



Cognitive semantics and cognitive theories of representation:

Session 1: Introduction

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Questions to ask

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- What is the meaning of the word “chair”?
- What is the meaning of the word “democracy”?
 - ▣ Is there a difference?
- Can we have meaning without language?
- What does it mean to **understand** something?
- Is a machine capable of understanding in principle?

Agents

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- entities achieving some goals by sensing and acting in their (real or virtual) environments
- bacteria, animals, humans, some computer programs and robots

Questions

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- To what extent can we say that they **understand** what they do?
- If they attribute some **meanings** to situations and events in their environments, what is the nature of these meanings?
- Do they use the same meanings when they communicate?
- Where do these meanings come from? Are they innate (pre-programmed) or learned?

Goal and Outline

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□ Goal

- ▣ Look for a theory of meaning and understanding applicable to non-human agents as well
- ▣ Propose design principles for building “understanding” agents

□ Outline

- ▣ Theories of meaning in semantics and semiotics
- ▣ Meanings in artificial systems
 - problems
 - design principles
 - examples – computational models

Semantics

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- non-denotational



- denotational



Semantics

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- non-denotational
 - functionalist (e.g. late Wittgenstein): “meaning in use”
- denotational
 - -
 -
 -

Semantics

8

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 - ▣ functionalist (e.g. late Wittgenstein): “meaning in use”
- denotational
 - ▣ **realist:** meanings are “out there” in the world, objective, common for all
 -
 -
 - ▣ **cognitive:** meanings are “mental” entities, subjective, individual

Semantics

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- non-denotational
 - ▣ functionalist (e.g. late Wittgenstein): “meaning in use”
- denotational
 - ▣ **realist**: meanings are “out there” in the world, objective, common for all
 - extensional (Tarski)
 - intensional (Karnap, Kripke, Montague)
 - ▣ **cognitive**: meanings are “mental” entities, subjective, individual

Semiotic Approach to Meaning

- Meaning is creation and interpretation of *signs*.
- „Anything can be a sign as long as someone interprets it as 'signifying' something, i.e. referring to or standing for something other than itself.“
(Chandler, 2007)
- “Nothing is a sign unless it is interpreted as a sign.”
(Peirce, 1931-58)

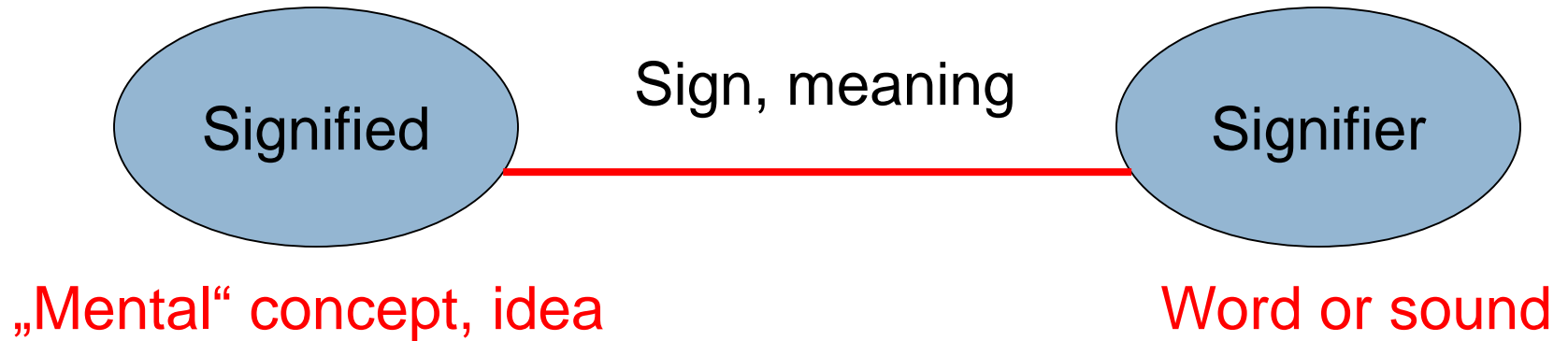
Semiotics

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- Semiotics differs from linguistics in that it generalizes from linguistic signs to signs in any medium or sensory modality.
- Semiotics is the study of signs as complex dyadic or triadic relations.

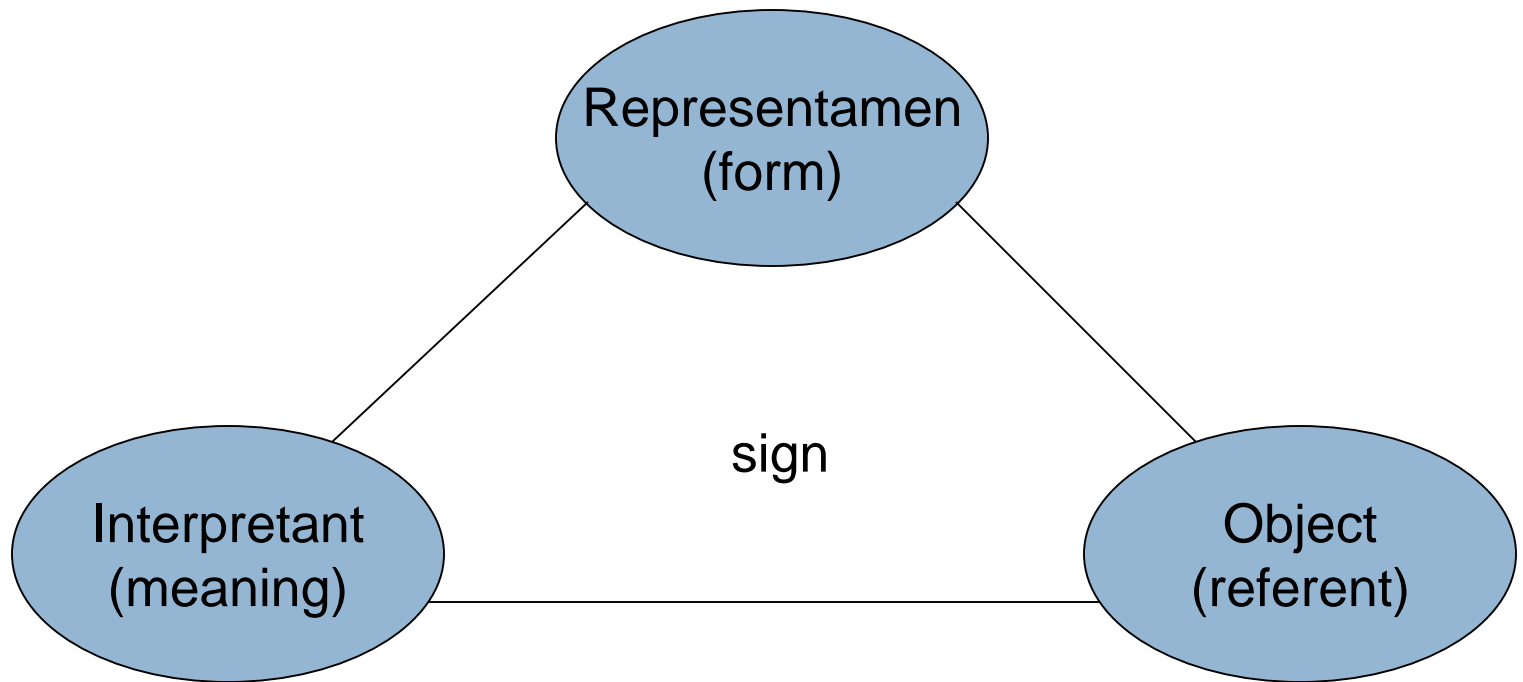
Sign as a Dyadic Relation (de Saussure)

