



Grounded cognition

Abstract concepts

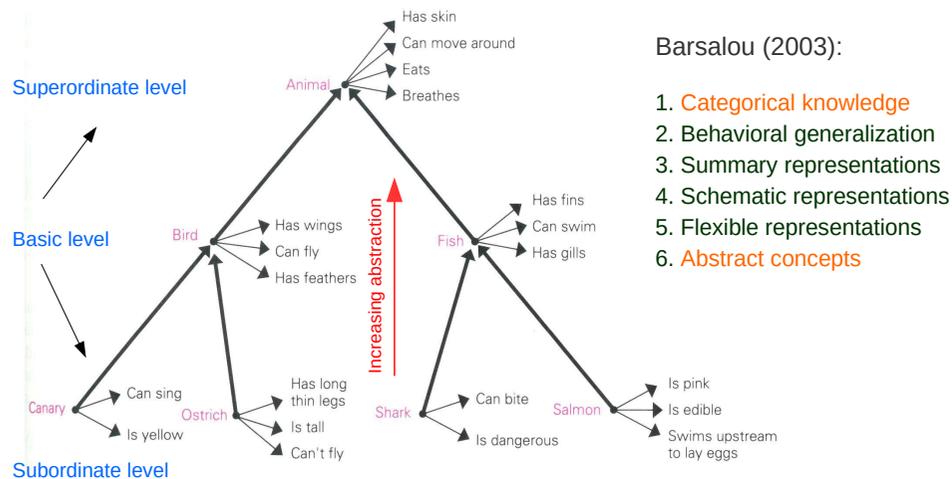
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Introduction

- Concrete concept has a single and perceptually bounded object as referent
- On the contrary, abstract concept does not have this property
- They refer to more complex situations, their content is **more variable** both within and across individuals.
- Embodied (grounded) approach has been quite successful, but
- ... many experts recognize that in order to fully account for the representation of abstract concepts an extension beyond purely grounded approach is needed.

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Abstraction in psychology



- Abstraction (mammal) vs abstractness (beauty) (Borghi and Binkofski, 2014)

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Differences b/w concrete and abstract words (1)

- Kousta, Vigliocco, Vinson, Andrews, & Del Campo (2011): differences in imageability, perceivability,...
- Schwanenflugel (1992): differences in the context availability of concrete versus abstract words, which they measured by asking participants to rate the ease with which they could imagine **a context** in which the word might appear. Context availability was lower for abstract words, and this factor proved to be a strong predictor of performance.
- Troche, Crutch, & Reilly (2014): systematic differences in word meanings, assessed in latent semantic space.
- Hill, Reichart, & Korhonen (2014): (1) abstract concepts are mainly organized according to association, whereas concrete concepts are organized according to (semantic) similarity (2) abstract words have more, but weaker, associations with other words, (3) abstract words have more symmetric associations than concrete words.

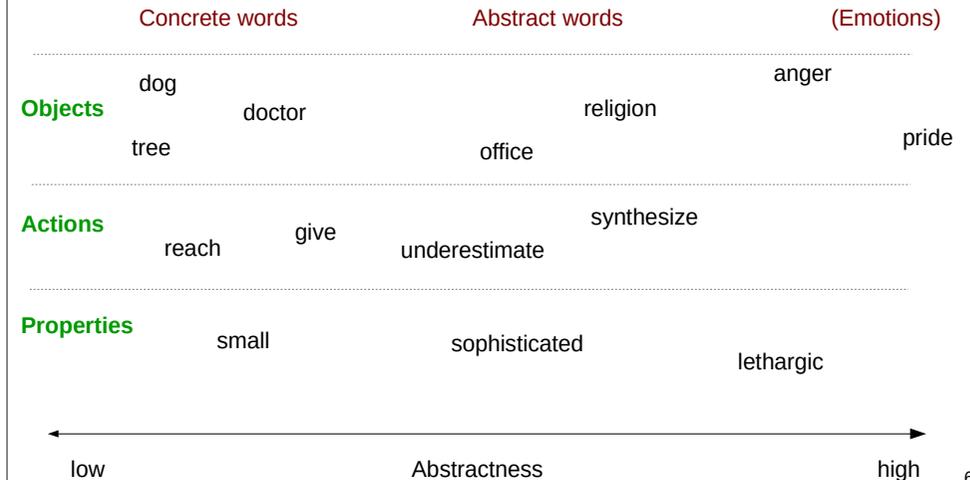
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Differences b/w concrete and abstract words (2)

