Week 10.1

Mental imagery and spatial cognition

Language

10/29/2018
Roadmap

• Mental imagery
• Spatial cognition
• Summary of cognitive functions
  – Perception
  – Attention
  – Memory
• Language and cognition
• Human language vs. animal communication
Learning objectives of the day

• What does the fMRI study of word concreteness tell us about mental imagery?
• What is the main potential problem with mental image scanning studies?
• Can you analyze a perceptual event in terms of what we’ve learned so far?
• What are the major differences between human language and animal communication?
• What are the subfields of linguistics? Can you describe what those fields are about?
Brain activation of concrete vs. abstract words

Jessen et al. (2000)

• Recognition memory task
• List of words (concrete and abstract)
• Training
• Testing: recognition memory (fMRI scan)
Brain activation of concrete vs. abstract words

Jessen et al. (2000)
Dual-coding theory
Spatial equivalence

https://imotions.com/blog/7-terms-metrics-eye-tracking/
Potential problems with mental imagery studies

Zenon Pylyshyn

- Subjects’ knowledge about the task
- Scan physically from A to B
  ➔ mentally scan from A to B

https://ruccs.rutgers.edu/zenon
Spatial cognition

• Knowing where we are

• Knowing where to go

• When do we use our spatial cognition?
Spatial cognition
Video Games and Spatial Cognition

Ian Spence and Jing Feng
University of Toronto

Video game enthusiasts spend many hours at play, and this intense activity has the potential to alter both brain and behavior. We review studies that investigate the ability of video games to modify processes in spatial cognition. We outline the initial stages of research into the underlying mechanisms of learning, and we also consider possible applications of this new knowledge. Several experiments have shown that playing action games induces changes in a number of sensory, perceptual, and attentional abilities that are important for many tasks in spatial cognition. These basic capacities include contrast sensitivity, spatial resolution, the attentional visual field, enumeration, multiple object tracking, and visuomotor coordination and speed. In addition to altering performance on basic tasks, playing action video games has a beneficial effect on more complex spatial tasks such as mental rotation, thus demonstrating that learning generalizes far beyond the training activities in the game. Far transfer of this sort is generally elusive in learning, and we discuss some early attempts to elucidate the brain functions that are responsible. Finally, we suggest that studying video games may contribute not only to an improved understanding of the mechanisms of learning but may also offer new approaches to teaching spatial skills.

Keywords: action video game, spatial attention, perceptual learning, gender differences, brain training
Interim summary
Cognitive processes

Analyze the following events in terms of perception, attention, memory (sensory, working, long-term)

1. Discriminating between two meaningless sounds in an experiment
2. Unintentionally seeing pedestrians passing by while thinking about the meeting agenda
3. Spotting airplanes flying by and identifying the type of aircraft
What is language?
Cognition without language?
...Who am I?

https://www.youtube.com/watch?v=UkX47t2QaRs
Key features of human language

- Arbitrariness
- Productivity
- Displacement
- Duality of patterning
- Reflexiveness
- Cultural transmission
Communication in human vs. non-human primates

https://www.youtube.com/watch?v=GorgFtCqP
Es
Key features differentiating human language from animal communication?

a. Arbitrariness
b. Productivity
c. Displacement
d. Duality of patterning
e. Reflexiveness
f. Cultural transmission
Study of Language

- Syntax
- Semantics
- Phonology
- Phonetics
- Morphology
- Pragmatics
Phonology vs. Phonetics

- **Phonology**
  - Language-specific
  - /\textit{str}/: possible in English but not in Japanese

- **Phonetics**
  - Acoustics and articulation of sounds
Interdisciplinary study of language

- Psycholinguistics
- Neurolinguistics
- Computational linguistics
- Cognitive linguistics
- Philosophy of language
- Sociolinguistics
- Anthropological linguistics
- Historical linguistics
Cognitive approaches to the study of language

- Perception
- Attention
- Working memory
- Long-term memory
- Concepts
  - Connectionist models
    - Semantic network
  - Boxes-and-arrows models
Cognitive approaches to the study of language

• Language development
• Language and thought
• Language and reasoning
Language and thought

**Examples of stimuli and responses, showing the effect of verbal labels**

<table>
<thead>
<tr>
<th>Curtains in a window</th>
<th>Diamond in a rectangle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottle</td>
<td>Stirrup</td>
</tr>
<tr>
<td>Eyeglass</td>
<td>Dumb-bell</td>
</tr>
<tr>
<td>Kidney bean</td>
<td>Canoe</td>
</tr>
<tr>
<td>Crescent moon</td>
<td>Letter “C”</td>
</tr>
<tr>
<td>Two</td>
<td>Eight</td>
</tr>
<tr>
<td>Ship's wheel</td>
<td>Sun</td>
</tr>
<tr>
<td>Hour glass</td>
<td>Table</td>
</tr>
<tr>
<td>Beehive</td>
<td>Hat</td>
</tr>
<tr>
<td>Pine tree</td>
<td>Trowel</td>
</tr>
<tr>
<td>Gun</td>
<td>Broom</td>
</tr>
<tr>
<td>Seven</td>
<td>Four</td>
</tr>
</tbody>
</table>
Views on language
Chomsky vs. Skinner
Views on language
Chomsky vs. Skinner

- Generative grammar
- Formal syntax and phonology
- Reinforcement and conditioning
- Stimulus-response
- Behavioral studies of verbal behavior
Generative grammar: what’s being generated?

- Sentences
  \[ S \rightarrow NP \ VP \]
  \[ S \rightarrow NP \ VP \ PP \]

- Sound changes
  the /p/ in ‘sport’ vs. ‘port’
Cognitive processes involved in the processing of imagery and words

Mountain