Low boundary tone: Evidence from the acoustic differences between Cantonese sentence-final particles with low-falling tone

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Abstract

This study investigated the nature of the tones on Cantonese sentence-final particles (SFPs) with low-falling tone. Four Cantonese SFPs with different intonations were examined: aau4, le4, lei4, and za44. Ten native adult speakers of Cantonese participated in production experiments. Smoothing Spline ANOVA results suggested that, despite the same citation tone (tone 4, low-falling tone), the F0 of aau4, le4, and za44 was significantly lower than that of lei4 when they functioned as expressing intonation at the utterance-final position. However, there were no significant differences between the F0 of all four SFPs and their (near-)homophones when they were produced as lexical items in the middle of a sentence. The F0 differences found between the SFPs at the utterance-final position can be attributed to the superimposition of low boundary tone on aau4, le4, and za44. My results supported the hypothesis that the low-falling tone on aau4, le4, and za44 is a combination of lexical tone (tone 4) and intonation (low boundary tone), and that on lei4 is merely tonal.

Index Terms: low boundary tone, sentence-final particles, tone, intonation, Cantonese

1. Introduction

This study investigates the nature of the tones on Cantonese sentence-final particles (SFPs) with low-falling tone.

Cantonese is a tonal language. Every Cantonese syllable carries a lexical tone (T) which is crucial for differentiating word meanings. There are six lexical tones (T1-T6) based on pitch contrast alone [1], [2]. Table 1 summarizes the information on the six tones using Chao’s 5-level system for annotation. The numbers in the “relative pitch” column in Table 1 represent the relative starting and ending pitch of each tone, with 1 being the lowest and 5 the highest pitch of a speaker’s normal range. They are superscripted in IPA phonetic notation [3], [4].

Table 1: The six contrastive Cantonese lexical tones based on pitch contrast alone.

<table>
<thead>
<tr>
<th>Tone</th>
<th>Descriptive pitch contour</th>
<th>Relative pitch</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>High level</td>
<td>55</td>
</tr>
<tr>
<td>2</td>
<td>High rising</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>Mid level</td>
<td>33</td>
</tr>
<tr>
<td>4</td>
<td>Low falling</td>
<td>21</td>
</tr>
<tr>
<td>5</td>
<td>Low rising</td>
<td>23</td>
</tr>
<tr>
<td>6</td>
<td>Low level</td>
<td>22</td>
</tr>
</tbody>
</table>

As far as intonation is concerned, Cantonese relies on boundary tones on the utterance-final syllables to signal intonation [5]-[8]. It also possesses a complex system of over 40 sentence-final particles (SFPs) with diverse meanings and functions. SFPs serve various communicative functions, including speech acts, evidentiality, affective and emotional coloring [9]. They are particles that typically attach to the end of an utterance, while the part of the utterance excluding the SFPs is called the “utterance body” [10]. For example, both (1) and (2) have the same utterance body nei4 fan3gaa33 (“you sleep”).1 The use of aau4 in (1) transforms the statement into a question [9], and the use of le4 in (2) expresses an imperative intonation, with which the speaker makes confident suggestions [11].

(1) Nei4 fan3gaa33 aau4?
2sg sleep SFP?
“Are you sleeping?”

(2) Nei4 fan3gaa33 le4.
2sg sleep SFP.
“I suggest that you should sleep.”

Similar to other lexical items, the tones on Cantonese SFPs can help differentiate distinct meanings between particles having the same segmental combination. For instance, aal is an imperative particle that signals “lively” suggestions, requests, or advice to the hearer; aal is an emotion softener; aal is a question particle [9], [11], [12].

