Reasoning with complementary pathways, not competing processes

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In Two Minds: July 7 2006

Modelling dual processes in one mind

- S1: multiple autonomous subsystems processing information in parallel
- S2: von Neuman style serial processes, limited working memory capacity
- Evans (2003): "an important challenge is to develop models to show how such two distinct systems interact in one brain"

- Are there really two systems, or can S2 processing also be achieved by the S1 subsystems?

Walk, talk, and chew gum?

Is the interaction of two processes a big problem?

Don’t we normally do many things at once?

Reasoning

"WHEN man reasoneth, he does nothing else but conceive a sum total, from addition of parcels… For reason, in this sense, is nothing but reckoning"

- Hobbes (1651) Leviathan, Chapter V: Of Reason and Science

Emotional thought

"without bodily states following on the perception, the latter would be purely cognitive in form, pale, colourless, destitute of emotional warmth"

William James (1890) The Principles of Psychology Ch.XXV The Emotions

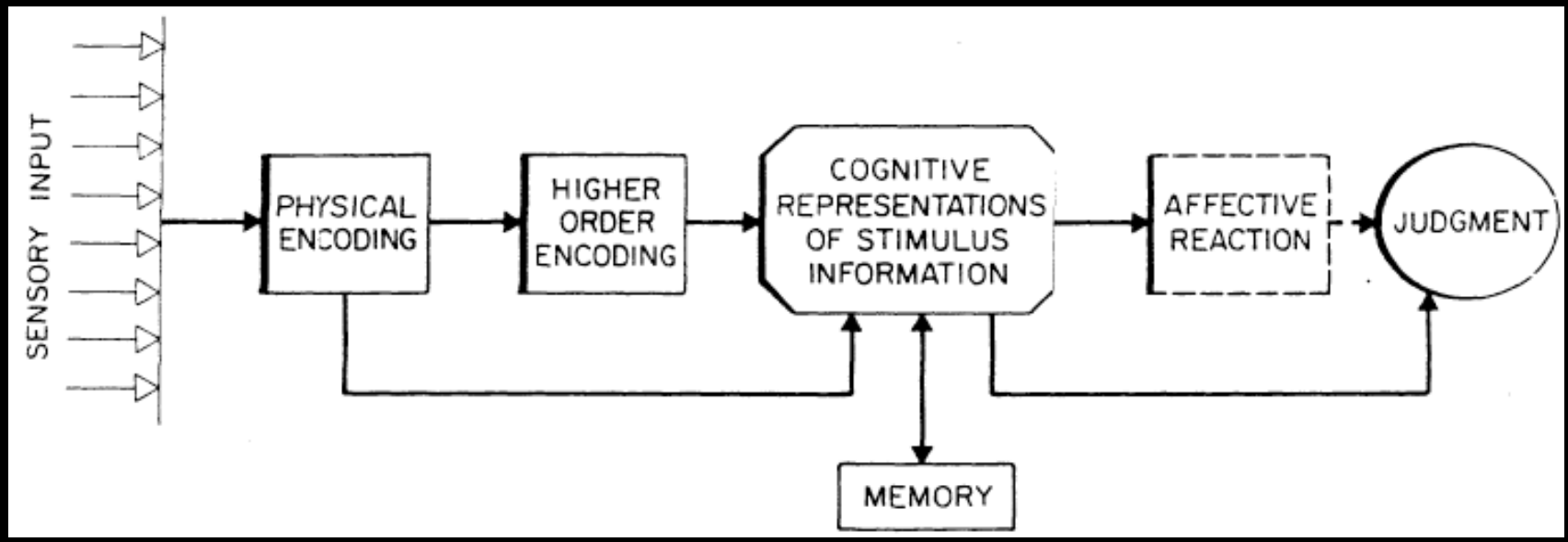
Emotional thought

"if we fancy some strong emotion,and then try to abstract from our consciousness of it all the feelings of its bodily symptoms, we find we have nothing left behind,no 'mind-stuff' out of which the emotion can be constituted,and that a cold and neutral state of intellectual perception is all that remains."

