Parallel implicit and explicit processing mechanisms in statistical language learning

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Introduction

- Statistical learning refers to the discovery of patterns in the input.
- The learning of word boundaries can occur through an implicit computation of transitional probabilities, which are statistically predictive relationships between syllables (Saffran et al., 1996).
- Statistical learning is considered a domain-general resource (Kirkham et al., 2002), although domain-specific interference effects have not been investigated in detail.
- Our previous research has demonstrated a domain-specific interference effect between verbal statistical learning and a concurrent, explicit non-auditory phonological task, when exposure to the artificial language is 28-minutes (Noonan & Archibald, in prep).
- However, the marginal effects observed in our previous study might reflect overlearning of the stimuli over our extended exposure time.
- The present study examined how explicit domain-general and -specific working memory tasks with low or high demands impaired the statistical learning of word boundaries in a 7-minute artificial language.

Method

Participants
- 105 young adults
- English monolingual; normal hearing/vision

Procedure
- 7 min
- Artificial Language Stimuli
  - Six trisyllabic “words” generated from 12 CV syllables
  - Unsegemnted language stream: Only cue to word boundaries were the transitional probabilities between syllables

Explicit Working Memory Task
- Participants completed a computer administered n-back task, or a control task
- Concurrent with language exposure
- 4 working memory task conditions + control (no task):
  - Verbal WM: Low Load (0-back) or High Load (2-back)
  - Visuospatial WM: Low Load (0-back) or High Load (2-back)

Hypotheses

- “Word”/nonword test pair: e.g.: “putibu or pubati”?
- Trisyllabic nonwords with transitional probabilities of zero

Results

TABLE 1:

<table>
<thead>
<tr>
<th>Task Load</th>
<th>No Load</th>
<th>Low Load</th>
<th>High Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>M (SD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verbal</td>
<td>XX</td>
<td>XX</td>
<td>XX</td>
</tr>
<tr>
<td>Visuospatial</td>
<td>XX</td>
<td>XX</td>
<td>XX</td>
</tr>
</tbody>
</table>

TABLE 2:

<table>
<thead>
<tr>
<th>Task Domain</th>
<th>Task Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Load</td>
<td>M (SD)</td>
</tr>
<tr>
<td>Verbal</td>
<td>19.83 (3.21)</td>
</tr>
<tr>
<td>Visuospatial</td>
<td>22.06 (3.67)</td>
</tr>
</tbody>
</table>

Means and effect sizes of word identification scores (out of 36)

- Table 2: Task Domain
- Table 1: Predicted differences in word segmentation abilities, if constrained by domain-general capacities (purple) or verbal capacity (blue)

Note: Experimental groups compared individually to controls using planned simple contrasts; bolded values are p < .05

Conclusions

- Control condition
  - Successfully segmented words
  - Concurrent low load working memory task
  - Successfully segmented words
  - No different from controls
  - Equivalent regardless of task domain
  - Concurrent high load working memory task
  - Significantly lower word identification scores than controls
  - No different from chance
  - Lower score regardless of task domain

- Explicitly and implicitly coding of new information
  - May tap similar resources
  - Costs to implicit learning when under demanding processing conditions
  - Extended exposure time (Noonan & Archibald, in prep) might facilitate learning for cross-domain as same-domain interference

References