Working memory and attention

Exam review

BCS153 Week 15.2
4/25/19
Roadmap

• Metacognition and executive control
• Attention and working memory revisited
  ➢ Downing’s study: whether WM guides attention when visual search is not required
• Wrap up
• Review of key experiments after Exam 2
From the perspective of metacognition/executive control

- Visual search (variable target) vs. n-back task (e.g., 3 6 2 9 0 8 9)

  - Similarities
    - Selecting, maintaining, updating
  
  - Differences
    - No visual search required in n-back
    - Verbal WM in n-back
From the perspective of metacognition/executive control

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

→ Maintaining search target in VWM
→ Suppress irrelevant info
→ Better attentional/executive control
Interim summary from Woodman et al. (2007)

• 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.
Visual WM guides selective attention... but can it be the opposite: selective attention first filters out irrelevant input to allow for more efficient processing in WM (classical view)?
Where does attention fit in the working memory model?

Baddeley (2000)
Downing’s study: Exp. 1

• Slightly different from Woodman’s

• NO VISUAL SEARCH OF TARGET REQUIRED

• Predictions

  ➢ IF WM guides selective attention → faster RT to probe on matched location

  ➢ IF WM is independent of attention → no difference of RT between matched and mismatched
Downing’s study

Exp. 1 results:
• Faster RT to probe at the location of matched face
  → Visual WM guides selective attention
  → Task effect: fixed location of the bracket? Other types of objects?

Exp. 2.
Sample (face or line-drawing) → two probes → Bracket judgment → judge the orientation of bracket opening (discrimination) → decide if the item matches the sample

Sample (face or line-drawing) → two probes → one item moving up or down → judge the direction of motion → decide if the item matches the sample
Downing’s study: Results from Exp. 2

Effect of probe independent of object type

→ WM guides ATTN
→ Stronger in the motion task

• Why overall slower responses in discrimination than motion task?

![Graph showing response time for motion and discrimination tasks with bars for objects and faces, indicating differences in response times for match and mismatch conditions.](image)
Downing’s study: Exp. 3

• Q: Can we obtain the same pattern of results if Ss are not required to maintain the sample in WM?

• A modified task: Sample object → size judgment → simultaneous display of sample and another object (one of which moving up or down) → judgment of motion direction → END of trial (no match-to-sample task)

• Group 1: the original task in Exp. 2 (with motion judgment)
• Group 2: the current modified task (w/o WM requirement)

➢ Prediction?
  ▪ If WM not required in Group 2 → matched location of probe not faster than mismatched in Group 2
Downing’s study: Comparison of results

Exp. 3

Motion Task

Exp. 2
Downing’s study: Comparison of results

• Faster RT to probe on mismatched objects! Why??

• Sample object not actively maintained in WM
  → Weak neural responses to repeated items passively registered
  → competitive disadvantage compared to the mismatched item
  → Slower RT observed in matched item
  → Oddball effect
Downing’s study: Exp. 4

- Between-condition difference really resulting from WM or simply an effect of matching task independent of attention probe?

→ Search for match begins as soon as seeing two objects at the same time
Downing’s study: Exp. 4

• A modified WM task → no need to do match
Paradigm: Maintain geometric shapes in WM → Motion direction judgment → Unpredictable questions about the shape at the end of trial

• Results similar to Experiment 2 (in the objects condition)
➢ Not an artifact of the matching task

![Response Time (ms)](images/Exp_2_chart.png)
Summary of Downing’s study

• Experiment 1: justify the relationship between WM and attention

• Experiment 2: generalize results of Exp.1 to different types of object and add a modified task (motion direction)

• Experiment 3: test if WM is required to obtain the same effect in Exp. 2; another task without maintaining the sample (size judgment)

• Experiment 4: Get rid of the matching task
Take-home messages

• Working memory guides attention even when visual search is not required.

• When visual search is required, WM guides attention if the target is frequently changing.
Wrap up

Looking back...can you name at least one key thing in each topic?

• Core debates in cognitive science
• Human cognitive evolution
• Embodied cognition
• Metacognition
• Language and cognition
• Computation, AI and cognition
• Concept and categorization
• Memory and consciousness
Review

Prototypes and exemplars (Smith & Minda: Exp 1)
Review

Prototypes and exemplars (Smith & Minda: Exp 2)
Review

- Kuhl/cool study

Discrimination

Category rating
Review
Memory and consciousness

![Graph showing conversion threshold and semantic cue information with annotations]

**TABLE 2**
Recall and “remember” judgements in Experiment 1

<table>
<thead>
<tr>
<th></th>
<th>Free recall</th>
<th>Category recall</th>
<th>Letter recall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability of recall</td>
<td>.51</td>
<td>.35</td>
<td>.10</td>
</tr>
<tr>
<td>Probability of recall conditionized on remaining items</td>
<td>(.51)</td>
<td>.54</td>
<td>.74</td>
</tr>
<tr>
<td>Probability of “remember” judgement</td>
<td>.88</td>
<td>.75</td>
<td>.48</td>
</tr>
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