William James (1890) The Principles of Psychology Ch.XXV The Emotions

Simplistic linear models

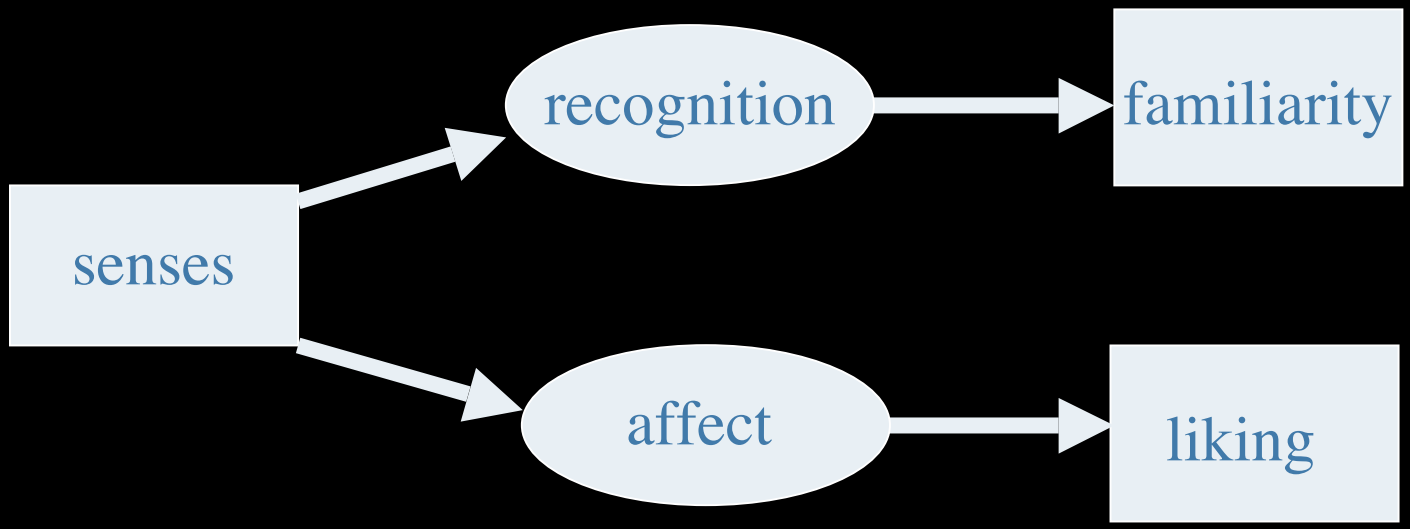
- Zajonc (1980) critiqued linear cognitive models for being too slow



Zajonc RB (1980) Feeling and Thinking: Preferences need no inferences. *American Psychologist, 35*, 151-175

Two routes

Discriminanda and Preferenda



"affective phenomena deserve far more attention than they have received from cognitive psychologists and a closer cognitive scrutiny from social psychologists"

Zajonc RB (1980) Feeling and Thinking: Preferences need no inferences. *American Psychologist, 35*, 151-175

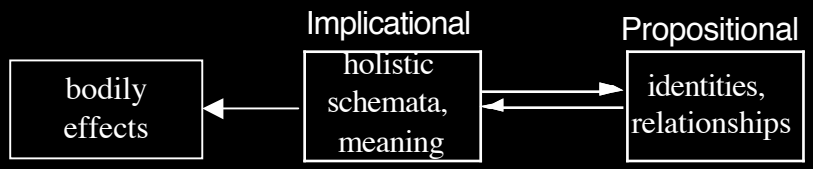
Role of language

- Typical System 2 tasks rely on language
- Matching biases:
  - Information matching lexical content of problem taken as relevant
  - Information not matching is neglected
- Varies with abstractness of the material:
  - Absence of prior knowledge
  - Lack of coherence with schemata
  - No overlap with beliefs

  Allowing S1 processing to compete with S2 processing

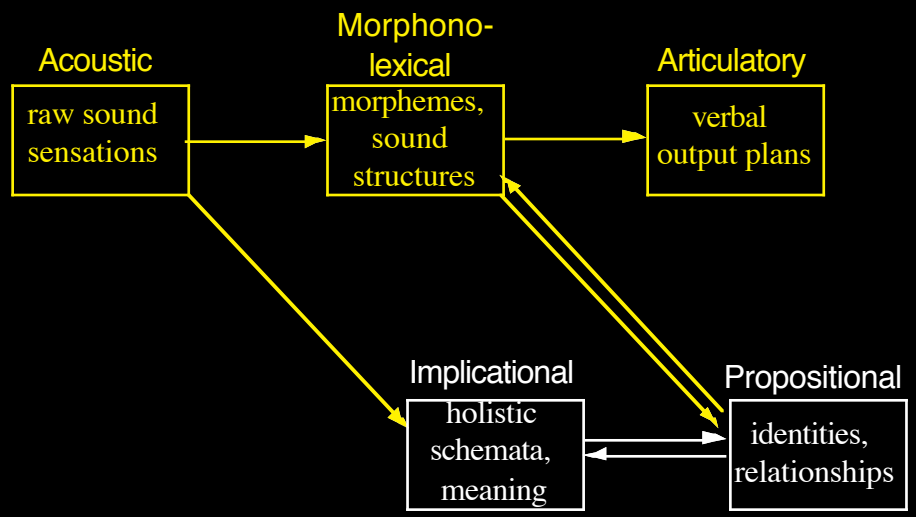
Psycholinguistic model of semantics

- Two levels of meaning:
- Propositional
  - Specific, factual, identity, referential
- Implicational
  - Generic, inferential, schematic, affective
- Each informs the other