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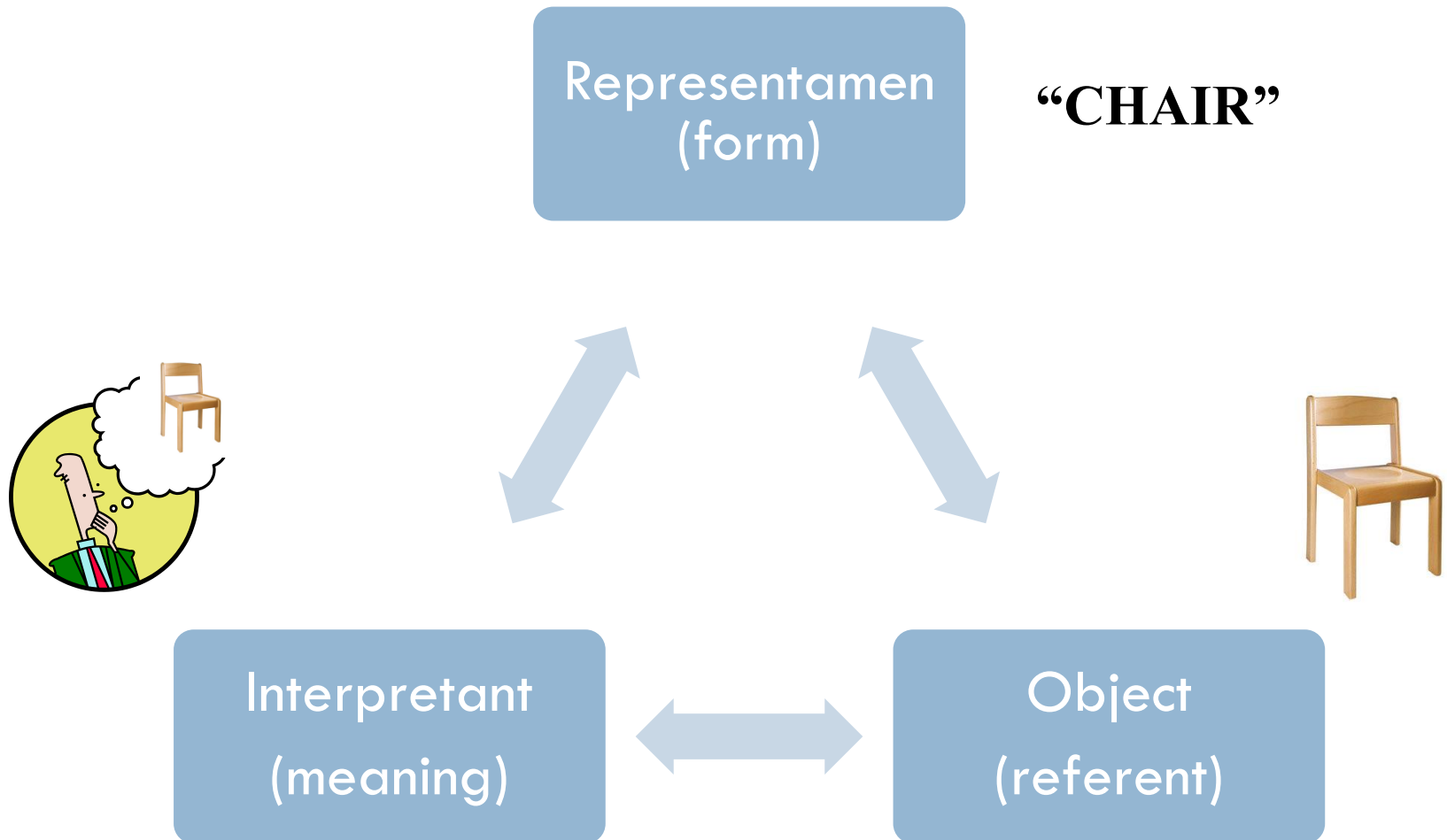
Sign as a Triad (Peirce)