Ladd [13] (later revised as Ladd [14]) was one of the first to propose that intonation be redefined to include particles if they have similar functions. Wakefield [15]-[17] argued that Cantonese SFPs are the equivalent of English intonation. Thence, there have been at least three hypotheses in the debate on the nature of the tones on Cantonese SFPs. First, it has been argued that tones on Cantonese SFPs are wholly intonational [12], [18]-[21]. For instance, the low-falling tone (T4, [21]) on SFPs is the consequence of the superimposition of low boundary tone on SFPs with a hypothetically neutral tone. It is argued that even if they are perceived as the same (citation) tone, their acoustics differ from one another because the “tones” on the SFPs are entirely intonation in nature and susceptible to the varying intonations in production. It is also argued that Cantonese low boundary tone encodes semantic/pragmatic functions of speaker-oriented subjectivity.

1 This paper adopts Jyutping romanization [33] for transcribing Cantonese examples. The onset and rhyme of each syllable are transcribed alphabetically, followed by a number (1-6) representing the lexical tones (T1-T6).
(e.g., the speaker has presupposition, the speaker does not expect the interlocutor to further participate in the discourse, etc.) [12], [20], [22]. Low boundary tone has been argued as a crucial component of some frameworks of Cantonese prosodic phonology, particularly its involvement in changing and/or composing the tones of SFPs [12], [18], [20]. Second, on the contrary, Wu [23] showed no significant differences between the fundamental frequency (F0) of lexical tones and that of the tones on SFPs, suggesting a tonal nature of the tones on SFPs. Third, some studies argued that the tones on SFPs are a combination of lexical tone and intonation (e.g., superimposing boundary tones on the inherent lexical tones of SFPs) [6], [10].

Different predictions are made by the three hypotheses of the nature of the tones on Cantonese SFPs. First, the hypothesis of the tones on SFPs being wholly intonational will have different F0 when they express intonation at the utterance-final position. Second, the hypothesis of the tones on SFPs being merely tonal predicts that the F0 of the SFPs with the same tone will be the same even when they function as expressing intonation at the utterance-final position. Their F0 will also be the same as that of other lexical items with the same tone when they are produced as lexical items in the middle of a sentence. Third, the hypothesis of the tones on SFPs being a combination of tone and intonation will predict that some SFPs being superimposed by the low boundary tone (e.g., SFPs whose functions are pertinent to speaker-oriented subjectivity) will have the same but lower F0 than other SFPs with the same tone at the utterance-final position. However, they will have the same F0 as that of other lexical items with the same tone when being produced as lexical items in the middle of a sentence.

Previous phonetics studies focused on SFPs with high-level tone (T1), high-rising tone (T2), and mid-level tone (T3) [5], [18], [23], [24]. Theoretical frameworks of Cantonese prosodic phonology (involving boundary tones and SFPs) were proposed based on SFPs with low-falling tone (T4); however, to the best of my knowledge, no previous studies have explored the phonetics of SFPs with low-falling tone. The current study is the first to investigate the nature of the tones (the involvement and interaction of tone and intonation) on Cantonese SFPs with low-falling tone. This can bridge an important gap between previous empirical findings of phonetics studies and theoretical frameworks of Cantonese prosodic phonology.

2. Methods

2.1. Participants and procedure

Ten native adult speakers of Cantonese were recruited (5 females, 5 males; mean age = 27.7 years old). According to the language background questionnaires, Cantonese was reported to be the dominant and first language of all participants. None of them reported any history of speech, hearing, or language problems.

2.2. Materials

There are few SFPs with low-falling tone; four of which with different intonations were examined in the present study. Table 2 summarizes their functions; within which, the semantic/pragmatic functions of aa4, le4, and za4 carry strong sense of speaker-oriented subjectivity [9], [11], [12], [19]. For instance, both aa4 and za4 are used when the speaker has a presupposition and asks for verification. Sometimes, they are used in rhetorical questions, and the speakers do not seek answers from the interlocutors but make assertions. Also, the use of le4 implies confident suggestions made by the speakers, involving high speaker-oriented subjectivity.

With reference to Tsui and Tong [25], the four SFPs listed in Table 2 were examined in three experimental conditions in the present study.

