Implosives and the Inherent F0 Perturbation in Chinese Dialects

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INTRODUCTION
It is generally noticed that in a tonal language such as Chinese, phonation types are the phonetic cause of tonogenesis, different phonation modes can define three tonological registers, and the initial consonants of a syllable and the consonants at the end of the syllable would perturb the pitch contour [1]. In the traditional Chinese phonology, the “voiced” (actually, in most cases, they are sounds with slack voice, not real voiced consonants) initial consonants correspond to Yang tonal category, a lower tonal category, while the voiceless initial consonants correspond to Yin tonal category, a higher tonal category. However, implosives in Chinese dialects are contradicted to this rule. The voiced implosives are corresponding to the higher tonal category. Previous studies discussed about the consonantal perturbation on F0 of the following vowels. The physiological mechanism of F0 control is refined. However, the tonal perturbation of implosives in Chinese dialect is rarely mentioned. Current study is going to explore two questions: 1) which tonological register do implosive initial consonants correspond to? High, Mid, or Low? 2) How do implosive initials perturb the pitch contour?

It is found that generally, implosive initials correspond to the Mid tonological register, just as the voiceless initials do. But there are a few cases in which implosive initials can be produced with slack voice and creaky voice, when the syllable is produced with these phonation types. Also, it is found that implosive initials have its inherent F0. It ranges from 130-180Hz for male speaker; and 180-280Hz for female speaker. The inherent F0 for implosives produced with slack voice and creaky voice could be lower.

OBJECTS

1. The relationship between implosive initial and the tonological register.
   - Implosives can vary between modal voice and more constricted phonatory setting [2], e.g., the creaky voiced implosives in Hausa and Lendu, and the voiceless implosives in Igbo and Kichean languages.
   - In Chinese: the modal voice implosive and the laryngeal constricted are not phonologically contrastive. The phonatory settings are features parallel with the low pitch.
   - In Wu dialect,
     - implosives are modal voiced.
     - The “voiced” implosive initial correspond to Yin tonal category, just as the voiceless stop initials do [3], [4].
     - Modal voice and slack voice contrasted.
   - In Min and Yue dialect, (Figure 1)
     - vary between modal voice, creaky voice and slack voice.
     - phonologically not contrastive.
     - features parallel with low pitch.
   - The isolated phonatory setting of the implosive initial. (Figure 2)
     - When the syllable is creaky, the implosive initial can be modal voice.
     - But if the syllable is modal voice, the initial implosive can not be laryngeal constricted.
   - Summary:
     - modal voiced implosive correspond to the Mid tonological register.
     - The laryngealized implosives do not correspond to a certain tonological register, since the modal voice and laryngeal constricted phonation are not contrastive.

2. How do implosives perturb the pitch contour inherently?
   - aerodynamically and physically, implosive will not restrain the change of vocal fold tension, implosive initial do not depress the onset F0.
   - Do implosives have an inherent F0 ?
   - determined by the tension of the vocal cords when they are closed.
   - The mean value of F0 at the start of the initial (F0_c1), (table 1).

Table 1. The mean value of F0_c1, and the mean value of the duration of initial consonant of three female speaker and three male speakers.

<table>
<thead>
<tr>
<th>Speaker</th>
<th>F0_c1 (Hz)</th>
<th>F0_c3 (Hz)</th>
<th>F0_c2 (Hz)</th>
<th>Mean durat (Ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ms</td>
<td>245</td>
<td>196</td>
<td>245</td>
<td>21</td>
</tr>
<tr>
<td>Ms</td>
<td>277</td>
<td>168</td>
<td>189</td>
<td>142</td>
</tr>
<tr>
<td>Ms</td>
<td>152</td>
<td>87</td>
<td>135</td>
<td>79</td>
</tr>
</tbody>
</table>

Hypothesis:
+ If the F0 of the first 1/5 duration of the final (F0_f1) is higher than the mean value of F0_c1, then there will be a rising curve on the pitch contour of the initial consonant (F0_c3>F0_c1).
+ If the F0_f1 is lower than the mean F0_c1, then, there will be a falling curve on the pitch contour of the initial consonant (F0_c3 < F0_c1).

T-test:

Z = (F0_f1 - mean F0_c1) / (SD of F0_c3 - F0_c1)
Z = 5.569 (P< 0.001, N=96), which means for these sample recordings, Z1=0 is significant at the level of 0.001.

The hypothesis that the implosives initials have an inherent F0 is correct.

FUTURE STUDY
- What is the relationship of implosive and tonological register, when the modal voiced implosive and the laryngealized implosive are phonologically contrastive?
- Can the laryngealized implosive be followed by segments with modal voice?
- Whether the constricted laryngeal settings will cause the ingressive glottalic air stream? If the phonatory features disappeared, the aerodynamic feature will become the contrastive feature?

REFERENCES