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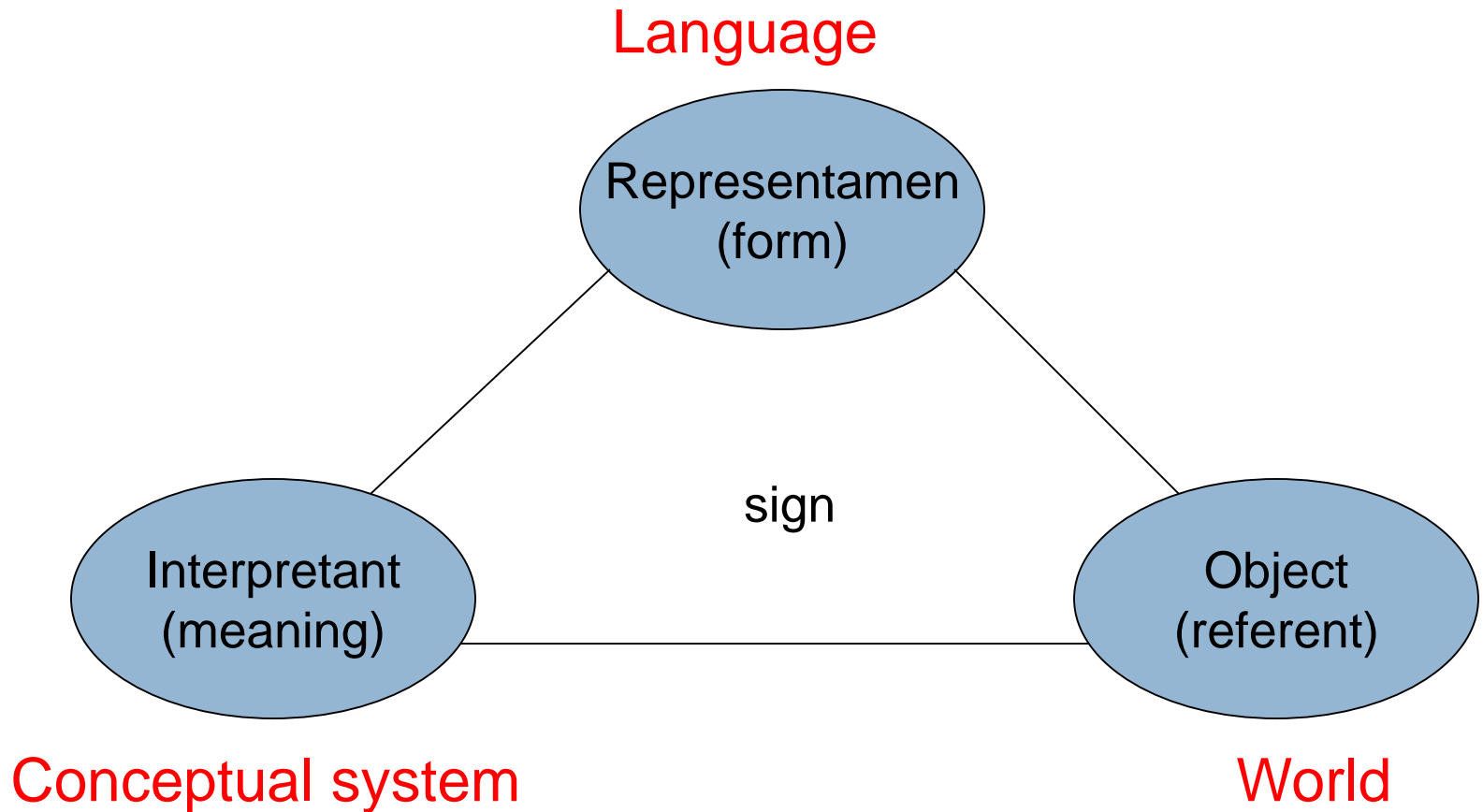
Semiotic triangle – example

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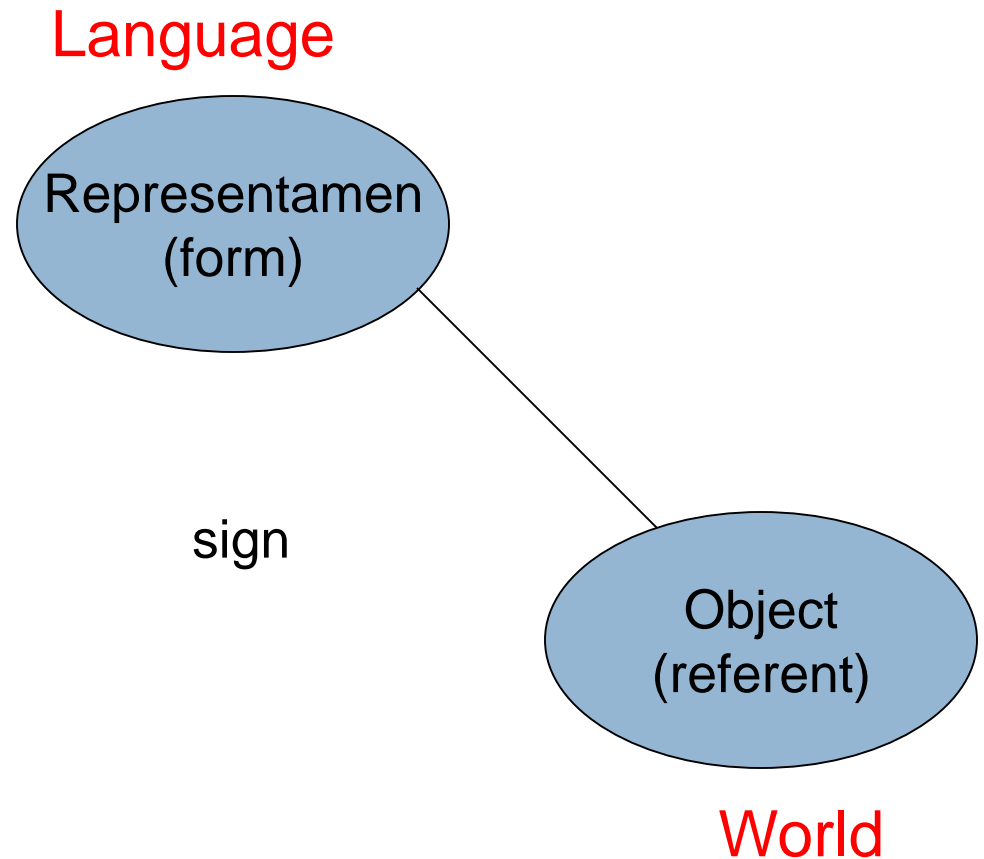
Semiotic triangle

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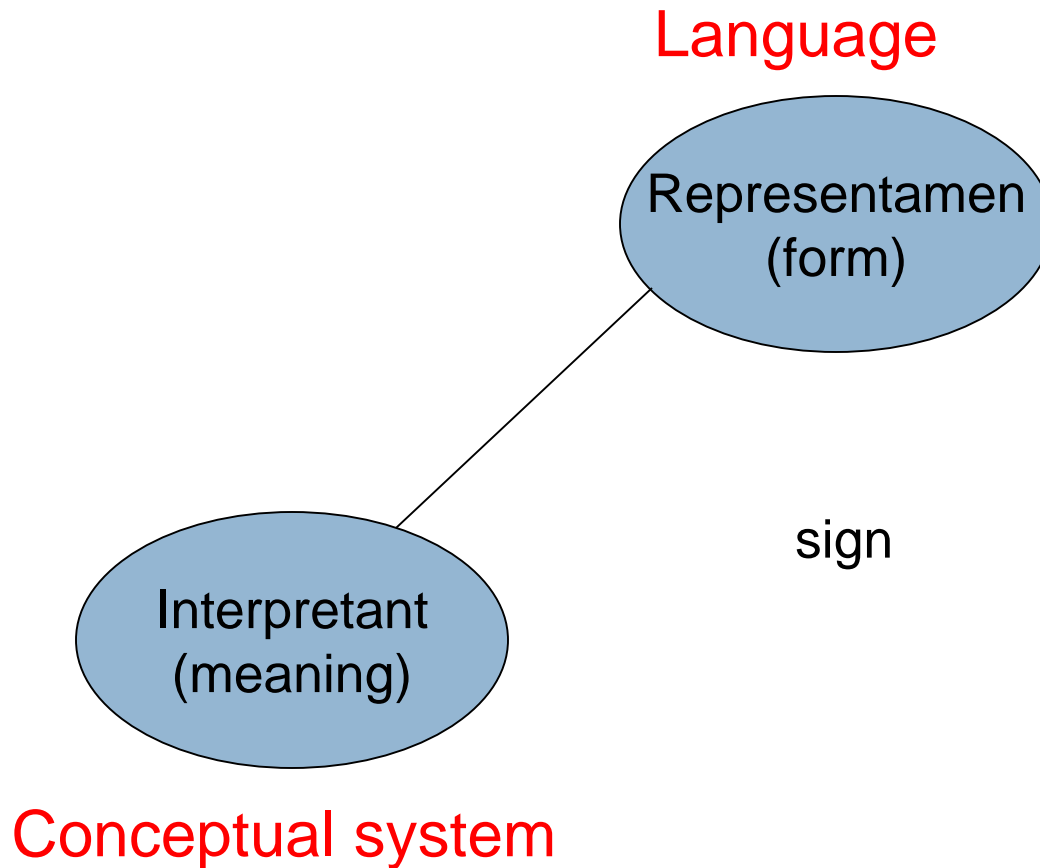
Realist semantics

