1. Introduction

Many languages have a two-way laryngeal contrast in stops, but phonetic implementation of this contrast varies cross-linguistically (Keating, 1984):
- True voicing languages (e.g., Spanish) exhibit phonetic voicing (vocal fold vibration during closure) for stops with the feature [voice].
- In German, stops with the feature [voice] (or no [spread glottis]) are often phonetically voiceless in utterance-initial position (Jessen & Ringen, 2002, Beckman et al., 2013).
- Initiating or maintaining phonation during stop closure involves several adjustments, including tongue root advancement to enlarge oral cavity volume (Westbury, 1983).
- Ultrasound imaging shows that in American English, the tongue root is more advanced for VOICED stops, whether phonated or unphonated, in utterance-initial position (Ahn, 2015).

Research Question:
- Does German VOICED stops in utterance-initial position show different tongue position from voiceless stops even without acoustic phonation during closure? If so, why?

2. Methodology

**Stimuli and Procedure**

- **VOICED**:
  - Build a 'poorly tuned' /k/.
  - Darf nicht (not allowed to).
  - Gibt Hitch (gives advice).
- **VOICELESS**:
  - Pass gut, this well.
  - Leid zwei (part two).
  - Kah (buys shopping).

**Participants:** 9 speakers of German (5 female/4 male)

Possible Outcomes

- If VOICED stops show more ATR than VOICELESS stops:
  - It confirms the results of English. Laryngeal contrasts are reflected in tongue position in German, even without acoustic phonation.
- If VOICED and VOICELESS stops show no difference in tongue position:
  - English and German might not appear to have the same articulatory implementation for the laryngeal contrasts that have been often treated as the same representation in the phonological literature.

3. Results

<table>
<thead>
<tr>
<th>Speaker</th>
<th>Labial stops</th>
<th>Alveolar stops</th>
<th>Velar stops</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1 (M)</td>
<td>Lowered TB</td>
<td>d &gt; t</td>
<td>no difference</td>
</tr>
<tr>
<td>S2 (M)</td>
<td>Lowered TB</td>
<td>g &gt; k</td>
<td>no difference</td>
</tr>
<tr>
<td>S3 (F)</td>
<td>Lowered TB</td>
<td>g &gt; k</td>
<td>no difference</td>
</tr>
<tr>
<td>S4 (F)</td>
<td>Lowered TB</td>
<td>g &gt; k</td>
<td>no difference</td>
</tr>
<tr>
<td>S5 (M)</td>
<td>Lowered TB</td>
<td>d &gt; t</td>
<td>no difference</td>
</tr>
<tr>
<td>S6 (M)</td>
<td>Lowered TB</td>
<td>g &gt; k</td>
<td>no difference</td>
</tr>
<tr>
<td>S7 (F)</td>
<td>Lowered TB</td>
<td>g &gt; k</td>
<td>no difference</td>
</tr>
<tr>
<td>S8 (F)</td>
<td>Lowered TB</td>
<td>no difference</td>
<td>no difference</td>
</tr>
<tr>
<td>S9 (F)</td>
<td>Lowered TB</td>
<td>no difference</td>
<td>no difference</td>
</tr>
</tbody>
</table>

- **A > B:** A shows more advanced tongue root than B.
- **Lowered TB:** Tongue body/front is lowered for voiceless stops compared to voiceless stops.
- **No correlation of the results with dialects.**
- **Most utterance-initial VOICED stops were unphonated:** only 5 phonated stops out of 270 VOICED stops across all speakers.
- **Labial stops:** VOICED stops lowered the tongue body/front compared to voiceless stops for all speakers (cf: Westbury, 1983, Ahn 2015 for English).
- **Labial stops pattern differently from alveolar and velar stops.**
- **Alveolar stops:** 5 speakers advanced the tongue root for voiceless stops, 2 speakers lowered the tongue body/front, and no difference for 2 speakers (cf. lowered tongue position of /d/ than /t/; Hamann & Fuchs, 2010).
- **Velar stops:** Most speakers advanced the tongue root for VOICED stops except for two speakers (S1, S9).

4. Discussion

- **A clear distinction in tongue position between VOICED and VOICELESS stops**
- **English (Ahn, 2015) & German**

- The results are similar to English: ATR or tongue body/front lowering is showed for VOICED stops even in languages without acoustic phonation.
- Some differences found can be language-specific. German stops showed consistent results for labial and variation for alveolar stops; English showed consistent results for alveolar stops.

Selected References & Acknowledgements


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