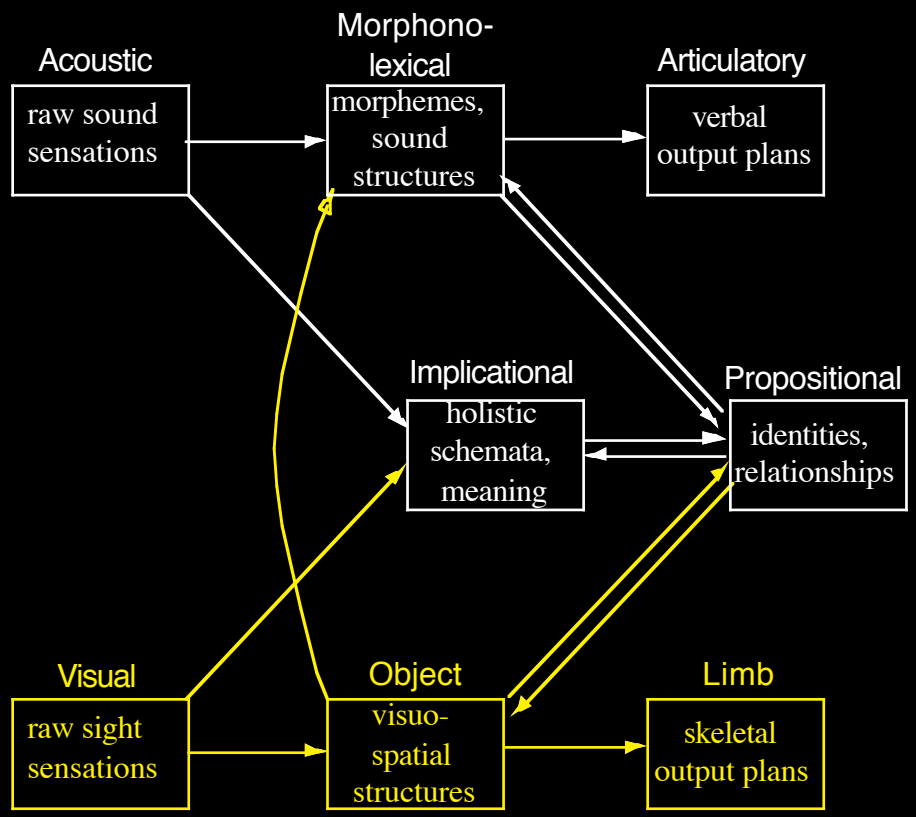
Understanding speech

- Auditory stream parsed into sound units
- Propositions extracted from sound units
- Implications inferred from Propositions
- Propositions derived from Implications
- But Implications also directly inferred from affective markers in auditory representation