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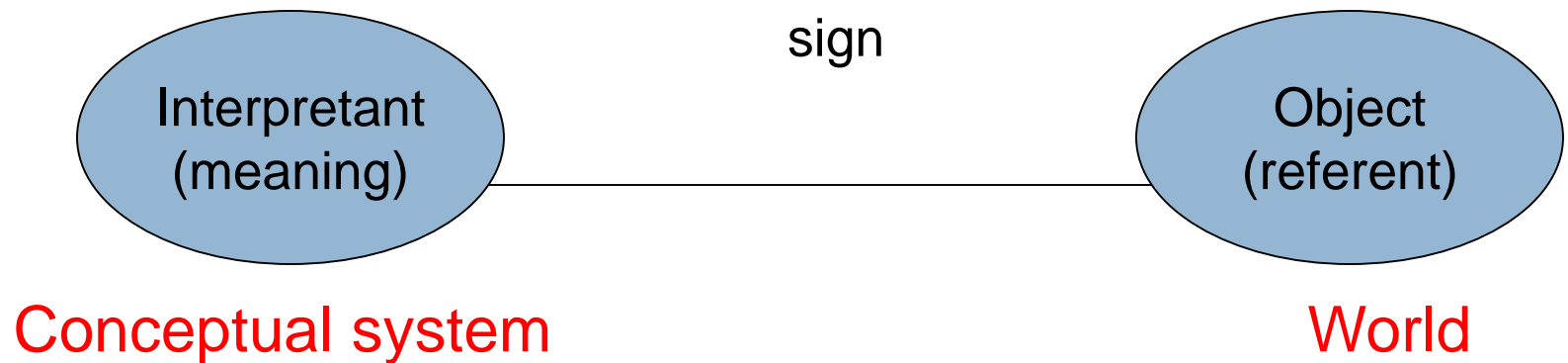
Cognitive semantics

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Preverbal semantics

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Types of Sign

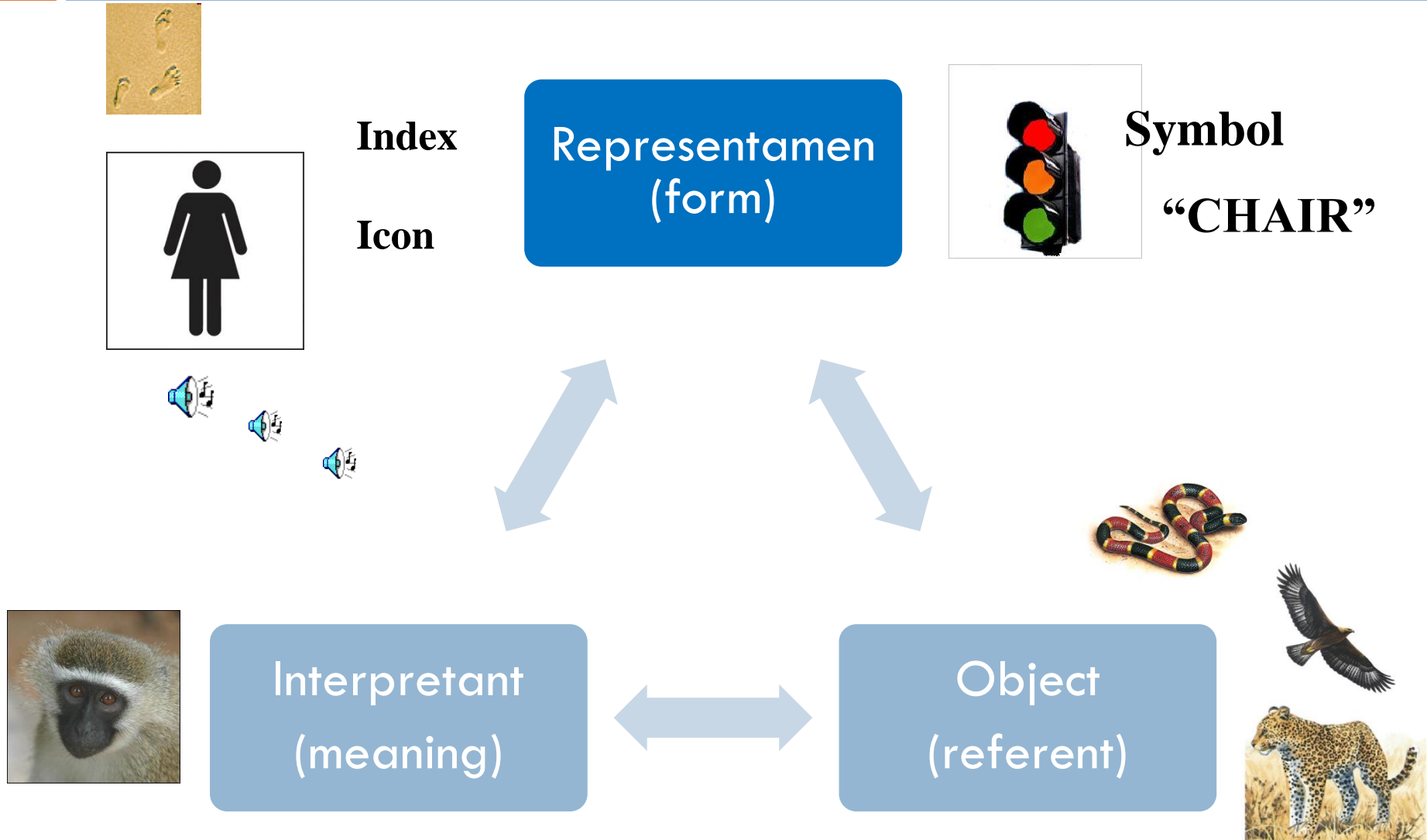
(relation between representamen and object)

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- Indexical - causal or physical link
- Iconic - imitation, similarity
- Symbolic - arbitrary link

Semiotic triangle (Pierce)

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Semiosis

- A sign is not an absolute or ontological property of a thing, but rather it is a relational, situated and interpretive role that a thing can have only within a particular context of relationships.
- What constitutes a sign for one observer (interpreter), can be just a useless or imperceptible noise for another one, depending on the interpreter's embodiment, society and the history of interactions.
- A particular interaction between the representamen, the object and the interpretant is referred to by Peirce as (act of) *semiosis*.

