Cognitive semantics and cognitive theories of representation:

Session 3: Meanings in Animals: Evolutionary View

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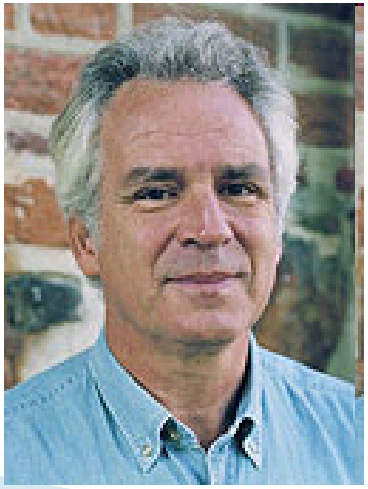
Evolution of (human-like) cognitive abilities

- categorization, planning, deceiving, self-awareness, language.
- What kinds of **representations** are required for these to evolve?



(Gärdenfors, 1996)

Representation

- Representation is an individual phenomenon by which an organism structures its knowledge with regards to its environment. (Vauclair, 1990)
- Animals use the incoming information as cues to "perceptual inferences," which ***add* information** to what is obtained by the psychophysical transducers. That which adds information to sensory input I propose to call a *representation.*
  - Categorization: When a bird **sees** an object **as food**, the bird's brain is **adding** information about the perceived object.

Representation: Why a snake can't think of a mouse

- Do ticks (last lecture) have any central representation of mammals?
- Snake example (Sjölander, 1993)

Evolution of central representation

- Related to **cross-modality**
  - Evolutionary value: Multimodal information extraction of environmental information is likely to result in more veridical perception
  - Cross-modal perception requires the derivation of modality-free information, a “representation”

Two types of representation: Why can chimp make a tool

- Cued
  - Stands for something that is **present in the current external situation** of the representing organism or **triggered** by something in a **recent situation**
    - E.g. animal recognizes certain object as food, mate, etc.
- Detached
  - Stands for objects or events that are **neither present in the current situation nor triggered** by some **recent situation**
    - Memory that can be evoked independently of the context where the memory was created
    - Also “spatial maps” (Tolman 1948)

How can we tell them apart?

- Probably there is no sharp distinction but more of a *degree of detachment,* e.g. capacity for representing *object permanence* involves some level of detachment

What is the evolutionary advantage of detached representations?

- Craik (1943):
  - If the organism carries a “small-scale model” of external reality and of its own possible actions within its head, it is able to try out various alternatives, conclude which are the best of them, react to future situations before they arise, utilize the knowledge of past events in dealing with the present and future, and in every way to react on a much fuller, safer and more competent manner to the emergencies which face it.

Inner environment: Why lizards don't dream

- **Inner environment = Collection of all detached representations of an organism**
  - All things the organism can actively "think" about
- spatial maps in rats (and possibly in birds)
  - operational test: ability to take shortcuts
- dreaming, play
- related to the development of neocortex, i.e. roughly with the appearance of mammals.

Inner environment

- Necessary for representing objects (e.g. food, predators, mates), places (where food or shelter can be found), actions (and their consequences), even **when these things are not perceptually present**
- Necessary for planning, deception, self-awareness

Planning: Why the squirrel does not make any provisions for winter

- It needs representations of
  - Goal and start situation
  - Sequences of actions
  - The outcomes of the actions.
- They have to be detached otherwise it is not possible for the animal to choose different actions.
- $\Rightarrow$ Planning presupposes **inner environment**.