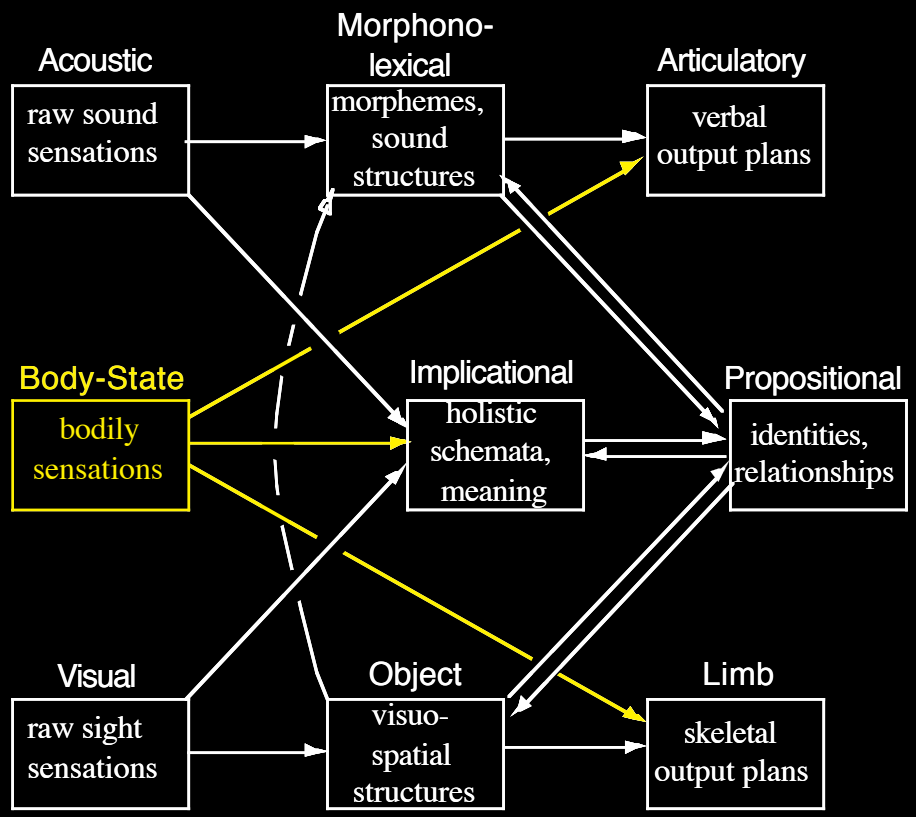
Seeing things

- A parallel pair of routes for vision
- Structural parsing of Objects guiding motor action;
- Derivation of Propositions from Objects
- Direct inference of Implications



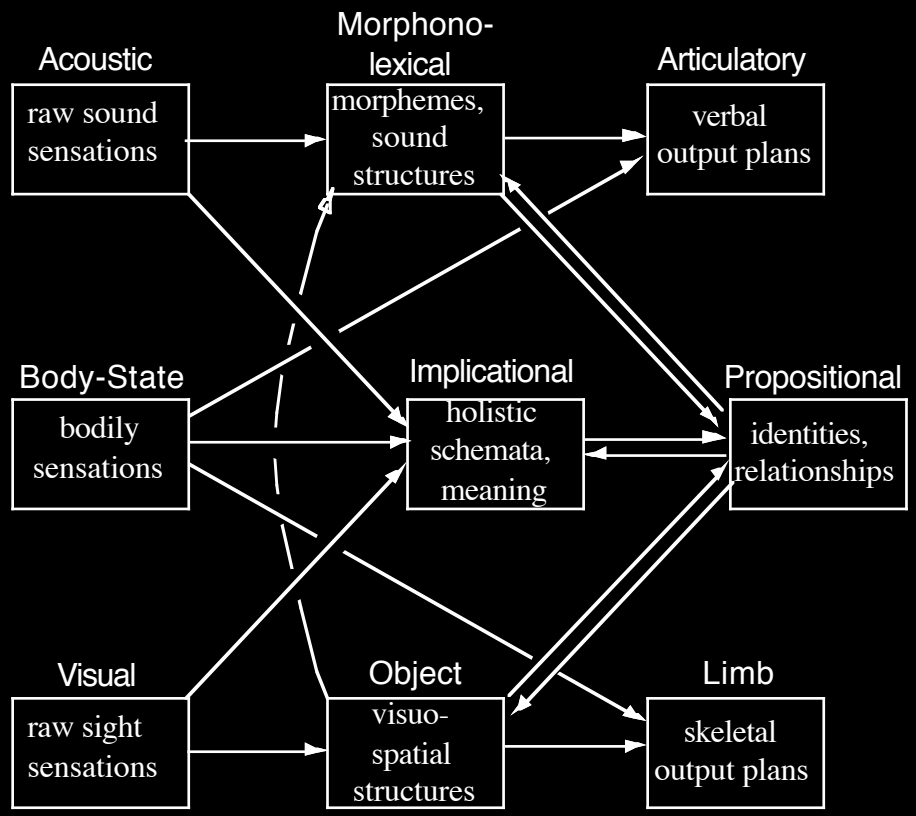
Feeling things

- Bodily sensations - including taste, smell, touch
- No structural parsing, just affective inference and proprioceptive feedback