Consequences

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- Meanings are subjective (individual)
- Meanings are construed dynamically and undergo changes

Linguistics: Syntax, Semantics, Pragmatics

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- **Syntax** is a subfield of linguistics that studies the construction of complex signs from simpler signs (the rules that determine the way sentences are formed by the combination of lexical items into phrases).
- **Semantics** studies aspects of meaning that are expressed in systems of signs (a language, code, or other form of representation).
- **Pragmatics** studies how language is practically used by individuals and communities and how it is interpreted in particular circumstances

Cognitive Semantics [Gärdenfors]

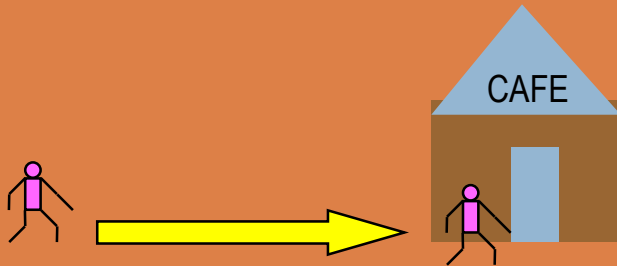
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1. Meaning is a conceptual structure in a cognitive system
2. **Conceptual structures are embodied (meaning is not independent of perception or bodily experience).**
3. Semantic elements are constructed from geometrical or topological structures (not symbols that can be composed according to some system of rules).
4. Cognitive models are primarily image-schematic (not propositional). Image schemas are transformed by metaphoric and metonymic operations.
5. Semantics is primary to syntax and partly determines it (syntax cannot be described independently of semantics).
6. Contrary to the Aristotelian paradigm based on necessary and sufficient conditions, concepts show prototype effects.

Meanings are embodied

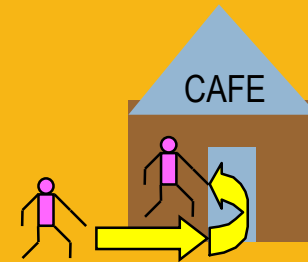
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to



- Goal of action = **at** cafe
- Source = **away** from cafe
- cafe = **point-like** location

into



- Goal of action = **inside** cafe
- Source = **outside** cafe
- cafe = **containing** location

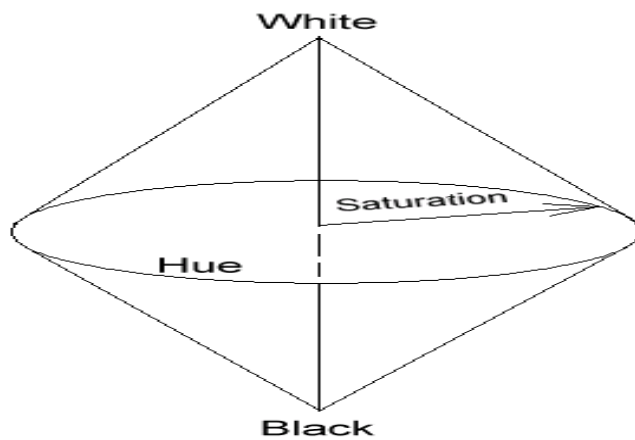
Cognitive Semantics

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Color space

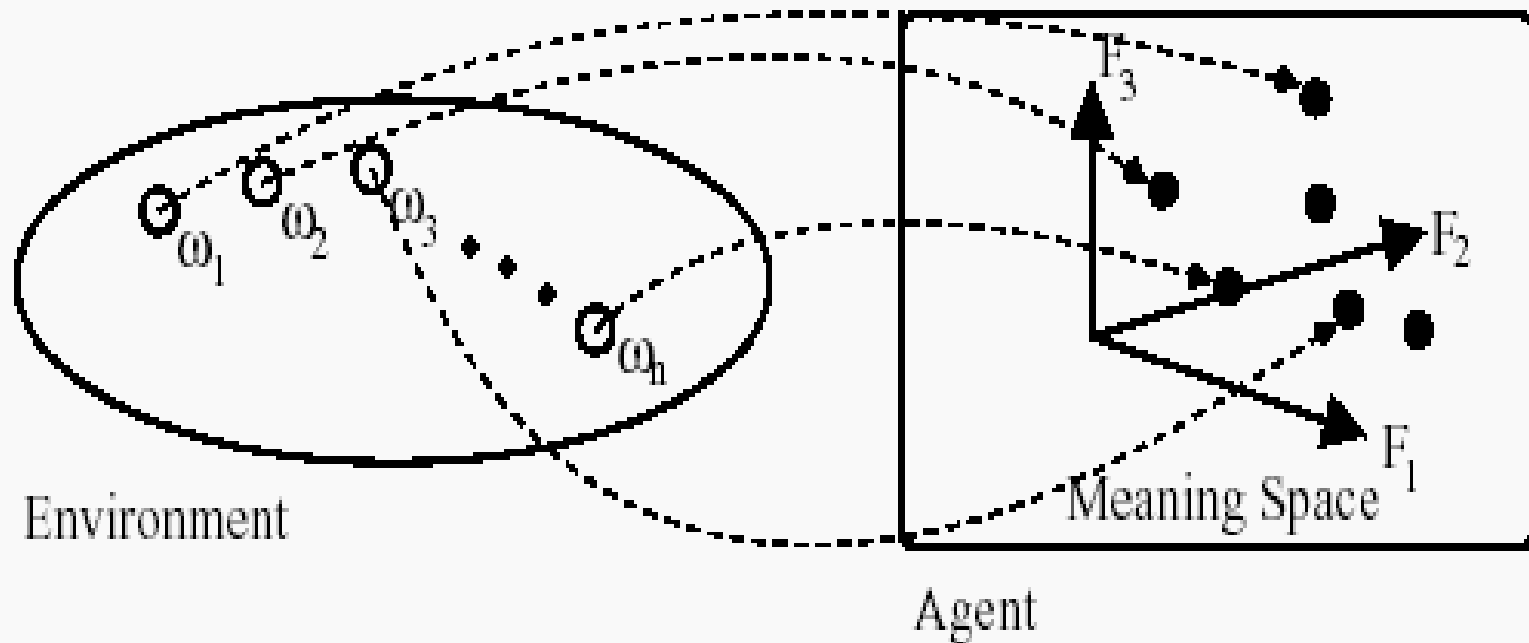
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Semantic elements are geometrical structures