Anticipatory planning

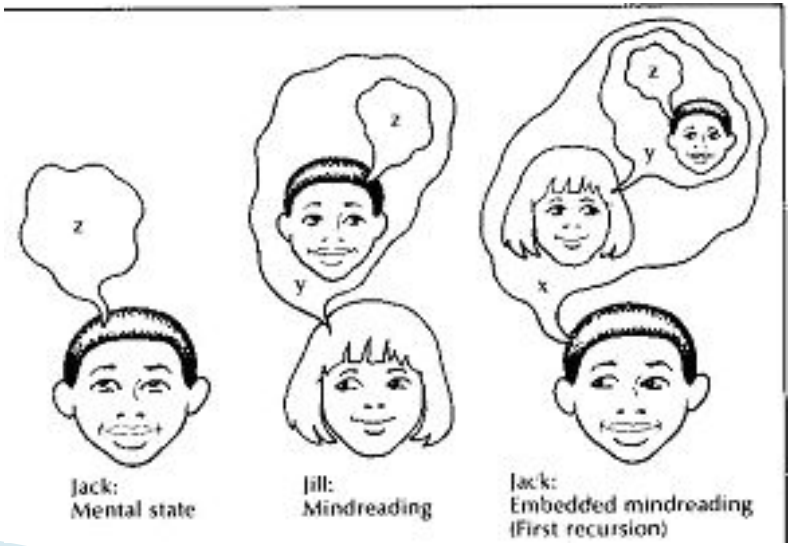
- Planning
  - for present needs (immediate)
  - for future needs (anticipatory)
- Most animals only plan for present needs
  - (but https://www.youtube.com/watch?v=AubNYJWxRac,
  - https://youtu.be/O6nNllouHpw)
- To plan for future needs one must be able to represent potential needs (imagine future wishes)
- There's some evidence that big apes, dolphins and corvids (jays, ravens) can do it
- Why is it so difficult?
  - Indirect solution is overshadowed by the direct presence of a more attractive stimulus
  - They cannot suppress their perception
  - children <2

Deceiving

- a good planner must consider the actions of other individuals.
- but deception requires even more: representing other agents not as acting things but as having inner environments of their own
- “representation of other minds”

Theory of Mind

- Special case of representation of inner environment of another individual
- leads to **self-awareness** (as a shortcut)
- an “I”-experience must be preceded by a “you”-experience (cf. M. Bubber, also V. Reddy: How infants know minds, HUP, 2010)



Self-awareness: Why baboons don't wear lipstick

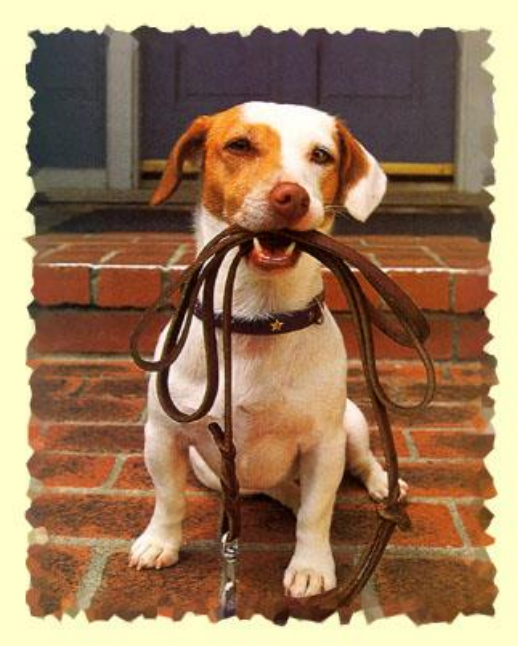
- chimpanzees and orangutans, but no other primates can recognize themselves in mirrors (Gallup, 1977). Update: also Asian elephants, gorillas, bottlenose dolphins, orca whales, magpies, ants, manta rays
  - only chimps can do it in a photograph
- mirror test (child development)

Language: Why bees don't tell stories to one another

- Animal communication

So what is missing in animal communication?

- The predominant function of language is to communicate about that which is *not* here and now.



What is missing?

- If we only live “here and now”, cued representations are sufficient.
- Language is needed to communicate your internal representation of what **could be**, what **has been**, and of those things and happenings that are **not present** in the vicinity = **detached representations**

Types of Sign

- Remember from Session 1?

- Indexical – causal or physical link – **SIGNALS**

- Iconic – imitation, similarity – **ICONS**
- Symbolic – arbitrary link – **SYMBOLS**

- **Signals refer to outside world, icons and symbols to inner environments**

Symbols vs. signals

- Signal evokes action appropriate to the presence of its object
- Symbol – not a proxy for its object but more of a **vehicle for the conception of object**
  - To conceive a thing or a situation is not the same as to "react toward it" overtly, or to be aware of its presence.
  - In talking about things we have conceptions of them not the things themselves; and **it is the conceptions, not the things, that symbols directly "mean".**

Symbols in cooperation

- If the common goal is present in the environment (ants), no need of joint representation
- If the goal is **detached** then a *common representation* must be produced before the action
  - **The inner worlds of the individuals must be coordinated.**

Another factor: Levels of grammaticality in communication

- Systems with single elements
- Compositional systems
- Systems with grammar

6 types of communication systems (Gärdenfors, 1995)

	Single elements	*Composition*	*Grammar*
Cued representations	Type 1 (Animal signs)	Type 2 (Bee's dances)	Type 3 Ø
Detached representations	Type 4 (One–word language)	Type 5 (Protolanguage)	Type 6 (Full language)

Table 1: Six types of communication systems. The examples of the different types will be explained in the text.