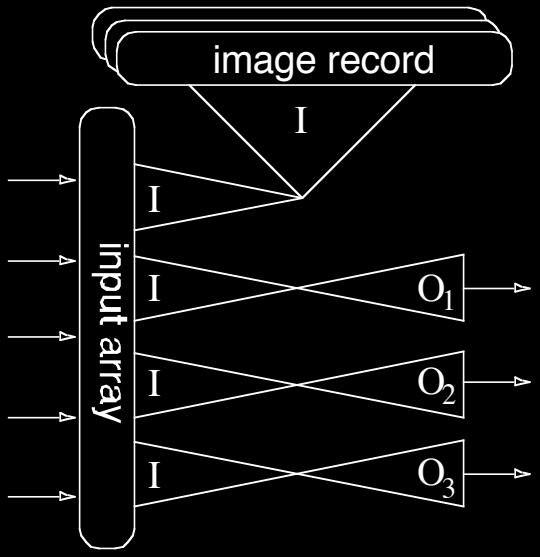
Feeling things

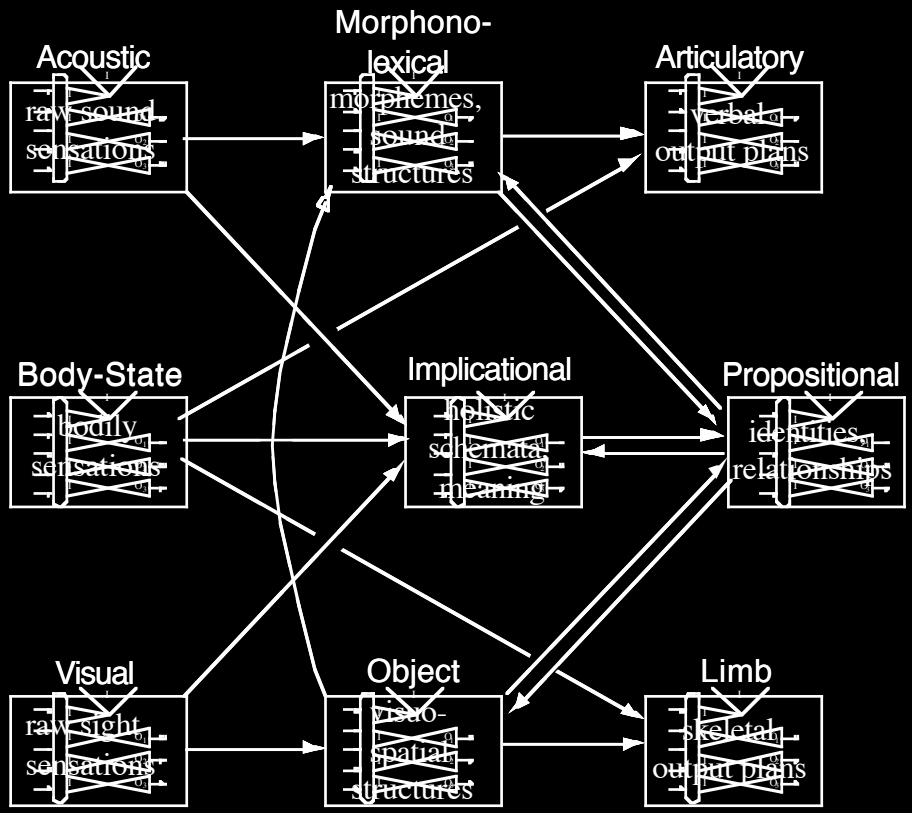
- Now a complete model of sensation, cognition and action.



Interacting Cognitive Subsystems

- Each subsystem autonomous
- No central executive
- Common subsystem architecture

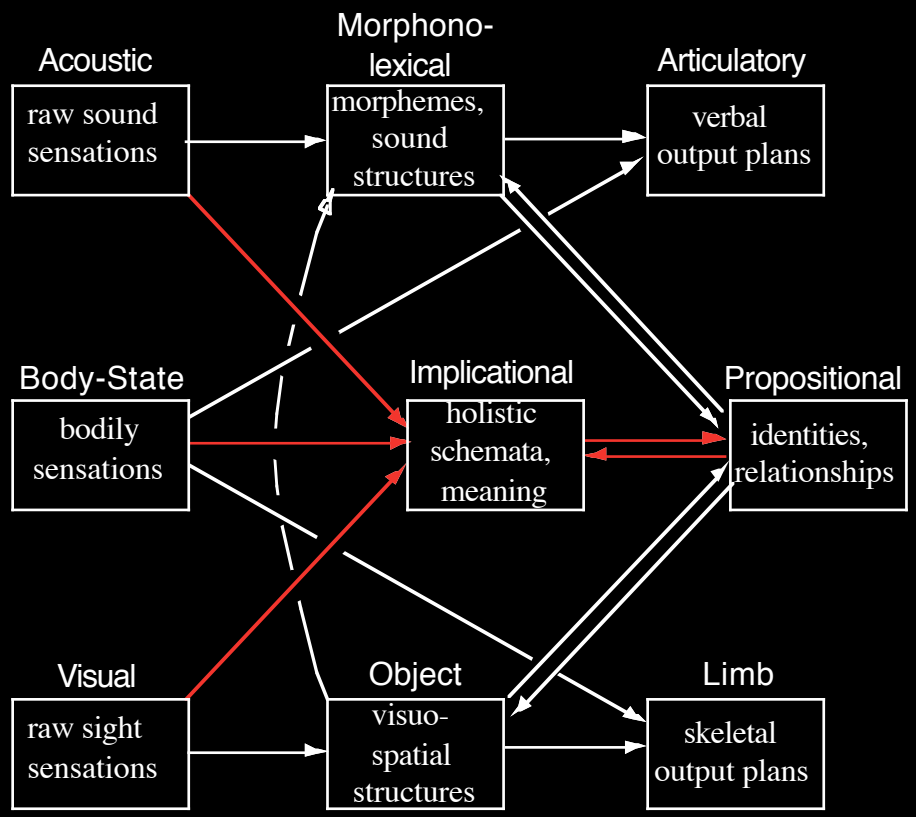




Barnard, P.J. (1985). Interacting Cognitive Subsystems: A psycholinguistic approach to short term memory. In A. Ellis (Ed.) *Progress in the Psychology of Language*, (Vol. 2), Chapter 6, London: Lawrence Erlbaum Associates, 197-258.

