition of the-end-result-of Understanding

An entity  $E$  has understood something,  $S$ ,

if and only if,

$E$  can present  $S$  in terms of a system of *own* primitives.

( $\square$  is a primitive iff  $E$ 's understanding of  $\square$  is immediate).

# Précis of the Argument

- A human, H, and an intelligent robot, R, would communicate on a topic T, if and only if:
  - either  $P_H = P_R$  for T (P for primitive); or
  - $P_H$  and  $P_M$  could be described in terms of each other.
  
- Since linguistic primitives are reducible to sense primitives except if they are purely linguistic, one needs language to describe the senses and senses to understand language. Hence  $P_H$  and  $P_R$  could not be described in terms of each other. In other words, human-machine communication is impossible.

3

# On the Nature of Consciousness



# The major issues in the study of Consciousness

(after Gelepithis 2001)

<input type="checkbox"/> <sub>1</sub> : Is it possible to incorporate consciousness into science?
<input type="checkbox"/> <sub>2</sub> : What is consciousness?
<input type="checkbox"/> <sub>3</sub> : The problem of qualia or the subjective - objective issue.
<input type="checkbox"/> <sub>4</sub> : The integrative and attentional nature of consciousness.
<input type="checkbox"/> <sub>5</sub> : Is consciousness an invariant?
<input type="checkbox"/> <sub>6</sub> : Are the words 'consciousness', 'awareness' and 'experience' absolute synonyms?
<input type="checkbox"/> <sub>7</sub> : The issue of altered states of consciousness.
<input type="checkbox"/> <sub>8</sub> : Account for the distinction between conscious (Cs) and unconscious (Ucs) processes.
<input type="checkbox"/> <sub>9</sub> : What is the relation between brain on the one hand and consciousness and the unconscious on the other?
<input type="checkbox"/> <sub>10</sub> : What is the relationship between consciousness and memory?
<input type="checkbox"/> <sub>11</sub> : Does consciousness have causal powers?

# The central Nexus of issues and attempts to resolve it

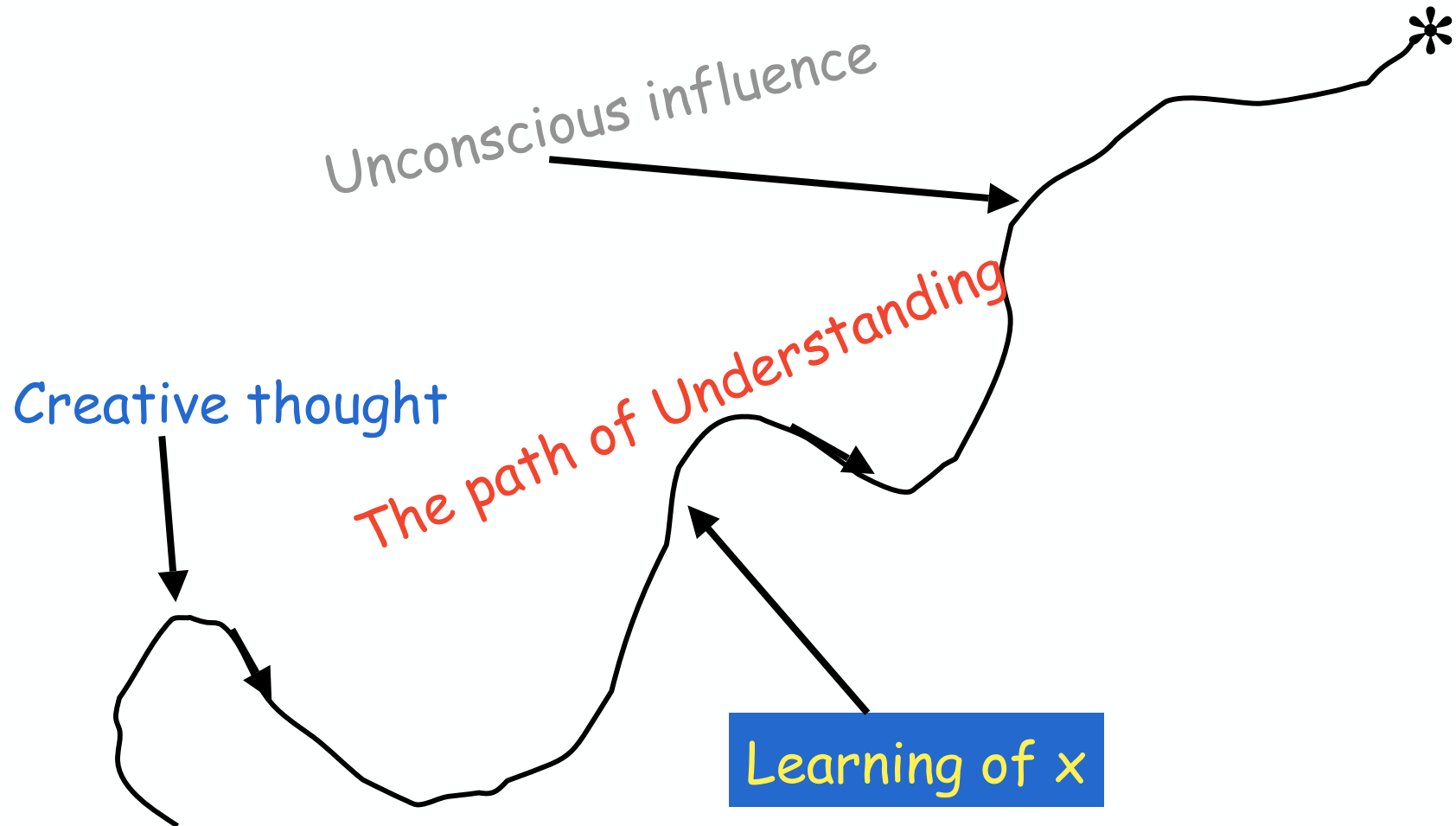
- The problem of Qualia or the subjective-objective issue. **None!**
- The integrative and attentional nature of consciousness. **(Crick, Taylor).**
- Account for the distinction between conscious (Cs) and unconscious (Ucs) processes. **(Freud).**
- What is the relation between brain on the one hand and C'ness and the Ucs on the other? **(Baars, Eccles, Edelman, Hameroff & Penrose).**

