Factors of auditory distraction in serial recall in adults

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Introduction

Duplex account for auditory distraction

- Attention capture – caused by the irrelevant sound diverting attentional resources
- Interference-by-process – caused by overlap of irrelevant sound and focal task processing

The Irrelevant sound effect (ISE) – in the presence of irrelevant auditory information, performance on serial order recall tasks is worsened

Changing state effect (CSE) – sounds that change over time are more disruptive than those that do not

The CSE has been shown not to demonstrate the relationships consistent with an attention capture account

- The effect is not moderated by factors that have been shown to moderate auditory attention capture

- Encoding difficulty
- Forewarning
- Working memory capacity – a measure of executive control over attention allocation
- There is no relationship between the size of the ISE and WMC

The CSE is generally attributed to obligatory order processing of auditory information interfering with rehearsal of the order of to-be-remembered (TBR) items

Present Study

- Test the duplex account of the ISE
- Use measures of attention control, and a measure of rehearsal to test relationships with the size of the ISE

Hypotheses:

1. WMC will not predict the size of the ISE
2. Anti-saccade task performance will not predict the size of the ISE
3. Rehearsal ability will predict the size of the ISE
4. WMC and anti-saccade performance will be significantly correlated

Method

- 92 Louisiana State University undergraduates
  - No hearing loss
  - Native English speaker
  - Normal or corrected vision
  - 85% or higher on the processing portion of the complex span tasks

Working memory capacity

- Individuals completed three WMC complex span tasks
- Operation Span (OSPAN)
- Symmetry Span (SSPAN)
- Reading Span (RSPAN)

Each WMC task had a storage component and a processing component

Participants were required to consistently disengage and reengage their attention between the two components of a task

Scoring

- WMC tasks: number of items successfully recalled in correct serial order
- Anti-saccade: percent of correct trials
- Digit span tasks: highest percent at which an individual successfully recalled at least 50% of the trials correctly

Rehearsal was scored as a difference between two digit span tasks

- Span was determined by individuals completing serial order recall on lists starting at list length 3
- After 4 trials, if an individual got 2 or more lists completely correct, list length increased by one
- Possible lists from 3-9 digits in length

During the first span task, individuals could perform subvocal rehearsal

During the second span task, individuals were required to concurrently articulate the word “the” twice a second

- Concurrent articulation prevents the individual from sub-vocally rehearsing the TBR items

- If individuals are unable to rehearse the difference in performance should predict the reliance on rehearsal

ISE task

- Run at their silent digit span
- Scored using strict serial position scoring

Half of the trials had no irrelevant sound and the other half had changing state words as irrelevant sound

- Random order of sound and speech trials
- The words were from a closed set of nine possible words

Results

Table 1

<table>
<thead>
<tr>
<th>Task</th>
<th>Mean</th>
<th>S. D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 OSPAN</td>
<td>55.36</td>
<td>(15.10)</td>
</tr>
<tr>
<td>2 SSPAN</td>
<td>28.18</td>
<td>(7.48)</td>
</tr>
<tr>
<td>3 RSPAN</td>
<td>51.32</td>
<td>(15.56)</td>
</tr>
<tr>
<td>4 Anti-saccade</td>
<td>.52</td>
<td>(.10)</td>
</tr>
<tr>
<td>5 Silent digit span</td>
<td>6.70</td>
<td>(1.21)</td>
</tr>
<tr>
<td>6 Articulatory suppression digit span</td>
<td>4.27</td>
<td>(.84)</td>
</tr>
<tr>
<td>7 Proportion correct on silent 64 trials</td>
<td>.87</td>
<td>(.10)</td>
</tr>
<tr>
<td>8 Proportion correct on changing state ISE trials</td>
<td>.77</td>
<td>(.15)</td>
</tr>
</tbody>
</table>

Table 2

<table>
<thead>
<tr>
<th>Task</th>
<th>CSPLAN</th>
<th>SSPAN</th>
<th>OSPAN</th>
<th>AVIC</th>
<th>DIS</th>
<th>ADS</th>
<th>Silen</th>
<th>S. D.</th>
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</thead>
<tbody>
<tr>
<td>1 OSPAN</td>
<td>–</td>
<td>–</td>
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<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>2 SSPAN</td>
<td>.54*</td>
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<td>–</td>
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<td>–</td>
<td>–</td>
<td>–</td>
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<tr>
<td>3 RSPAN</td>
<td>.55*</td>
<td>.45*</td>
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<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>4 Anti-saccade</td>
<td>.21*</td>
<td>.21*</td>
<td>.20*</td>
<td>–</td>
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<tr>
<td>5 Silent digit span</td>
<td>.26*</td>
<td>.24*</td>
<td>.43*</td>
<td>.22*</td>
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<td>.22*</td>
<td>.46*</td>
<td>.27*</td>
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<tr>
<td>7 Proportion correct on silent 64 trials</td>
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<td>.11</td>
<td>.49*</td>
<td>.16</td>
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<td>.16</td>
<td>.15*</td>
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Table 3

<table>
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<tr>
<th>Task</th>
<th>1</th>
<th>2</th>
<th>3</th>
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</thead>
<tbody>
<tr>
<td>1 WMC</td>
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<td>–</td>
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<td>2 Anti-saccade</td>
<td>.33*</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>3 Rehearsal</td>
<td>.07</td>
<td>.02</td>
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<td>–</td>
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<tr>
<td>4 Size of the ISE</td>
<td>.14</td>
<td>.02</td>
<td>.31*</td>
<td>–</td>
</tr>
</tbody>
</table>

The three WMC tasks were transformed into z-scores and added together to make a composite score of WMC

Rehearsal ability (silent span – art. supp. span)

- Performance on the task with the ability to rehearse minus performance without the ability to rehearse should be an estimate of how much individuals rely on rehearsal in serial order recall

The size of the ISE = (% correct in silence – % correct in speech)

Discussion

- An individual’s reliance on rehearsal in serial order recall is a significant predictor of how much they are affected by irrelevant sound

- More rehearsal = more chances to be disrupted by irrelevant sound

- Silent digit span predicts the ISE because individuals with a higher span tend to rehearse better, not just due to methodological similarities

The results supported all of our hypotheses and validated the current explanation for the cause of the ISE in adults

- During serial order recall, irrelevant sound limits an individual’s ability to rehearse the TBR items

The factors used to measure attention control have NO predictive value in regards to the size of the ISE

There are large amounts of variance in the ISE that remain unaccounted for

- This may indicate a need for further explanation into how auditory distractors impact performance

References