Introduction to Cognitive Science

(5: Physical Symbol Hyp. and Dyn. Sys.)

(Ch. 4 and 6)

PSSH

- Herbert Simon, Allen Newell, 1975, ACM Turing Award Speech:
  - Physical symbol system hypothesis (PSSH)
    - A physical symbol system has the necessary and sufficient means for general intelligent action
  - Symbols can be combined in complex symbols
  - Necessity claim
  - Sufficiency claim
- Note an interesting point: the systems that manipulate symbols can themselves be represented by physical symbols

Intelligence

- Thinking is no more than transforming symbols (Fodor, Phylyshyn: pushing forward some proof theory...)
  - Symbolic processes...
  - Is reasoning a symbolic process? What else is a symbolic process?
  - PSSH implies that intelligent behavior IS symbolic
- Problem solving:
  - What counts as solving a problem?
  - Search-space

Dynamical Systems

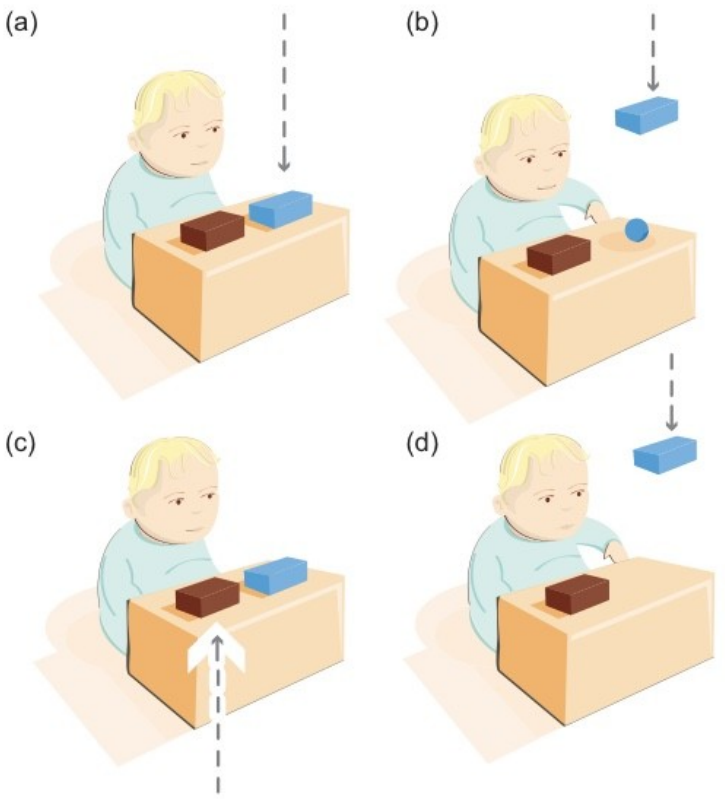
- Standard computational model might not represent well all phenomena it can simulate (universal Turing machine!)
- Time/latency plays a major role
- Logic/structure-based vs. change/calculus-based models of cognition?
  - Other foundations? GA, GoL,...
  - Dyn. Sys. Can be viewed in another, more narrow way: describing processes via equations (functions of vars changing over time), not (classical) computations
  - The difficult part: (1) find the variables, ~~(2) model the equation~~
- Connected to the P vs NP problem

Dyn Sys: cogSci without representations?

- Philosopher Tim van Gelder:
  - Cog. Sci try to reverse engineer the mind under the assumption that the mind is an information processing machine (PSSH)
  - What if it is not?
- Watt governor: not representational, not computational, not sequential and not decomposable, but it does the same thing, but better, as a computational model would.
- Point? Just because something can be modelled „informationally”, it does not mean that this is the only way to model it (and, by extension, the „right” way to model it)

A-not-B error

- Jean Piaget 1954 book: The Construction of Reality in the Child
- Up to around 7 months (up until 12 months) infants make a specific error
- If the child is primed, even though it sees the ball being moved it will still think it is the old place



1990s, parameters identified

- In the 1990s, Smith and Thelen identified several key things that affected the A-not-B situation
- The phenomenon is lessened by the following:
  - Tapping to the right side, drawing the infant's attention
  - Modifying the infant posture
  - Lenght of priming
- If A-not-B were a primarily cognitive phenomenon, it would not be dependent on this
- These parameters seem to contribute in raising the „activation level” for the infant to respond correctly

Classical sys and dyn sys

- Classical sys: explanation in terms of single information-processing mechanism
- Dyn. Sys: time-sensitive complex systems with subtle interdependencies and time-sensitivities
  - They seem to be simpler since they do not invoke computations and representations
- CogSci is interdisciplinary and multilevel
- Dyn sys are higher level abstractions (like lambda calculus)