ORIGINAL ARTICLE

Intonational pitch features of interrogatives and declaratives in Chengdu dialect

Hongliu Jiang[*]

College of Foreign Languages and Cultures, Sichuan University, Chengdu, China

Abstract: As a representative of southwestern Mandarin, the Chengdu dialect has its own distinctive pitch features in phonology of tone and intonation. Research on the pronunciation and lexical tone of the Chengdu dialect has a long history with a certain amount of theoretical results. However, research on intonation of Chengdu dialect is still rare. The writer provides an acoustic analysis of research into intonational pitch features of interrogative and declarative sentences of Chengdu dialect, discussing the F0 contour at the final syllable (character) of each sentence to find out if the statement or question mood is carried by the edge tone as well as the pitch perturbation between lexical tone and intonation on it. The results of this acoustic analysis show that there exist statement and question mood of Chengdu dialect carried by the final syllable within an intonational phrase as well as the perturbation on the final syllable (character) by the coexistence of its lexical tone and intonation.

Keywords: Chengdu dialect; lexical tone; intonation; pitch features; perturbation

*Corresponding author: Hongliu Jiang, College of Foreign Languages and Cultures, Sichuan University, Chengdu, China; hongliu_jane@aliyun.com

1. Introduction

Although the Chengdu dialect belongs to the Northern group of Chinese dialects, it has some of its own distinctive characteristics in both tone and intonation. Thus far, research on Chinese intonation has primarily focused on Standard Chinese (Putonghua). Studies on intonation in the Chengdu dialect are rare, especially those based on acoustic experimental analysis. In the late 1950s, Chang (1958) discussed tones and intonation in the Chengdu dialect based on his father's sound samples. Since then, it is hard to find other research reports in intonation of Chengdu dialect. What is more, over the last 70 years, the local dialects have changed in various ways as the young generation speak the Standard Chinese more than the local dialects in their daily lives. Thus, although they also speak the Chengdu dialect, we can find some changes in their local accent due to the impact of Standard Chinese. The writer conducts an acoustic analysis of research into

intonational pitch features of interrogative and declarative sentences of Chengdu dialect and the perturbation on the final syllable (character) by the coexistence of its lexical tone and intonation.

2. A brief introduction to the study of standard Chinese intonation

2.1. Intonational pitch features of Standard Chinese

As a tone language, Chinese intonation is more complex than non-tone language (intonation language) because the lexical tone and sentence intonation exist at the pitch level on the intonation bearing character in the same time. Wu (1990) pointed out that in a sentence there are both surface intonational components and the bottom of the character (lexical) tone or ligatures elements. They are mixed and even combined, and the pitch contour is very complicated and difficult to analyze clearly. Lin (2004) also remarks that distinguishing the pitch in intonation and in lexical tone has always been the core and difficulty in the study of Standard Chinese intonation.

In his study of intonational pitch features of Standard Chinese, Zhao (2002) firstly proposed that "the intonation of Chinese is actually the algebraic sum of the inherent lexical tone of character with the intonation itself", which he called a "small waves" coexisting with a "big waves", and this relationship can be further divided into "simultaneous superposition and continuous superposition". So far, the study of Chinese intonation has been deeply influenced by the view of "algebraic sum", mostly around the superposition of the tone and intonation. Wu believed that the "algebraic sum" that Zhao referred to was an increase in the adjustment of the pitch range, rather than a change in the pattern of pitch contour. The algebra of small waves and big waves can be understood as the algebraic sum of the average pitch value of the lexical tone and the intonation, while the shape of lexical tone has basically no change, which proves why it does not lose its lexical meaning. The big wave of intonation raised the small wave of tone, "only" for "the expression of mood, attitude ... and so on." (Wu, 1996)

Lin (2006, 2012) studies Chinese intonation from the perspective of AM theory, holding that Chinese intonation also has two variables: pitch accent and boundary tone, which respectively convey the focus information and mood. He points out (Lin, 2004): "The main feature of Standard Chinese intonation is the position and/or range of pitch (F_0) curve to pitch accent and boundary tone, while the feature of lexical tone is its pitch (F_0) contour. Therefore, the performance of intonation and lexical tone on pitch (F_0) is different." In terms of the intonation of tone language, Ladd (2008: 156) believes that it is important to consider the relation between tone (lexical) and intonation (postlexical) pitch features. As to tone-intonation interactions, Ladd (2008: 158) mentioned:

At least three kinds of phenomena have been cited as intonational features in tone languages. These are overall expansion or contraction of pitch range to express emotions, and/or to express intonational distinctions like question versus statement or incompleteness versus completeness; modification of specific tones, especially at the ends of phrases or utterances, to signal distinctions like question versus statement; and modification of overall contour shapes to signify certain intonational messages.

As for the relationship between lexical tone and intonation, most scholars agree that the mode of expression of lexical tone is the F_0 contour shape and the function is to express the lexical meaning of the character. The mode of intonation is the key of the sentence or utterance tune and the function

is to express the mood (Wu, 1990).

2.2. The pitch features of interrogative sentences in Standard Chinese

Chinese linguists have divergent opinions on pitch features of the intonation of Standard Chinese interrogative sentences. One view is that compared with the declarative sentence intonation pitch pattern, the question intonation pitch pattern is maintained as its lexical tone while the whole pitch scale is raised (represented by Wu and some other scholars). Another view is that the intonation pitch range is divided into treble lines and bass lines, and the degree of pitch change with different sentence types on these two lines is inconsistent. The change of intonational pitch range, however, is restricted by these two lines (represented mainly by Shen).

