Eye-Tracking Investigation of Relative Clause Processing in Two Groups of Bilingual Speakers

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Introduction

- First-language processing is "permeable" to the effects of later-learned languages.
- Dominance, or relative language proficiency, modulates the effects of later-learned languages on the first-learned language.
- This study examines bilingual processing of relative clauses, a structure with a widely documented processing asymmetry favoring subject relative clauses.
- We use eye-tracking in the visual world paradigm to measure processing of auditorily presented subject and object relative clauses in the first-learned language (Spanish).
- We compare heritage speakers of Spanish (English-dominant) to Spanish-English late bilinguals (Spanish-dominant).

Research Questions

1. Do fluent bilingual adults demonstrate the subject/object processing asymmetry in their first-learned language in the visual world paradigm?
2. Do heritage speakers differ from late bilinguals in their processing of relative clauses in the first-learned language?

Stimuli & Procedure

1. Subject relative clauses (n = 10)
   El gato, que jala al conejo, corta al oso.
   The cat, who pulls the rabbit, cuts the bear.
2. Object relative clauses (n = 10)
   El conejo, que el gato jala, corta al oso.
   The rabbit, who the cat pulls, cuts the bear.

One target image and two distractor images:

- Stimuli are presented auditorily as natural speech.
- Participants are asked to click the correct picture.
- Gaze fixations are recorded with a Tobii TX300 eye-tracker recording at 60 Hz.

Analysis

- Fixation data is binned to four temporal regions:
  - Region 1: Before the subject or object relative clause
  - Region 2: During the subject relative clause
  - Region 3: During the object relative clause
  - Region 4: After completion of the sentence

- Mean fixation proportions on the target image are calculated by group, by condition, by region.
- Fixation data is fit with beta regression models to analyze effects of group and condition on target fixation proportions in each region.

- Comprehension accuracy and log-transformed reaction time are modeled with logistic and linear mixed effects models to analyze effects of group and condition on behavioral responses.

Results

- Late bilinguals are significantly less likely to fixate on the target image during object relative clauses than subject relative clauses in Region 2 (p < .001) and Region 3 (p < .001).
- During subject relative clauses, heritage speakers are significantly less likely than late bilinguals to fixate on the target image in Region 2 (p < .01, p < .05).
- By Region 3, heritage speakers “catch up” to late bilinguals, i.e., the by-group difference is no longer significant (p = .62, p = .13).

Conclusions

- Both groups increase fixations to the target image prior to completion of the sentence, suggesting first-language predictive processing across groups. p < .01.
- Only late bilinguals demonstrate the subject relative clause processing advantage, suggesting that greater dominance in the first-learned language causes more active prediction in first-language processing.
- There are no group differences in comprehension accuracy or reaction time, suggesting that online processing is more sensitive to the effects of language dominance than offline comprehensions.

Participants

<table>
<thead>
<tr>
<th>Bilingual Group</th>
<th>Age</th>
<th>Age Of Arrival</th>
<th>Length of US Residency</th>
<th>Dominance Score (English)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS (n=19)</td>
<td>25.5 (7.1)</td>
<td>2.4 (3.0)</td>
<td>22.5 (6.0)</td>
<td>42.0 (35.0)</td>
</tr>
<tr>
<td>LB (n=20)</td>
<td>30.1 (9.2)</td>
<td>25.2 (7.2)</td>
<td>5.0 (5.1)</td>
<td>-66.8 (40.8)</td>
</tr>
</tbody>
</table>

Behavioral Data

- Across groups, participants are significantly less accurate on object relative clauses than subject relative clauses (p < .01).
- Group is not a significant predictor of accuracy.

Next Steps

- Analyze the effects of dominance along a continuum within and across the two participant groups.
- Analyze fixations during each word within each temporal region to determine what particular events are facilitating prediction in processing.
- Run the same experiment with English stimuli.

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