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Conceptual space [Gärdenfors]



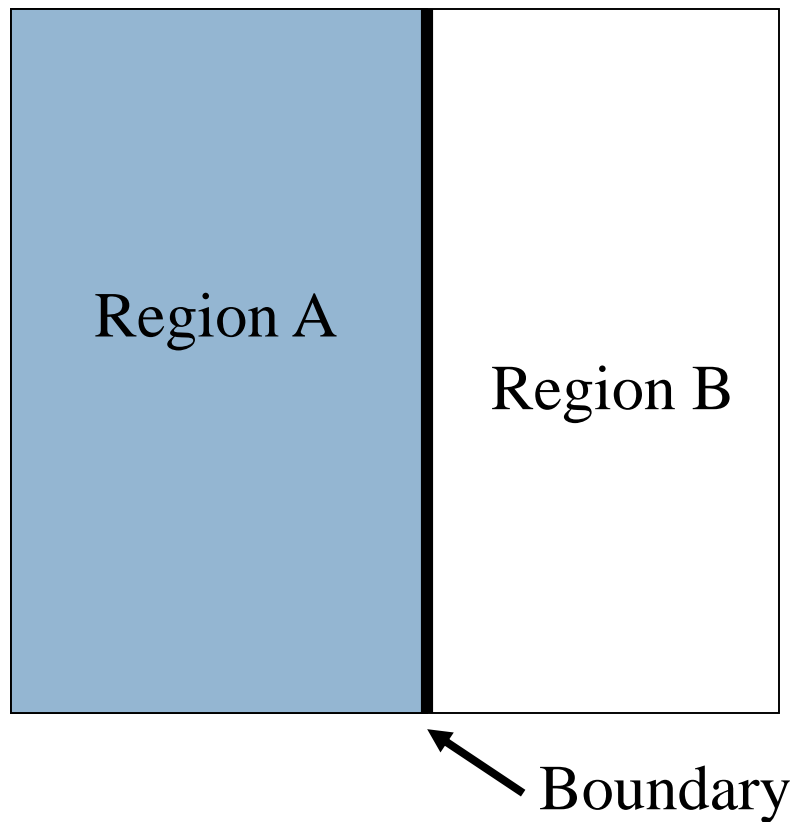
Cognitive Semantics

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Boundary Schema

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Roles:

Boundary

Region A

Region B

Bounded Region

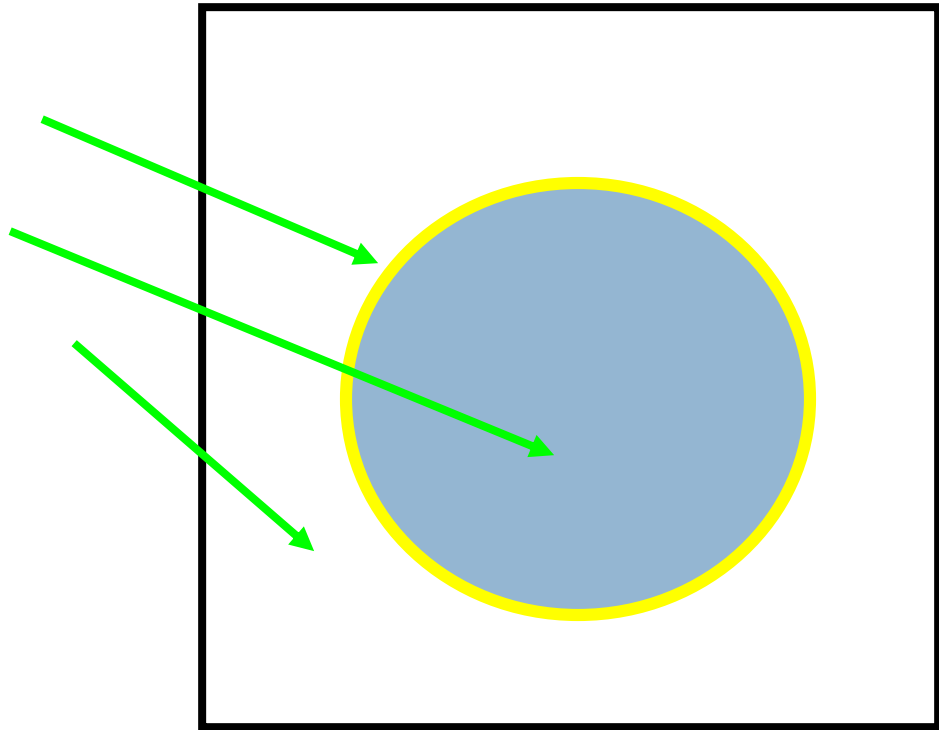
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Roles:

Boundary: closed

Bounded Region

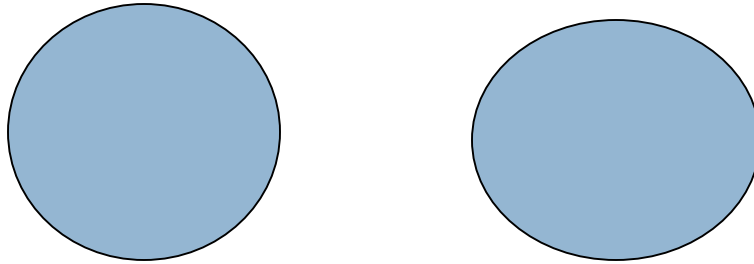
Background region



Topological Relations

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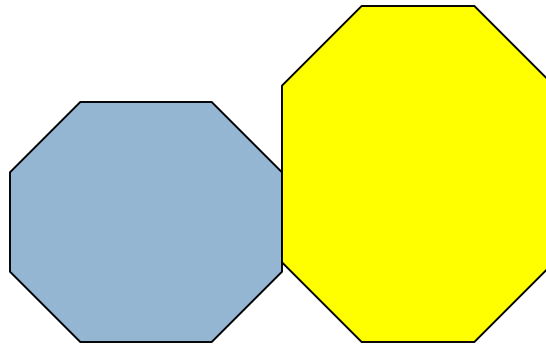
□ Separation