Table 2: The four SFPs investigated in Condition 1.

<table>
<thead>
<tr>
<th>SFP</th>
<th>Sentence type</th>
<th>Function</th>
</tr>
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<tbody>
<tr>
<td>aa4</td>
<td>Interrogative</td>
<td>Ask for verifying speaker’s presupposition</td>
</tr>
<tr>
<td>le4</td>
<td>Declarative</td>
<td>Confidently making suggestions</td>
</tr>
<tr>
<td>le4’</td>
<td>Interrogative/Declarative</td>
<td>Past, before, just now</td>
</tr>
<tr>
<td>za4</td>
<td>Interrogative</td>
<td>Restrictive focus (“only”) + ask for verifying speaker’s presupposition</td>
</tr>
</tbody>
</table>

2.2.1. Condition 1: SFP at the end of the sentence

Three utterance bodies (3)-(5) were designed with the same lexical tones (T4), length, and syntactic structures to ensure similar prosody and metrics of each sentence. SFPs were placed at the utterance-final position in Condition 1, functioning as expressing intonation. For instance, (3) Ceon4wong4 jau4 wan4naam4 aa4 (“Did Emperor Qin travel in Yunnan?”). There were three versions of Condition 1 with each version formulated by two of three utterance bodies. One of the three versions was randomly assigned to each participant. With the aid of contexts, participants were asked to produce each SFP six times (2 utterance bodies in each version × 3 repetitions).

(3) Ceon4wong4 jau4 wan4naam4 __ (秦王遊雲南)
Emperor Qin travel Yunnan
“Emperor Qin travels in Yunnan”

(4) Noeng4noeng4 kau4 mei4san4 __ (娘娘求微臣)
Queen beg humble servant
“The queen begs me, the humble servant”

(5) Muang4jau4 haung4 coeng4seng4 __ (盲人行長城)
Blind people walk Great Wall
“Blind people walk on the Great Wall”

2.2.2. Conditions 2 and 3: SFPs and (near-)homophones in the middle of the sentence

To investigate whether the four SFPs have different inherent tones, the four SFPs and their (near-)homophones were placed in the blank of (6) in Conditions 2 and 3 respectively. They received no influence from the utterance-final intonation (e.g., boundary tones) since they were produced as lexical items (i.e., not expressing intonation) in the middle of a sentence (i.e., not at the right boundary of an intonational phrase).

Lei4 and lai4 are free variations of the same particle [11]. This paper henceforth uses le4 to represent the particle for simplicity.
Although the four SFPs have the same citation tone (T4), the F0 of le4 (blue curve in Figure 1) was significantly higher than that of aa4, le4, and zaa4 (other curves in Figure 1) starting from the 7th normalized time-point when they functioned as expressing intonation at the utterance-final position. There was no significant difference between the F0 of aa4, le4, and zaa4 at all time-points.

3.2. Results of Conditions 2 and 3

Figure 2 shows the SSANOVA results of Conditions 2 and 3. Red curves show the F0 measurements of the four SFPs in Condition 2 in four plots respectively. Cyan curves show the F0 measurements of their (near-)homophones in Condition 3.

There were no significant differences in the F0 of all four pairs of SFPs and their (near-)homophones at all time-points when they were produced as lexical items in the middle of a sentence.

4. Discussion

This study investigates the nature of the tones on the SFPs with low-falling tone. Even though the four SFPs examined carried the same citation tone (T4), results of Condition 1 showed that the F0 of aa4, le4, and zaa4 was significantly lower than that of lei4 when they functioned as expressing intonation at the utterance-final position. In addition, results of Conditions 2 and 3 showed that there were no significant differences between the F0 of the SFPs and their (near-)homophones when they were produced as lexical items in the middle of a sentence (i.e., no influence from boundary tones), suggesting that the four SFPs have the same lexical tone as that of other lexical items of T4 (i.e., the four SFPs do not have inherently different tones).