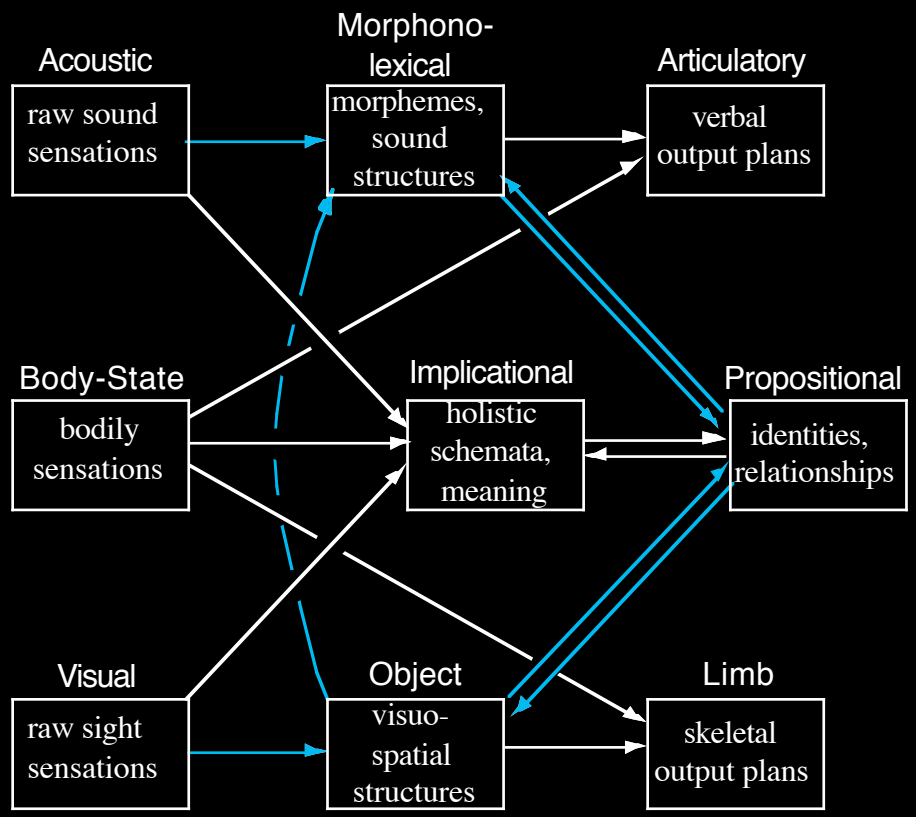
Route 1

- Direct affective inference from sensation provides top-down contextual frame
- Is this System 1?