Topological Relations

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- Separation
- **Contact**



Topological Relations

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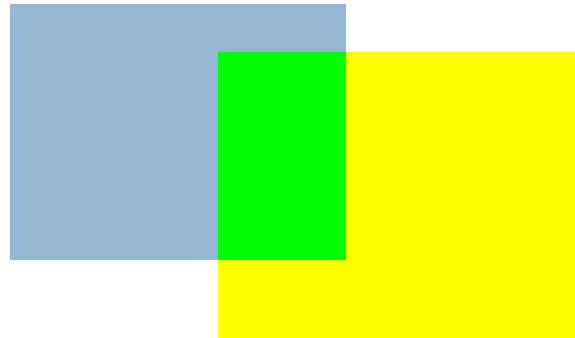
- Separation
- Contact
- **Coincidence:**



Topological Relations

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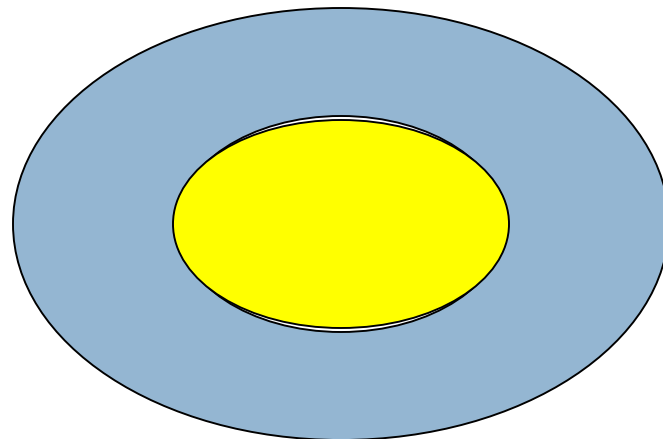
- Separation
- Contact
- Coincidence:
 - **Overlap**



Topological Relations

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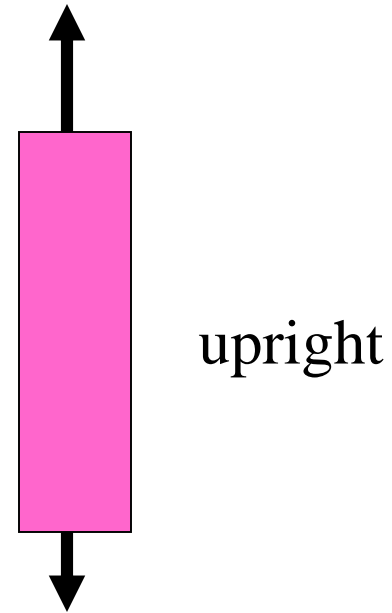
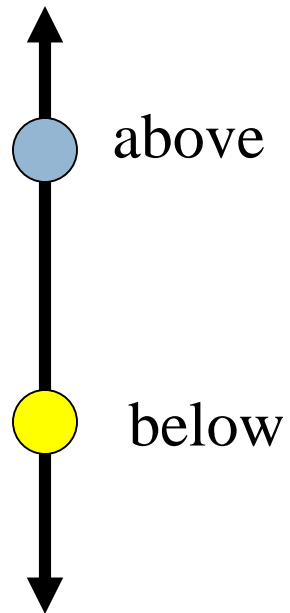
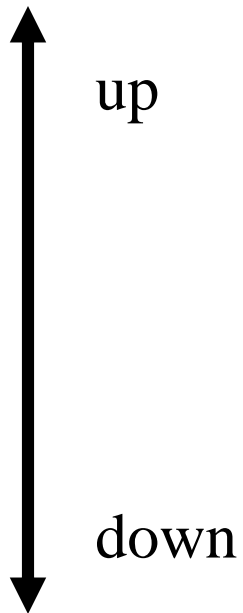
- Separation
- Contact
- Coincidence:
 - Overlap
 - Inclusion
- Encircle/surround



Orientation

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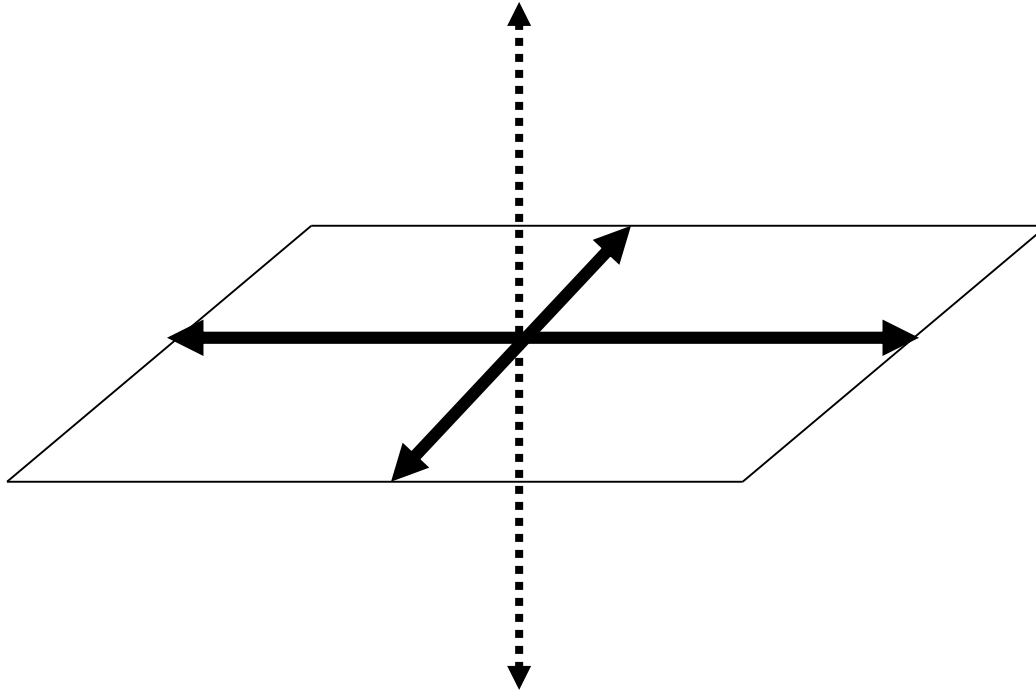
- Vertical axis -- *up/down*