# Proposal

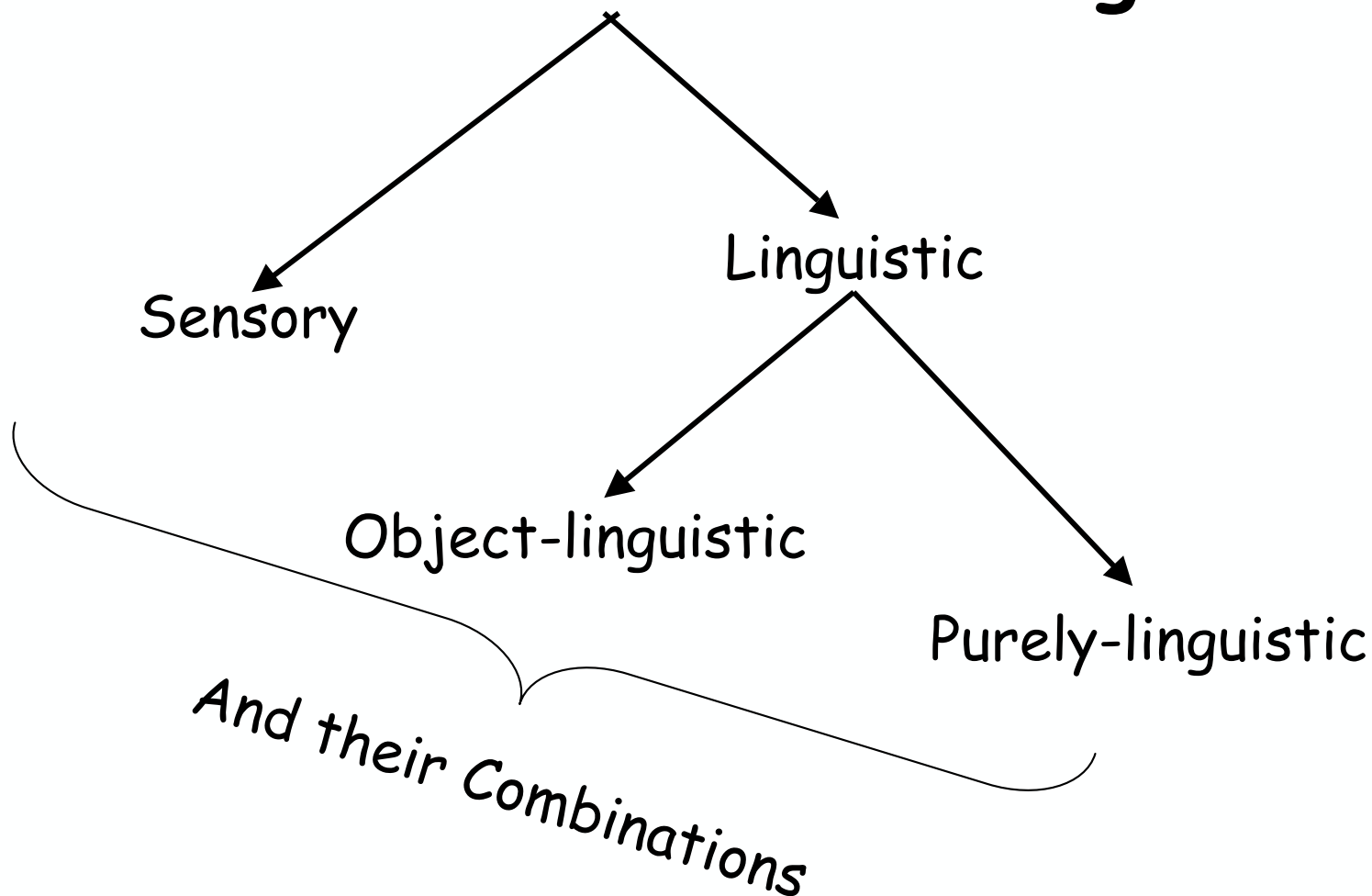
Consciousness is the totality  
of the Ontogenetically-created\*  
Paths of Understanding.