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Vervet monkeys

- 3 different calls
  - Eagle
  - Leopard
  - Snake

- Only in presence of cue
- Not capable of deception

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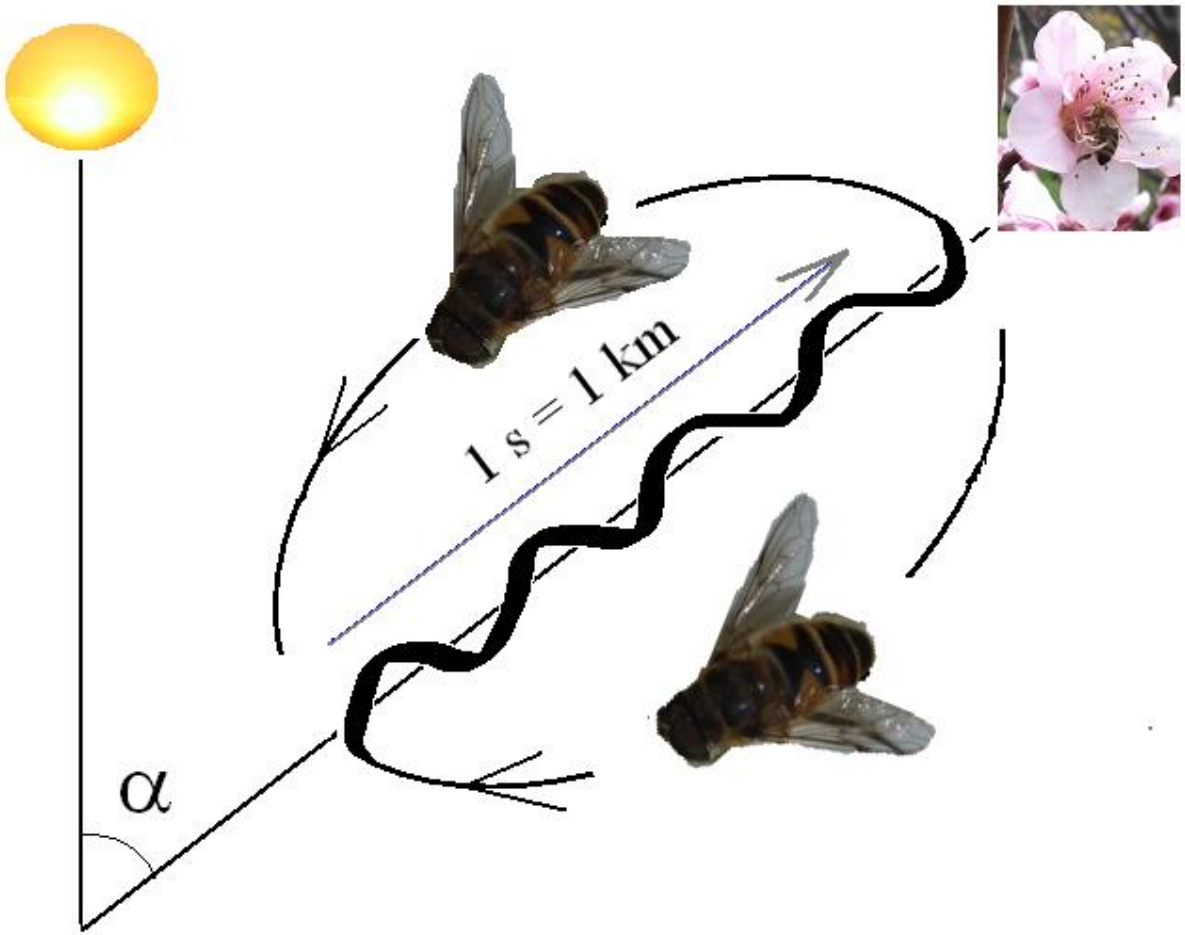
Bee dances



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Protolanguages

- Children 18-24 months
- Trained primates
- Savage children
- Pidgin languages

Possible course of the evolution of human language

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Questions?