Orientation

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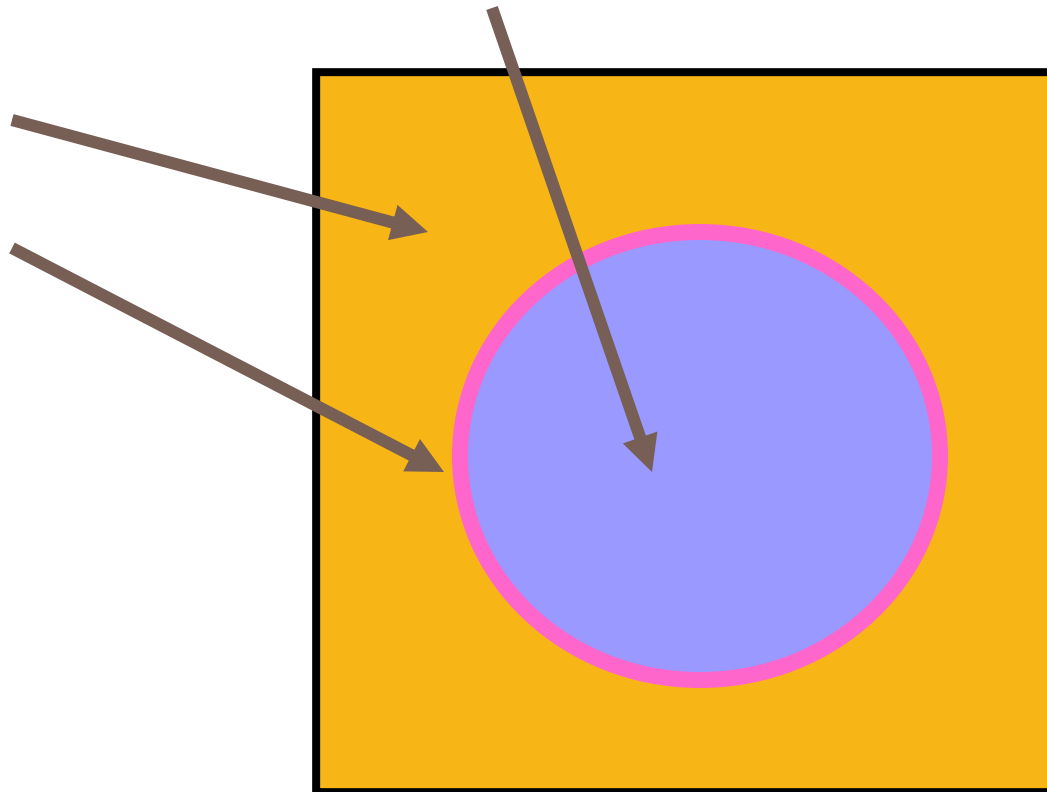
Horizontal plane – *Two axes:*



Container Schema

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- Roles:
 - Interior: bounded region
 - Exterior
 - Boundary



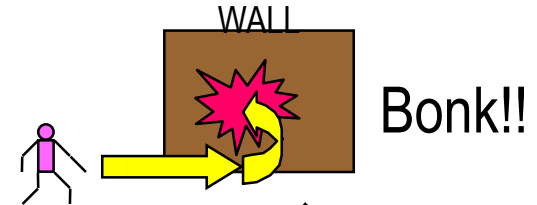
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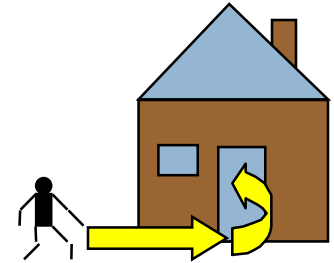
Syntax is not independent of semantics

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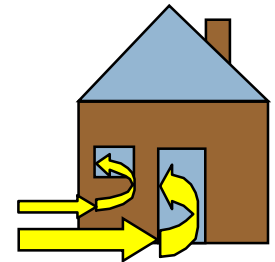
The scientist walked into **the wall**.



The hobo **drifted** into the house.



The smoke drifted into the house.



Cognitive Semantics

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Meaning and categorization

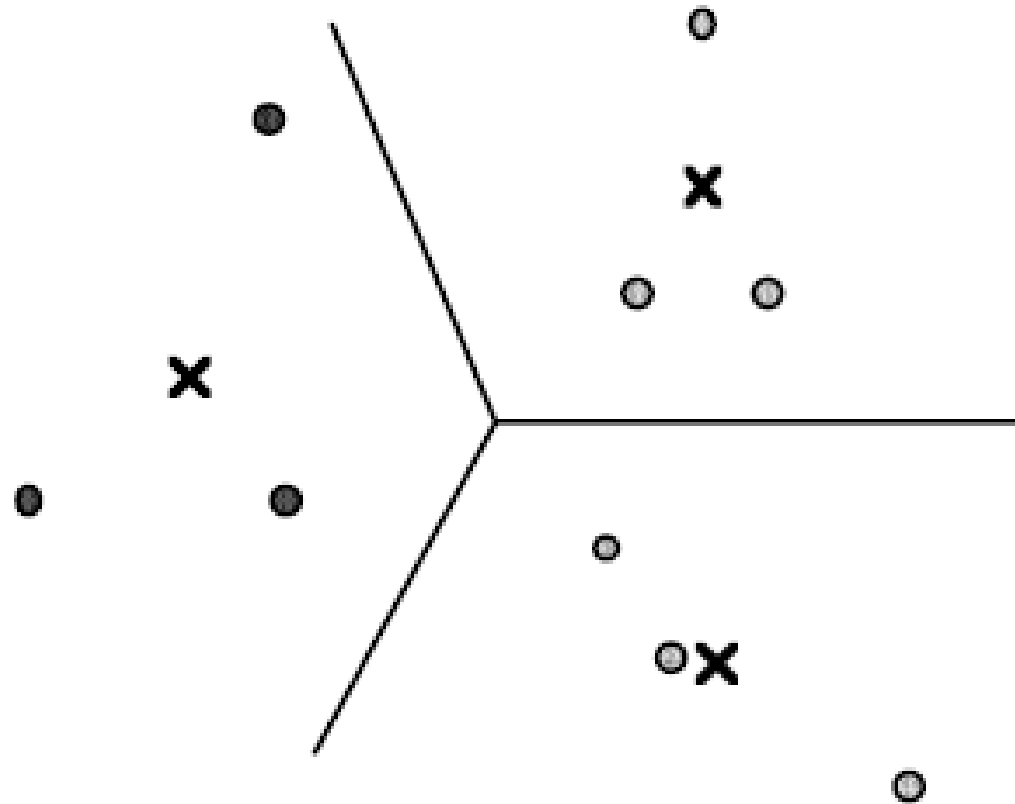
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□ „CHAIR“



Categorization in a Conceptual Space

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Main topics

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- Semiotics
- Meaning in animal world – evolutionary view
- Cognitive semantics
 - ▣ Image schemas
 - ▣ Basic level categories
 - ▣ Metaphors
- Conceptual spaces
- Meaning in brain
- Meaning and grammar/syntax
- Meaning in artificial systems

Thank you

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