Neural tracking of attended speech in monolingual and bilingual children

Jacqueline Phelps, Mirjana Bozic

Department of Psychology, University of Cambridge, Cambridge, UK

Contact: jap9@cam.ac.uk

1. Background

We examined how bilingualism in childhood influences the neural encoding of attended speech, as compared to monolinguals. Studies in adults have shown differences in the neural mechanisms of selective attention, even when bilinguals and monolinguals display equivalent performance. These studies suggest that the crucial consequence of bilingualism might be that it triggers neuroplastic adaptation that is more subtle than what has been captured by behavioural tests alone. It is however unclear to what extent such changes affect the mechanisms of selective attention in bilingual children.

Using the ‘Cocktail Party’ paradigm, we presented listeners with spoken narratives and manipulated the type of the competing stream to create interference at different levels of intelligibility. We then calculated the stimulus reconstruction accuracy of attended and unattended speech envelopes to reveal their attentional coding in each group.

2. Conditions

<table>
<thead>
<tr>
<th>Condition</th>
<th>Monolingual (N = 24) children</th>
<th>Bilingual (N = 24) children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native Language interference (Native)</td>
<td>English</td>
<td>A different English narrative</td>
</tr>
<tr>
<td>Unknown Language interference (Unknown)</td>
<td>English</td>
<td>A narrative in Latin</td>
</tr>
<tr>
<td>Non-Linguistic interference (Non-Ling)</td>
<td>English</td>
<td>Well-matched acoustic signal (Musical Rain)</td>
</tr>
<tr>
<td>No Interference (Single Talker)</td>
<td>English</td>
<td>N/A</td>
</tr>
</tbody>
</table>

3. Methods

Participants. 48 typically-developing school-age children split into two categories: bilingual (N=24, mean age 9.3) and monolingual (N=24, mean age 9.56). All were fluent speakers of English and all the bilingual children were exposed to at least one other language at home on a daily basis.

Stimuli. Four children’s stories with 120 sentences in each (sentences were 3 to 5 long). Each story was divided into two blocks, with 60 sentences per block (3–3 min).

Procedure. Each condition, participants attended to 2 blocks (2x60 = 120 attended sentences) separated between their L and R ear. Attended story was always in English. The first story had no interference (control condition). The subsequent three stories were presented in a random order with a competing stream (Native Language, Unknown Language, or MoR) simultaneously presented in the other ear. There were 480 attended and unattended sentences in total per participant.

Comprehension. After each block, participants completed 10 cloze test questions on the story they attended to, resulting in 80 responses per participant. Accuracy was 78.5% for monolinguals and 78.96% for bilinguals.

4. Attended and Unattended reconstruction accuracy results

<table>
<thead>
<tr>
<th>Condition</th>
<th>Monolinguals attended/unattended</th>
<th>Bilinguals attended/unattended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attended</td>
<td>0.04</td>
<td>0.02</td>
</tr>
<tr>
<td>Unattended</td>
<td>0.06</td>
<td>0.04</td>
</tr>
</tbody>
</table>

5. Summary and Conclusions

- The presence of interference did not impair behavioural performance of listeners, with both groups performing equally well on the comprehension task.

- Neural data showed more accurate reconstruction of the attended envelopes, suggesting enhanced encoding of the attended stream.

- In monolinguals, the type of interference significantly modulated the stimulus reconstruction accuracy of attended speech.

- In bilinguals, the type of distractor did not modulate the accuracy of stimulus reconstruction of the attended stream.

- Direct comparisons between the groups revealed overall lower accuracy scores across unattended stream in bilinguals, arguably lending support to the theory that the experience of processing two languages enhances children’s ability to attend selectively to relevant information and control interference.¹⁴

- This suggests that, even when behavioural responses are equivalent, monolingual and bilingual children exhibit different patterns of neural entrainment to attended and unattended speech envelopes.

- Furthermore, the groups’ encoding of attended speech directly replicates the pattern of results previously observed in adults.⁵

References


