AN ELECTROPALATOGRAPHIC AND ACOUSTIC STUDY OF THE TONAL EFFECTS ON VOWEL PRODUCTION IN STANDARD CHINESE

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RESEARCH QUESTION
Tone-conditioned vowel articulation and acoustics in Standard Chinese.

METHOD
62-electrode WinEPG system

Stimuli, speaker, and procedures
Monosyllables uttered at least in three tones

<table>
<thead>
<tr>
<th>Vowel</th>
<th>LA</th>
<th>AP</th>
<th>AL</th>
<th>RE</th>
<th>PA</th>
<th>VE</th>
<th>Zero</th>
</tr>
</thead>
<tbody>
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Table 1. Monosyllable Stimuli. (Six consonantal places of articulation for the initials were considered regarding the phonotactic constraints and the availability of Chinese monosyllables with at least three tones (and including T3). Monosyllables with zero initials were also included. LA stands for bilabial (labial-dental), AP for apical, AL for alveolar, BE for retroflex, PA for alveolo-palatal, and VE for velar. The syllables with an asterisk on the right have no T1 tone; the underlined syllables have no T2 tone.)

Measurements

EPG measures
TC: the contact ratio for the pseudo-palate;
CoG: Center of gravity;
CA: Contact anteriority;
CP: Contact posteriority;
CC: Contact centrality;

Acoustic measures
F1: First formant
F2: Second formant

EGG measure
F0 trajectory

RESULTS
Tonal patterns across vowels uttered by the speaker

Tonal effect on /i, y, i2/

For zero-initial /i/ - Global tonal effect:
- Less F0 in T4;
- More F1 in T4;
- Higher F1 in T4;
- Less TC, CoG, CA, CP, CC in T4;
- More TC, CoG, CC in T3;
- Less TC, CC in T3;
- Higher F1 in T3.

For non-zero-initial /i/ - Global tonal effect:
- More TC and/or CP and CC in T3;
- Less TC in T3;
- Higher F1 in T3.

For non-zero-initial /y/ - Global tonal effect:
- More TC, CoG, CC in T3;
- Less TC, CC in T4;
- Higher F1 in T4.

For /i1/ - Global tonal effect:
- Less EPG indices in T4;
- More TC but larger CoG in T3;
- Less TC and/or CC in T3;
- More TC, CoG, CC in T4;

For /i2/ - Global tonal effect:
- Less EPG indices in T4;
- More TC, CoG, CC in T3;
- Less TC, CC in T3;
- Higher F1 in T4.

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DISCUSSION & CONCLUSION
1) The tonal effect depends on the constriction place for vowels: the anterior constriction involves higher and/or more advanced tongue gesture, and posterior constriction involves lowered and retracted tongue gesture;
2) The tonal effect is relatively global in the vocalic interval, which is assumed to be dependent on the initial pitch value;
3) The F1 is consistently higher in T4 across vowels, which might be attributed to the raised larynx that leads to the shortened vocal tract;
4) Tongue-pull hypothesis is not sufficient to explain the tone-vowel interaction; A finer mechanism is to be explored in future work.