Working memory (WM)

• WM is a complex cognitive system that allows us to retain short-term access to a limited amount of information.

• Time-Based Resource-Sharing model (TBRS) Barrouillet, Bernardin, & Camos, 2004

• WM, two main functions:
  – Maintenance
  – Processing

• Both functions are managed by the same limited resource: Attention

• Two independent systems of maintenance:
  – Articulatory rehearsal (→ verbal phonological loop)
  – Attentional refreshing (→ multimodal executive loop)
Attentional refreshing in a WM span task

Opportunities of attentional refreshing
Involving long-term memory (LTM)

- LTM is well known to increase the recall in WM task (e.g. frequency or lexicality effects)
  (Besner & Davelaar, 1982; Hulme, Maughan, & Brown, 1991; Miler, 1956; Ericsson & Kintsch, 1995; Cowan, 2008)

- To involve LTM representations in WM span task: Create lists of associatively related words in French

  \( \rightarrow \textit{Associative relatedness} \) : Groups of words that are in association, based on a recurrent use or appearance of these words together

  "rabbit – carrot – ear"

  Animal   Vegetable   Anatomic part

  No semantic similarity
Aim of the study

In the field of the Time-Based Resource-Sharing Model (TBRS)

- Explore the associative relatedness effect (rabbit) in WM span task
  - If relatedness effect, LTM was engaged in the task.
- Investigate the relationship between WM and LTM
- Question the nature of the attentional refreshing
- Compare adults and children performances on the same task
Hypothesis: Attentional refreshing and LTM

Opportunities of attentional refreshing

- LTM might be involved during the refreshing process
- Better recall for associatively related words than for unrelated
Hypothesis: Attentional refreshing and LTM

- Manipulation of the attentional refreshing via cognitive load variation
- If the concurrent task is highly demanding, then the relatedness effect might be weaker.
- Attentional refreshing allows the implication of LTM.
Predictions

- Effect of associative relatedness
- Effect of the cognitive load (availability of refreshing)
- Interaction cognitive load x associative relatedness

→ Attentional refreshing allows us to repair memories in LTM
Children:

- Main effect of the cognitive load
- No or weak effect of relatedness
- No interaction effect

# Method

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Age</th>
<th>Ratio</th>
<th>8 within-subject conditions</th>
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</thead>
<tbody>
<tr>
<td>Adults</td>
<td>24</td>
<td>$M = 21.1$</td>
<td>21</td>
<td>Block a -&gt; b</td>
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<tr>
<td></td>
<td></td>
<td>$SD = 1.88$</td>
<td>female</td>
<td>Block b -&gt; a</td>
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<td>Children</td>
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<td>$M = 11.21$</td>
<td>14</td>
<td>Block a -&gt; b</td>
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<tr>
<td></td>
<td></td>
<td>$SD = .83$</td>
<td>female</td>
<td>Block b -&gt; a</td>
</tr>
</tbody>
</table>

**List 1**
- Load
- Low -> High Load
- High -> Low Load

**List 2**
- Load
- Low -> High Load
- High -> Low Load

**“Ba-bi-boo”**
Cognitive load manipulation

Low load:
Color judgment

Capture: $M = 484\text{ms} ; \ SD = 108\text{ms}$
(According to a localization task, by Vergauve, Camos, & Barrouillet, 2014)

→ Estimated load = 0.32

High load:
Parity judgment

Capture: $M = 744\text{ms} ; \ SD = 61\text{ms}$
(Barrouillet & Vergauve, 2007)

→ Estimated load = 0.49

Barrouillet et al., 2004
Results : Span

2x2x2 repeated measures ANOVA on span performance with relatedness and cognitive load within-subjects factors and age as between-subject factor.

- Sig. main effect of relatedness $F(1,47) = 157.05, p<.001$
- Sig. main effect of cognitive load $F(1,47) = 8.87, p=.005$
- Sig. main effect of age $F(1,46) = 11.19, p=.002$
- No interaction effect relatedness x load $F(1,47) = .13, p=.72$
- No interaction with age $p>.35$

→ Bayes factor of 8.620e+21 for the relatedness + cognitive load + age model
Results: Reaction times on concurrent tasks

**Unexpected effect:**
- Sig. main effect of relatedness
  \[ F(1,47) = 19.36, \ p < .001 \]
Discussion

– Significant main effect of associative relatedness: Implication of the LTM, existence of associative relatedness in WM span task
  • Weaker in children Reyna, 2012b; Reyna & Brainerd, 2011

– Significant main effect of the load:
  • Weaker in adults
  • Both concurrent tasks allowed enough time to involve sufficient LTM?

– No interaction effect between relatedness x load
  • LTM is not managed by attentional refreshing
  • On-going studies that also showed no interaction between attentional refreshing system and effects of frequency and lexicality
  • BUT: attentional refreshing might still intervene in another way
Thank you for your attention!
References