- Chatterjee (2010): proposes three functional-anatomic axes in the brain that could be related to **gradedness of abstraction**. These are: (1) lateral axis – laterality differences in the processing of sensory and motor attributes of concepts, (2) ventral–dorsal axis – a shift from rich conceptual information to more schematic relationships, and (3) centripetal axis – from sensory and motor cortices to peri-Sylvian language cortices.
- Taylor, Hobbs, Burrioni, & Siegelmann (2015): Based on meta-analysis of fMRI data: regions deeper in the brain (i.e. remote from the **sensorimotor periphery**) represent more abstract functions.
- Borghi et al (2017): Abstract concepts are less stable over time and are shaped more by current life experiences, situations, and culture compared with concrete concepts. Abstract concepts are also by far the most variable.
- Also, most concrete concepts can be inscribed into the two broad categories of natural objects and artifacts, whereas abstract concepts come instead in a great variety.

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Abstractness continuum



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Research trends

- It is necessary to distinguish **different kinds of abstract concepts** and their corresponding brain representations.
 - Abstract concepts are heterogeneous, so it has been difficult to find an overarching theory.
- Emergence of **multiple representation views**
 - abstract concepts are grounded in sensorimotor systems but also involve linguistic, emotional and social experiences as well as internal experiences.
- Exploration of the **variability** of abstract concepts across natural languages
 - Natural languages shape the way we think about and use concepts. Abstract concepts – more detached from sensory experiences – could be more affected by linguistic variability.

(Borghi, Barc, Binkofski, Tummolini, 2018)

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Kinds of abstract concepts (1)

- Meta-analysis of 4 types: numerical, emotional, morality judgements and theory of mind.
 - large overlap in brain areas with concrete concepts → indirect grounding in objects and situations,
 - wide spread across brain areas → maybe more mechanisms required for all kinds of abstract concepts (Desai et al)
- Neural correlates of **polarity sentences** using fMRI: Clear distinctions found between affirmative abstract, negative abstract, affirmative concrete and negative concrete sentences.
 - Sentential negation polarity modulates brain activation in distributed semantic networks (Chio et al)

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Kinds of abstract concepts (2)

- Numerical knowledge: number concepts are placed along the abstract-to-concrete continuum (Fischer and Shaki, 2019)
- Embodied theory of emotional concepts proposed (Winkielman, Coulson and Niedenthal, 2019)
- Link between affective motivation and motor actions studied using tDCS, evidence provided for the grounding of emotional concepts (Brookshire and Casasanto, 2019)
- Moral concepts are argued to belong to (more general) evaluative concepts, including aesthetic concepts. They all are used to evaluate things as good or bad, evoking different emotions, going beyond mere perception (Fingerhut and Prinz, 2019)

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Grounding in perception and action

- both concrete and abstract concepts are grounded in Embodied Simulation mechanisms and in experience-based bodily regions (Cuccio and Gallese),
 - at the same time, they might differ in acquisition and representation, via icon and abduction (Peirce).
- Arguments for hybrid grounding – sensorimotor and linguistic systems: (Pecher and Zeelenberg)
 - Conceptual metaphor theory: evoked image schemas supramodal, rather than modal
 - Situated cognition: abstract concepts derive their meaning from being situated, but the question is whether this provides sensory-motor grounding.

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Grounding in inner experience

- Situated conceptualization framework proposed (instead of traditional distinction between concrete and abstract), concepts represented in the context of situated action (Barsalou et al)
- Mega-study based on modality-specific ratings of perceptual strength for over 30 000 words: grounding of concepts on interoception, i.e. sensation within the body (Connell et al.)
- Exploration whether metacognition about concepts, i.e. the thoughts and feelings about a concept, can itself ground abstract concepts; found important especially for abstract concepts (Shea)

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Grounding in linguistic and social experience

- WAT (Words As social Tools) theory proposed: linguistic, social and inner experience play a role of paramount importance for abstract concepts;
 - ‘social metacognition’ used: if inadequacy of a concept is recognized, the need to rely on others’ knowledge is used to integrate it (Borghi et al.)
- proposal that languages are not highly iconic exactly because abstractness is so pervasive (Lupyan and Winter)
- Odour concepts studied (difficult to conceptualize and verbalize): in naming task, TRs and facial expressions measured; different terms but same emotions observed for different language speakers → cultures and languages can differently shape our (even abstract) concepts (Majid et al.)

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