Working memory and attention

BCS153 Week 15.1
4/23/19
Where is Wally?

https://www.thinglink.com/scene/979681015876288514
Where is this guy?

https://www.thinglink.com/scene/979681015876288514
A slightly different type of search
Discussion

• What are the differences between the two types of search (looking for a person vs. looking for words in a puzzle)?

• Think about:
  1. What do you need to do in terms of cognitive processes before starting the search?
  2. What types of memory are involved in two different types of search?
Roadmap

• Visual search and working memory
• Cognitive neuroscientific evidence for visual search
• Woodman et al. (2007): Visual search and Visual WM
• Metacognition and executive control
From long-term to working memory

Baddeley (2000)
Where does attention fit in the working memory model?

Baddeley (2000)
Does visual working memory guide selective attention in the search task?

Hypotheses:

• Constant target – Long-term memory

• Variable target – Visual working memory
Dorsal and ventral stream of visual processing

The role of prefrontal cortex in Visual WM - Evidence from primates (macaque)

Rossi et al. (2007)

• Variable target – impaired search
• Constant target – little difference from monkeys with intact PFC
Woodman et al. (2007): Study design

Main RQ: Is VWM always involved in visual search task?
• Two groups: constant-target, variable target
• Two tasks:
  ➢ Memory task (VWM)
  ➢ Visual search task

• 3 within-group conditions
  ➢ Memory alone
  ➢ Search alone
  ➢ Memory + Search
Woodman et al. (2007): Paradigm

Verbal WM suppression task at the beginning of each trial

→ Keep repeating numbers of letters during the task
Woodman et al. (2007): predictions

• Two possible scenarios in the memory + search condition:
  
  ➢ Search target replaced/interfered by target in memory task → inefficient search

  ➢ Search target interferes memory target pattern → poorer memory performance
Woodman et al (2007): Results

![Graph showing reaction times for different set sizes in the Constant-Target Condition. The graph illustrates the relationship between set size and reaction time, with distinct lines for different conditions: Search Alone: Present, Search Alone: Absent, Search & Memory: Present, and Search & Memory: Absent. The data points and error bars indicate variability in reaction times.](image-url)
Woodman et al (2007): Results
The role of frontal eye field (FEF) in visual search

• Efficiency of attention allocation modulated by target change frequency

• Slower neural response to changing target
Woodman et al (2007): Results

- **Memory task accuracy**
Woodman et al (2007): Results

- **Search task accuracy** (graph produced based on Table 1.)

![Graph showing search accuracy in constant-target condition.](image)
Woodman et al (2007): Results

- **Search task accuracy** (graph produced based on Table 1.)

![Search accuracy in variable-target condition graph](image-url)
Memory representation for the constant target

• Storage in long-term memory → rapid retrieval → automaticity

• Repetition priming (consciously processed): also LTM based

• Non-visual representation → stored in subsystem of prefrontal WM regions
From the perspective of metacognition/executive control

- Selecting
- Maintaining
- Updating
- Rerouting
From the perspective of metacognition/executive control

• Selecting
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→ Which of the above are involved in the constant- vs. variable-target search?

→ Similarities and differences between the visual search and n-back task (e.g., 3 6 2 9 0 8 9)?
From the perspective of metacognition/executive control

• Why maintaining the variable-target in Visua WM?
  ➢ Limited capacity of executive control

→ Maintaining search target in VWM
→ Suppress irrelevant info
→ Better attentional/executive control
Take-home messages

• Visual WM is not always needed in a visual search task – target dependent

• VMW guides selective attention only when the target is variable.

• LTM guides selective attention in a visual search task when the target remains constant.

• LTM guides selective attention in a word puzzle task when the targets are unknown.