\* Communication plays a fundamental  
role in such a creation.

# Aspects of the Process of Understanding

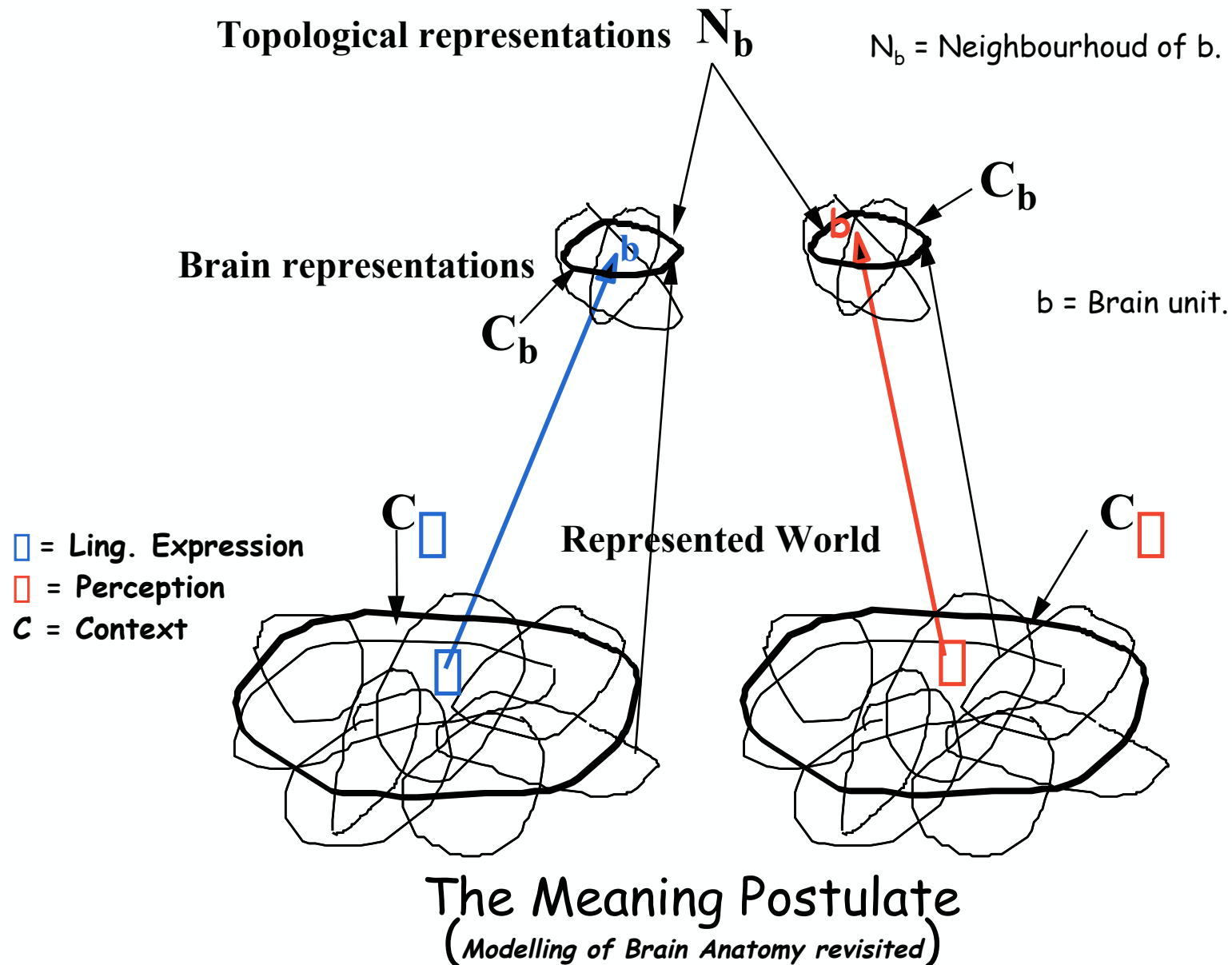


# Kinds of Understanding

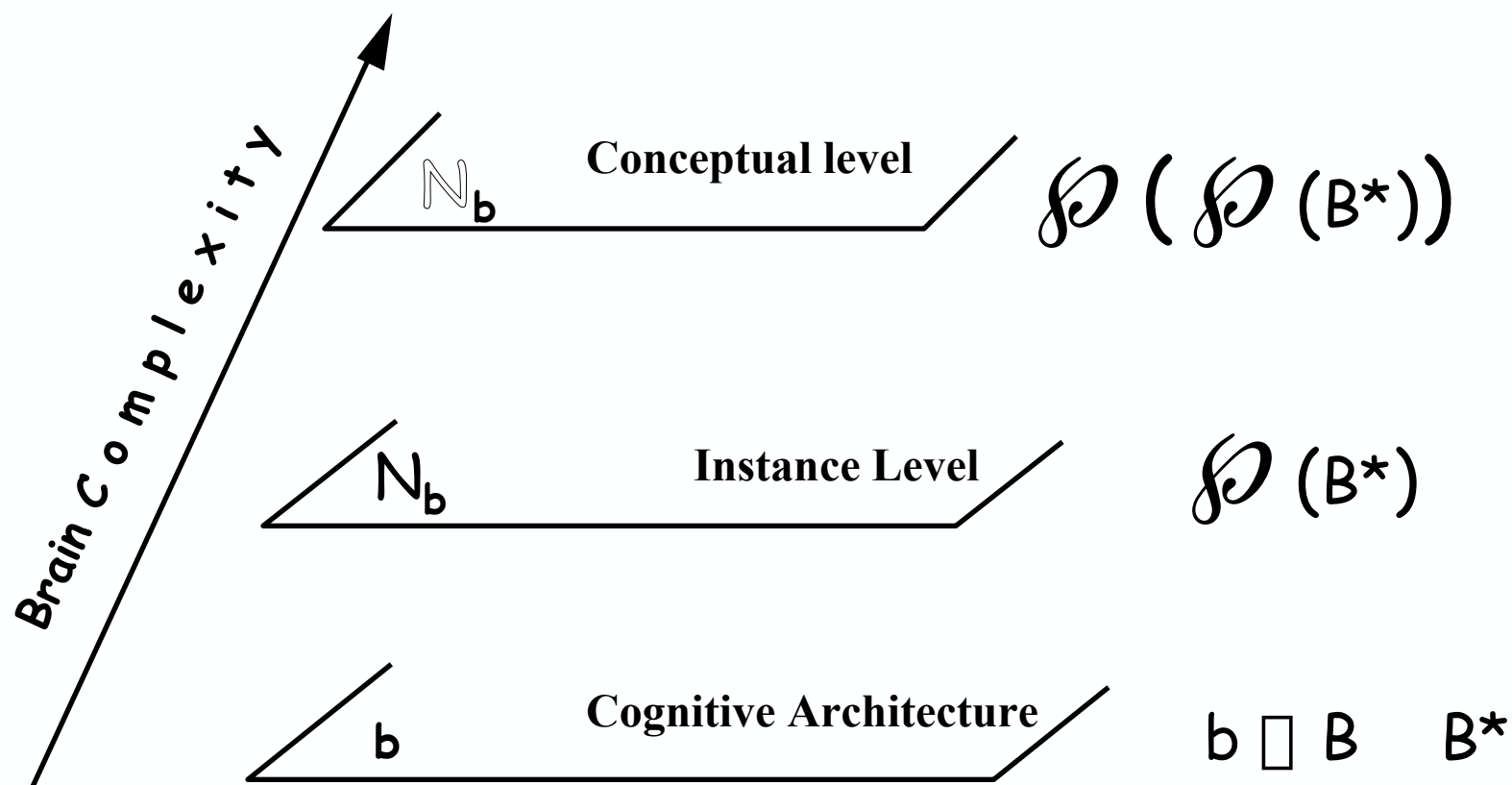


# Brain Complexity (Potential vs Actual) <sup>30</sup>

- Neural states:  $10^{100,000.000.000.000}$
- Mental phenomena (MP):  $10^{99,999.999.999.998}$
- Conscious MP:  $10^{99,999.999.999.976}$
- Assume Number of Chess games:  $10^{120}$ 
  - one experiences 1CMP/sec and lives 120yrs.
- Then Elementary particles in known Universe:  $10^{80}$ 
  - Total conscious experience:  $4 \times 10^9$  CMP.



# Topological modelling of Human semantic structures





# Basic modelling idea

- **Instances of Concepts correspond to Topological Neighbourhoods.**
- **Concepts correspond to Neighbourhood Families.**
- **Semantic Structures correspond to Neighbourhood Systems.**