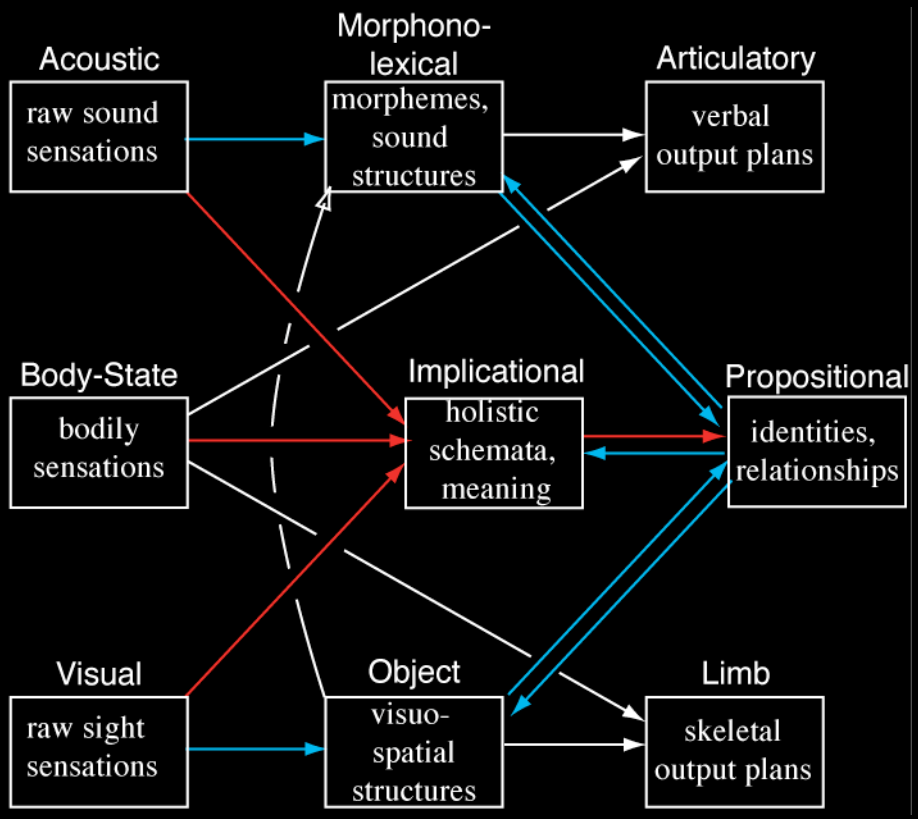
Route 2

- Slower serial parsing of structures and propositions allows detailed modelling of external world
- Is this System 2?



Cycle routes

- Route 1 activity is direct and fast
- Route 2 allows slower reciprocal cycles of activity
- But over time each process learns its mappings and becomes proceduralised
- These can operate without memory access or cycles
- Enables Route 2 activity to become automated

