THE IMPACT OF AGING AND HEARING STATUS ON VERBAL SHORT-TERM MEMORY

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INTRODUCTION
- Cognitive decline in older adults
  - Short-term memory (e.g., Maylor, 1999)
- Decrease in hearing acuity
Surprenant (2007):

- Adults > 70 years
  - 1/3 : clinically significant hearing loss
  - Almost 100% : mild hearing loss

Standard STM tasks:
- span tasks ➔ items presented auditorily
Baltes and Lindenberger (1997); Lindenberger and Baltes (1994):

- Cognitive functioning ↔ Sensory functioning (vision and hearing)
- Especially old age
Rabbit (1991): old participants with a mild hearing loss recalled fewer words than old participants with a good hearing.

**How could hearing impairment interfere with STM capacities?**

- *The effortfulness hypothesis* (Rabbit 1968; 1991)
Hypotheses

- Older participants with a hearing loss
- Young participants with a hearing loss, matched for hearing thresholds
- Young participants with no hearing loss
METHODS
## Participants

<table>
<thead>
<tr>
<th>Variable</th>
<th>Controls</th>
<th>Young hearing-matched</th>
<th>Elderly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of participants</td>
<td>16</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Age (years)</td>
<td>18-30</td>
<td>18-30</td>
<td>60-75</td>
</tr>
<tr>
<td>Gender (M/F)</td>
<td>6/10</td>
<td>5/11</td>
<td>5/11</td>
</tr>
<tr>
<td>Hearing threshold (dB HL)</td>
<td>7.12 (2.16)</td>
<td>17.20 (5.34)</td>
<td>18.76 (5.56)</td>
</tr>
<tr>
<td>Vocabulary level</td>
<td>0.77 (0.09)</td>
<td>0.77 (0.08)</td>
<td>0.86 (0.09)</td>
</tr>
<tr>
<td>Mill Hill (proportions)</td>
<td></td>
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<tr>
<td>Processing speed (ms)</td>
<td>395.64 (80.18)</td>
<td>398.47 (62.14)</td>
<td>475.410 (110.94)</td>
</tr>
</tbody>
</table>
Participants

- Matched for academic background: ≥ 12 years of schooling
- Native French speakers
- Corrected or normal vision
- No hearing aid
- No
  - dementia (Mattis Scale > 130/144)
  - neurological, neuropsychological, psychiatric disorders
  - medication use
Materials:

- STM memory tasks
  - Immediate serial recall of high frequency words
  - Immediate serial recall of similar and dissimilar words
  - Serial order reconstruction task

- Online phonological processing
  - Speeded nonword repetition task
Materials: Immediate Serial Recall (ISR)

- **ISR of high frequency words** (Majerus, 2006)
  - High frequency CVC words (Content, Mousty, & Radeau, 1990)
  - Lists with increasing length (1 to 6 items)

- % words correctly recalled in their order of presentation

**Phonological processing**
- Words not known in advance
- Open pool
- New on every trial
Materials: Immediate Serial Recall

- **ISR of similar and dissimilar words** (Majerus, 2005)
  - 8 similar and 8 dissimilar words of moderate frequency (Content et al., 1990)
  - Matched for imageability
  - Lists with increasing length (2 to 8 items)
  - Similar words: differed only by the onset phoneme (e.g., bois-roi)

- % words correctly recalled in their order of presentation

Similar condition: Phonological processing: almost identical words
Materials: serial order reconstruction

Serial order reconstruction task (Majerus, 2005)

- Digits from 1 to 9
- Lists with increasing length (3 to 9)

- % digits correctly replaced in their order of presentation

Focused on the order of the items presented

- Phonological processing
  - Highly familiar stimuli
  - Known in advance
  - Provided at recall (cards representing digits were given)
Materials: phonological processing

- **Speeded nonword repetition task**
  - Impaired performance in STM → items misperceived?
  - Online phonological processing of auditory items
  - Minimal STM load
  - Nonwords presented in isolation
  - Task = recall the nonwords
  - CVC – low phonotactic frequency (Tubach & Boë, 1990)
RESULTS
ISR of high frequency words

\[ F(2,45) = 5.60, \quad p < .01, \quad \eta^2 = .19 \]
ISR of phonologically similar and dissimilar words

**Similar condition**

![Graph showing % words recalled in order for elderly, young hearing-matched, and young controls groups. The graph for the similar condition shows significant differences between groups, indicated by **.]

\[ F(2, 45) = 6.89, \ p < .01, \ \eta^2 = .23 \]

**Dissimilar condition**

![Graph showing % words recalled in order for elderly, young hearing-matched, and young controls groups. The graph for the dissimilar condition shows significant differences between groups, indicated by **.]

\[ F(2, 45) = 7.99, \ p < .01, \ \eta^2 = .26 \]
Serial order reconstruction task

\[ F(2,45) = 7.55, \ p < .001; \quad \rho = .25 \]
Speeded nonword repetition task

\[ F(2, 45) = .48, \text{ ns.} \]
DISCUSSION
Speeded nonword repetition task: items well perceived
In STM tasks, performance decreased. Why?

- *The effortfulness hypothesis* (Rabbit 1968; 1991)
STM for serial order and STM for item information

- In typical STM tasks (e.g., digit span tasks), simultaneous storage of:
  - **Item information**: phonological and semantic properties
  - **Order information**: sequential order of the items

- Different mechanisms for the storage of item and order information
  - Experimental studies (e.g., Saint-Aubin & Poirier, 1999; Majerus et al., 2006b; Nairne & Kelly, 2004)
  - Neuropsychological data (e.g., Brock et al., 2004; Majerus et al. 2006a, 2007b)
  - Neuroimaging data (e.g., Majerus et al., 2006c, 2007a)
Majerus (2008); Majerus, Heiligenstein, Gautherot, Poncelet, and Van der Linden (2009); Majerus (2010)
Conclusions...

- Auditory factor influences STM more than does aging
- Auditory impairment → Attentional resources that would be otherwise available for STM
THANK YOU FOR YOUR ATTENTION