My results do not support the hypotheses that the low-falling tone on Cantonese SFPs is wholly intonational, or merely tonal. The former hypothesis predicts that SFPs with different intonations will have different F0 when they function as expressing intonation at the utterance-final position, and the latter predicts that they will have entirely the same F0. The results of Condition 1 showed that their F0 is neither different from each other, nor entirely the same. My results, thus, do not support both hypotheses as well as some frameworks of Cantonese prosodic phonology [12], [18], [20], [22], which are the origin of the latter hypothesis.
The results of Conditions 2 and 3 showed that the four SFPs do not have inherently different tones. I argue that the lower F0 of aah, le4, and le4 when functioning as expressing intonation at the utterance-final position (Condition 1) can be attributed to the superimposition of low boundary tone. The semantic/pragmatic functions of these three particles carry strong sense of speaker-oriented subjectivity [9], [11], [12], [19], and Cantonese low boundary tone was argued encoding speaker-oriented subjectivity [12], [20]. I argue that a low boundary tone was superimposed on aah, le4, and zaah in Condition 1 to mark the speakers’ subjective mood. By contrast, since le4 is a neutral temporal particle, the low boundary tone was not superimposed on le4. My results support the hypothesis that the low-falling tone on aah, le4, and zaah is a combination of lexical tone (T4) and intonation (low boundary tone) and that the low-falling tone on le4 is merely tonal.

The fact that native speakers perceive the four SFPs as having the same citation tone (T4) despite the F0 differences can be attributed to the floor effects of this lowest tone in Cantonese phonology. I argue that the low boundary tone can also be applied to other SFPs [30] and is more easily observed when the lexical tone of the SFPs is higher (e.g., T1: high-level tone). Previous studies have reported the use of high-falling tone [30] (instead of the “standard” high-level tone [31]) for SFPs with the citation tone T1 on some occasions. For instance, mel, a question particle, is produced with high-level tone in general questions but with high-falling tone in rhetorical questions [11], [19]. Rhetorical questions encode semantic/pragmatic functions of high speaker-oriented subjectivity. I argue that the high-falling tone of mel can be attributed to the superimposition of low boundary tone on its inherent T1. This is similar to how the low boundary tone is superimposed on aah and zaah which are also commonly used in rhetorical questions. Other examples of SFPs produced with high-falling tone instead of high-level tone are sin1 and tim1. Previous studies reported that sin1, a particle predominantly appears in questions, is produced with high-falling tone when it functions as expressing dissonant and questioning [11], [31]. Also, the mirative reading of the particle tim1 (i.e., surprising to the speaker’s knowledge) is often produced with high-falling tone [11], [32]. The occasions that high-falling tone is produced in both sin1 and tim1 are pertinent to speaker-oriented subjective emotions (dissonant/questioning and surprising respectively). I argue that the high-falling tone on these occasions can be attributed to the superimposition of low boundary tone on their inherent T1. These examples support the hypothesis that Cantonese low boundary tone is used to mark speakers’ subjective mood and can be applied to SFPs whose functions are pertinent to speaker-oriented subjectivity.

The above findings have implications for bridging the gap between empirical evidence of phonetics studies and theoretical frameworks of Cantonese prosodic phonology by exploring the nature of the tones (the involvement and interaction of tone and intonation) on SFPs.

5. Conclusions

This study is the first to investigate the nature of the tones on Cantonese SFPs with low-falling tone. I have shown differences in the F0 of SFPs with low-falling tone: the F0 of aah, le4, and zaah is significantly lower than that of le4 when they function as expressing intonation at the utterance-final position. This can be attributed to the superimposition of low boundary tone. My results support the hypothesis that the low-falling tone on aah, le4, and zaah is a combination of lexical tone (T4) and intonation (low boundary tone) and that the low-falling tone on le4 is merely tonal.

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7. References


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