Week 11.2

Language, thought and (lots of) problem solving

11/7/2018
Roadmap

• Language and thought
• Impact of aphasia on thinking
• Sapir-Whorf Hypothesis
• Language and thought: Pirahã
• Problem solving
  ➢ Common strategies
  ➢ Mental set
  ➢ Functional fixedness
  ➢ Convergent vs. divergent thinking
Learning objectives of the day

• To what extent is language essential to thinking?
• How does aphasia affect abstract thinking?
• What is Sapir-Whorf Hypothesis about? And why does Pirahã support linguistic relativism?
• What are the common problem-solving strategies?
• How do mental set and functional fixedness limit our creativity?
• What’s the difference between convergent and divergent thinking?
Language and thought

• “Cogito, ergo sum.” – R. Descartes

• Better verbal skills $\rightarrow$ better thinking?

• Is thinking also impacted by aphasia?
Impact of aphasia on abstract thinking

• Renzi et al. (1966)
• 4 groups of Ss
  ➢ Normal
  ➢ Aphasics
  ➢ Right-hemisphere damaged but non-aphasic
  ➢ Left-hemisphere damaged but non-aphasic
• Task: Weigl Sorting Test
Impact of aphasia on abstract thinking

• Renzi et al. (1966)

Task: Weigl Sorting Test

1. Group in any way
2. Verbalize sorting strategy
3. Sort in an alternative way
Impact of aphasia on abstract thinking

• Renzi et al. (1966)

Task: Weigl Sorting Test

Performance result:

Normal ≃
Right-hemisphere damaged but non-aphasic ≃
Left-hemisphere damaged but non-aphasic ≫
Aphasics
Sapir-Whorf Hypothesis

• Edward Sapir and Benjamin L. Whorf
  ➢ Linguistic determinism: The form of our language influences how we think, remember and perceive
  ➢ Linguistic relativism: Different languages generate different cognitive structures.
Sapir-Whorf Hypothesis

• Strong version
  ➢ Language determines thought.

• Weaker version
  ➢ Language affects only perception

• Weakest version
  ➢ The influence of language is “task-dependent”
Testing Sapir-Whorf: Pirahã language

Daniel Everett

< 400 speakers

Three words for counting:
One, two, many

http://www.messagetoeagle.com
Testing Sapir-Whorf: Pirahã language

Three words for counting: One, two, many

Sense of quantity influenced by their language

Frank et al. (2008)
Testing Sapir-Whorf: Pirahã language

Sense of quantity influenced by their language

Frank et al. (2008)

Quantity (Experimenter)

(Xs indicate incorrect responses; Diamonds indicate correct responses)
Is language essential for problem solving?

- What kind of problems?
  - Satisfying basic biological needs
  - Brain teasers
  - Other high-level problems (rotate a magic cube, verbal analogy, etc.)
Problem-solving in other species

https://www.youtube.com/watch?v=QmJ3xuJrUcM

What kind of problems did the crow solve?
Well-defined vs. ill-defined problems

• Ill-defined problems
  ➢ Open-ended
  ➢ Unclear actions needed to achieve the goal
  ➢ May generate some well-defined problems while solving the ill-defined ones.

• Well-defined problems
  ➢ Clear goal
  ➢ Narrower set of actions
  ➢ Easier to plan ahead than the ill-defined ones
What do we need for problem solving?

• Goal setting
• Attention
• Memory
• Experiences
• Knowledge about the problem itself: problem-specific
Common strategies in problem-solving

• Generate-and-test

Add two matches to correct the equation
Common strategies in problem-solving

- Working backward
- Planning of moves

Tower-of-Hanoi

Rules:
- One disk at a time
- Smaller disk on top of bigger disks

Goal: 3 disks on peg B but #3 on the bottom.
Common strategies in problem-solving

• Working backward

Tower-of-Hanoi

Rules:

One disk at a time

Smaller disk on top of bigger disks

Goal: Move #1 and 2 to peg B.
Common strategies in problem-solving

• Backtracking: commonly used in coding and debugging
Common strategies in problem-solving

• What are the differences among the following three strategies?
  ➢ Generate-and-test
  ➢ Working backward
  ➢ Backtracking
Suppose you are a doctor faced with a patient who has a malignant tumor in his stomach. It is impossible to operate of the patient, but unless the tumor is destroyed the patient will die. There is a kind of ray that can be used to destroy the tumor. If the rays reach the tumor all at once at a sufficiently high intensity, the tumor will be destroyed. Unfortunately, at this intensity the healthy tissue that the rays pass through on the way to the tumor will also be destroyed. At lower intensities, the rays are harmless to healthy tissue, but they will not affect the tumor, either. What type of procedure might be used to destroy the tumor with the rays and at the same time avoid destroying the healthy tissue?
Common strategies in problem-solving

• Reasoning by analogy

A small country was ruled from a strong fortress by a dictator. The fortress was situated in the middle of the country, surrounded by farms and villages. Many roads led to the fortress through the countryside. A rebel general vowed to capture the fortress. The general knew that an attack by his entire army would capture the fortress. He gathered his army at the head of one of the roads, ready to launch a full-scale direct attack. However, the general then learned that the dictator had planted mines on each of the roads. The mines were set so that small bodies of men could pass over them safely, since the dictator needed to move his troops and workers to and from the fortress. However, any large force would detonate the mines. It therefore seemed impossible to capture the fortress. However, the general devised a simple plan. He divided his armies into small groups and dispatched each group to the head of a different road. When all was ready, he gave the signal and each group marched down a different road. Each group continued down its road so that the entire army arrived together at the fortress at the same time. In this way, the general captured the fortress and overthrew the dictator.
Common strategies in problem-solving

• Reasoning by analogy – the tumor problem

Gick & Holyoak 1980; adopted from Reisberg 2019
Common strategies in problem-solving

• Reasoning by analogy
  ➢ Central executive in working memory → CEO
  ➢ Tree → Long-term memory
  ➢ Memory retrieval → catch one bird from a flock of birds
  ➢ Schema theory of attention → pick one apple from the tree
How mental set limits our creativity?

• Nine-dot problem

Connect all of the dots in one single attempt.
How mental set limits our creativity?

http://identity-mag.com
How functional fixedness blocks our creativity?

• The two-string problem

The two strings are attached to the ceiling and further apart, such that you cannot grab them at the same time. How would you tie the two strings together?
Functional fixedness

• The candle problem (Duncker 1945)

How would you attach the candle to the wall so that the wax doesn’t fall when the candle is lit?
Functional fixedness – Think outside the box!

- The candle problem (Duncker 1945; Fleck & Reisberg 2004)
Being creative - Convergent thinking

• Associate irrelevant concepts

➤ Try to find a word that can combine with each of the three words in the set to create another new set of three words or phrases (The Remote Associates Test)

1. Snow, down, out
2. Cross, rain, tie
3. Opera, hand, dish
4. Sense, courtesy, place
Being creative - Divergent thinking

• Think outside the box – be innovative
  ➢ The plier in the two-string problem
  ➢ The box in the candle problem
  ➢ The parking lot problem
  ➢ Most brain teasers