

11/30/11: Embodiment

Barsalou, L. W. (2008). Grounded cognition. *Annual Review of Psychology*, 59, 617-645.

### Standard theory

Modal system representations → amodal symbols = Knowledge

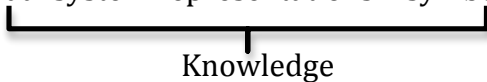
Perceptions → thought

Problems:

1. Little empirical evidence for the presence of amodal symbols.
2. Fails to explain how cognition interfaces with perception and action.
3. Where the brain stores amodal symbols.

### Grounded cognition

Modal system representations + symbols



-Mechanisms central to cognition: Simulation, Situated action, Bodily states  
Simulation: “reenactment of perceptual, motor, and introspective states acquired during experience with the world, body, and mind.” (Ex: Chair)

-Instead of fixed representations, multiple systems implement perception, action, and cognition with an infinite number of combinations or states.

Learning: Coupling between these states

-Perceptual symbol systems (PSS): retains the symbols of traditional theories but implements them with simulation and dynamic systems.

### Evidence

Perception

- Retrieving stimuli activate the perceptual states in which they were encoded.
  - Distort the recall of a red square towards the dark red square previously seen.
  - A gray banana is recalled as a bluish banana.
- Perception-action
  - Handle of a cup activates a grasping action.
- Space
  - Locating objects is easiest along the vertical axis, then front-back axis, then left-right axis.

Memory

- Implicit memory results from the simulation of perceptual memories.
  - Repetition priming is strongest with the modalities of the memory and stimulus match.
- Explicit memory
  - Similar neural pattern when studying faces as when remembering them.
  - Greater activation in modal areas when remembering an item that actually occurred compared to when remembering an item that did not actually occur.
- Working memory

- To maintain a working memory, neurons in the frontal lobes simulate the absent stimulus in the modal system that originally encoded it.

### Conceptual Processing

- Behavioral evidence
  - Switching from one modality to another while simulating properties incurs a switch cost.
- Lesion evidence
  - Lesions in a modality increase the likelihood of losing categories that rely on it.
- Neuroimaging evidence
  - When performing the property verification task, modal areas for the properties tested become active.

### Language Comprehension

- Replacing words with pictures does not disrupt processing.
- “The ranger saw the eagle in the sky.” Faster to name the eagle with outstretched wings.
- Motor system becomes active when reading the word for an action.
- When people read taboo words, increase skin conductance.

### Thought

- Physical reasoning
  - When viewing a static gear, people simulate its movement. (The slower its movement, the more time to draw an inference.)
  - Inferences suffer when WM is filled with visuospatial information compared to verbal.
- Abstract reasoning
  - “Next Wednesday’s meeting has been moved forward two days.”
  - “Foot of a mountain.”
  - “She ran like the wind.”

### Social Cognition

- Embodiment effects
  - People walk slower after activating the elderly stereotype.
  - When forced to smile, people report increased positive affect.
  - Pattern completion: You smile because you smiled there before.
- Social mirroring
  - Mirror neurons
  - Infer the intentions of others by simulating their actions.

## **Discussion points**

Is there a difference between simulation that includes a stimulus that actually occurred and simulation that includes a stimulus that did not actually occur?

- Modal areas are still activated

- “...internal states such as meta-cognition and affect constitute sources of knowledge no less important than external experience.”

Abstract concepts

Do metaphors actually represent how people think?

“Foot of a mountain.”

Physical reasoning

Can we never view a gear without simulating its motion?

Social Cognition

Do we need to simulate their actions to infer their intentions?

Are simulations and embodiments causal or epiphenomenal?