The role of labiolingual gestural coordination in spatiotemporal facilitation of Turkish, Turkmen and Hindi

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Motor facilitation and gestural economy

- Lingual harmonic patterns due to economized speech gestures yield motor facilitation by increasing speech rate or accuracy[1].
- Harmonic patterns articulated with lip protrusion gesture require more articulatory effort and so they do not yield motor facilitation.
- Back harmonic languages do not participate in height harmony[2], consequently, only back harmonic patterns yield motor facilitation.
- We present results from a study with two back harmonic languages Turkish and Turkmen and one non-harmonic language Hindi.
- Turkish front rounded vowels articulated with lip protrusion make larger gestures than back rounded vowels[3].
- We show that Turkish & Turkmen front round vowels formed with lip protrusion do not yield motor facilitation in back harmony. As also Hindi.

Research questions and variables

- Do back harmony patterns increase speech or error rates? & Do intervocalic consonants exert any influence on speech or error rates?
- Do back harmony patterns formed from front unrounded vowels increase speech/error rates compared to back harmony patterns formed from front rounded vowels?

Variables

Harmony Type (HT): Back harmony (BH), Disharmony (DH), Height harmony (HH); Consonantal Type (CT): /p/, /t/, /k/; Random Variable: Speaker; Condition types: Front unrounded (FU), front rounded (FR); Fixed effects: Speech & error rates

Experimental procedure and analysis

- 10 each, native Turkish and Turkmen, and 7 native Hindi speakers.
- We presented each token of the experimental stimuli for 5 seconds on a computer screen & instructed speakers to utter each phrase as many times as possible, as quickly as possible, as accurately as possible.
- Measurement: number of syllables uttered; speech rates were measured as - number of syllables/5 sec & Error rates were measured as - (number of syllables/number of tokens)*100.
- Speech rates and error rates were converted into logarithmic form for reducing the skew.
- Statistical model: Linear Mixed Effects (LME) model is used for verifying random effects of speaker and fixed effects of harmony & consonantal type.

Speech rates - HT & CT - LME test

LME test conducted to verify speech rates DH ≤ BH>HH

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>FU</td>
<td>p&lt;0.05</td>
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Verifying speech rates /p>/t>/k>/p/

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Error rates - HT & CT - LME test

LME test conducted to verify error rates DH > BH≤HH

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Stimuli

Type | FU condition | FR condition
--- | --- | ---
BH | i-e,i-u,o-o,i-36 | y-o,y-o-o-o,i-36
| pipe la pupo 36 | pyppa la popi 36
| Hindi | i-u,i-e,o-o,i-36 | y-y-y-o-o-y-36
| pope la pupi 36 | pyppa la popi 36
| Turkmen | i-o,i-e,u-e,i-36 | y-o-y-y-o-o-y-36
| pipo la popi 36 | pyppa la popi 36

Hypotheses

H1: Speech rate: DH ≤ BH >HH
H2: Error rate: DH ≥ BH <HH
H3: Speech rate: /p/>/t/>/k>/p/ & Error rate: /p/>/t/>/k>/p/

Speaker variance - LME test

Variance & residual deviance for speakers are less than 1; data is normally distributed.

Discussion, Conclusion and Further research

- Back harmonic patterns yield temporal facilitation in Turkish and Turkmen; labial protrusion of front rounded vowels prevents motor facilitation in back harmony. However, lip spreading and lip compression gestures yield temporal facilitation. Hindi, a non-harmonic language, does not yield any facilitation. Consonants /p/ and /t/ aid the harmonic patterns in temporal motor facilitation in Turkish and Turkmen respectively.
- Spatiotemporal facilitation in labial and lingual gestural coordination will be examined with EMMA, MRI and acoustic modelling.

References