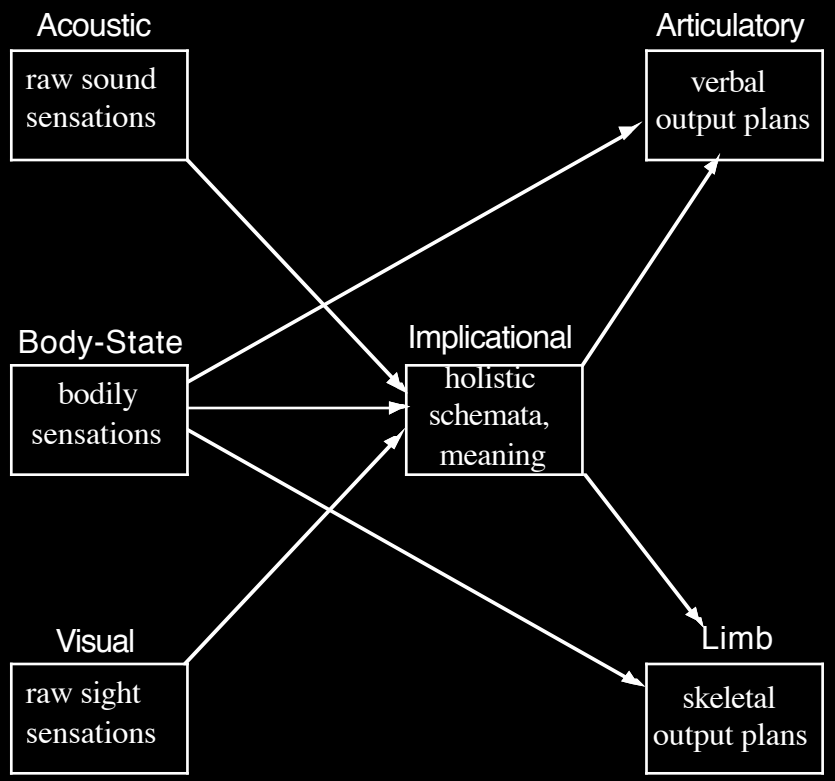


System 1 is automatic + route 1

System 2 is cyclic route 2

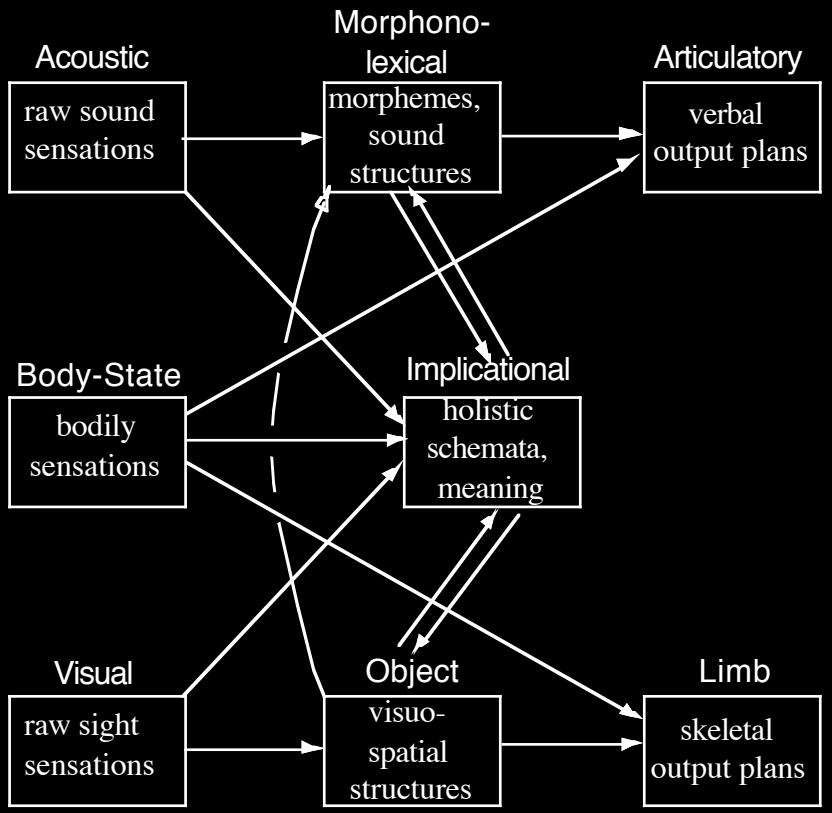
Evolution of cognition

- Simple organism
- builds cross-modal representations of world to guide responses



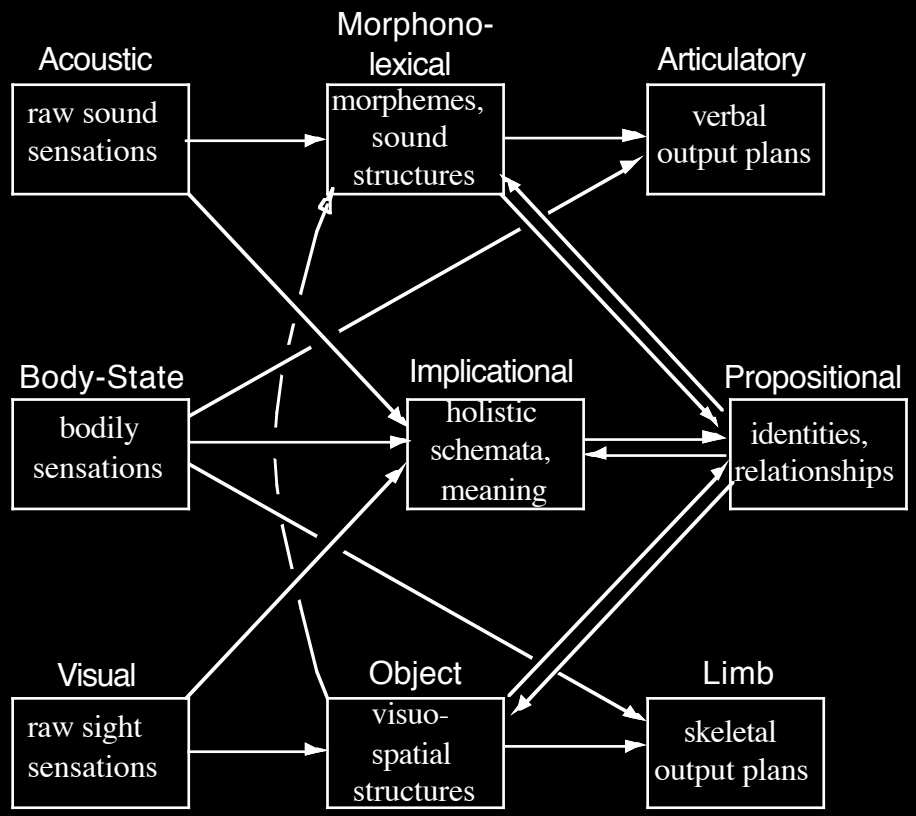
Extra representations

- Capacity to recognise structure in sensory streams facilitates inference and behaviour



Language comes last

- Secession of propositional representation
- Simultaneously enables language and creates dual routes
- Uniquely human?



Applications of ICS

- Inclusion of affect in an IP model
- Two levels of ‘meaning’
- Especially helpful in clinical application
- Provides broad framework for applied domains such as HCI
- Metatheoretic framework to link domain specific accounts of cognition

Key ICS resources

- Barnard, P.J. (1985). Interacting Cognitive Subsystems: A psycholinguistic approach to short term memory. In A. Ellis (Ed.) *Progress in the Psychology of Language*, (Vol. 2), Chapter 6, London: Lawrence Erlbaum Associates, 197-258.
- Teasdale, J.D. and Barnard, P.J. (1993). *Affect, Cognition and Change: Re-modelling Depressive Thought*. Hove: Lawrence Erlbaum Associates.
- May, J. (2001). Specifying the Central Executive may require complexity. In J.Andrade (ed) *Working Memory in Perspective*. Psychology Press: Hove. pp 261-277
- May, J. & Barnard, P.J. (2003). Cognitive Task Analysis in ICS. In D. Diaper & N. Stanton (Eds) *The Handbook of Task Analysis in Human-Computer Interaction*, pp. 291-325