Ma (1988) observes that the typical feature of the phonetic expression of Chinese interrogative sentences is the rising of pitch at the final character. The range of pitch rising at the end of an interrogative sentence is a sign to the strength or weakness of the question mood. Lin (2006) holds that question mood can only be carried by boundary syllable (character). That is to say, the distinction to the intonation between statement and question can only come from the boundary tone and has nothing to do whether with the F_0 pitch movement of each character before the boundary tone, or with the treble and bass lines of F_0. His research (Lin, 2004) on echo question in Standard Chinese corpus and declarative question in natural corpus finds that "for intonation phrase (IP), the information of question and statement is carried by one or two non-neutral syllables in the final prosodic character of the phrase, while a few are carried by the initial syllables. The syllables that carry this information are called boundary tones." This point of view illustrates the position of intonation in Standard Chinese. Through the phonetic experiments on declarative and interrogative sentences in the Beijing dialect, Shi (2013) finds that the intonation pitch pattern of interrogative sentences, compared with that of the declarative sentences, shows the raising and expansion of tone range, which illustrates that the intonational pitch features of Beijing dialect is close to that of Standard Chinese.

3. Statement and question intonation analysis of Chengdu dialect

3.1. The pitch features of lexical tone system in Chengdu dialect

Before discussing the intonation, it is necessary to briefly notice the lexical tone system of Chengdu dialect. As a representative of the southwestern official dialect, Chengdu dialect is classified as a "branch of the northern dialect" (Liang, 1982), but many previous studies (Chang, 1958; Cui, 1994; Liang, 1982; Liang and Huang, 1998; Zhen et al., 1990) in last century, have shown that Chengdu dialect has a significant differences in both the pronunciation and tone in many Chinese characters. Though having the differences from Standard Chinese, however, they have a relatively regular correspondence in lexical tone as Chengdu dialect is also a four-tone system -- the same as Standard Chinese. Although in some suburbs of Chengdu, a fifth tone known as *rù shēng* can still be detected.

The lexical tone system of Standard Chinese has four basic tone types: *yīn píng* (high-level), *yáng píng* (high-lift), *shǎng shēng* (falling-rising) and *qù shēng* (full falling). The sound values in a 5-scale measurement are as: *yīn* [55], *yáng* [35], *shǎng* [214] and *qù* [51]. Compared with the lexical tone system of Standard Chinese, the pitch values of each tone in Chengdu dialect are *yīn*

[55] (high level), *yáng* [21] (low falling), *shǎng* [53] (high falling) and *qù* [213] (falling-rising), and we can easily find the differences from the pitch value. Compared with the pitch value of Standard Chinese and Chengdu dialect, their pitch pattern of *yīn* is the same; the pitch patterns of *shǎng* and *qù* of Chengdu dialects are the same as *qù* and *shǎng* of Standard Chinese respectively. Therefore, the lexical tone of the characters with qù such as "*kàn*" (look) in Standard Chinese, are pronounced as the lexical tone of *shǎng* in Chengdu dialect. And the lexical tone of the characters with *shǎng* of Standard Chinese such as "*cǎi*" (color) are pronounced as the lexical tone of *qù* in Chengdu dialect. It can be seen that except for the tone of *yīn píng*, the pitch contour of the rest of the lexical tones are just reversed between Standard Chinese and Chengdu dialect.

3.2. AM theory as an analytical tool

The AM theory adopts the phonological goal of being able to characterise contours adequately in terms of a string of categorically distinct elements, and the phonetic goal of providing a mapping from phonological elements to continuous acoustic parameters (Ladd, 2008: 43). Ladd indicates that under the perspective of intonational phonology, intonation represents pitch contours phonologically as sequences of discrete intonational events. For languages like English, there are two main types of such events, pitch accent and edge tones. In tone languages with lexically specified pitch features, tonal events may have different functions, but the basic phonological structure is essentially the same (Ladd, 2008: 45). Ladd (2008: 46, 47) also mentions that the edge tone includes phrase accent and boundary tone, and both of which occur at or near the end of a prosodic phrase, after the last pitch accent. So for English, most of the nuclear tones of the British tradition can be readily translated into combinations of pitch accents and edge tones. According to Pierrehumbert, the edge tones are divided into two types: phrase accents and boundary tones and every intonation phrase ends with a sequence of a pitch accent, a phrase accent, and a boundary tone (Ladd, 2008: 88). According to Ladd (2008), Pierrehumbert's notation represents the contour as a string of pitch accents and edge tones. Thus, all pitch accents consist of a single H or L tone, or a combination of two tones.

When we observe the pitch features of intonation on tone languages, we can find that AM theory is the best-suited analytical tool, as Ladd (2008) indicated AM theory claims to provide a universal framework for discussing intonation. By analysing the intonational contours at one level of description as strings of tones, AM theory provides the basis for describing pitch phonology in all languages in the same terms. For tone languages like Chinese, because the lexical tones occur at nearly every character (syllable) and the pitch transitions between them span only milliseconds, whereas in English the pitch accents occur mostly only on prominent words, and the transitions may span several syllables (Ladd, 2008). Even if there are differences between tone and non-tone languages, Ladd indicates, however, there is no need to assume that tone languages involve an essentially different layer of phonological structure. So, for English and Standard Chinese, the edge tones act as signals of phrasing and in some cases also cue the difference between statements and questions (Ladd, 2008: 157). Therefore, it is suitable for AM theory as an analytical tool to observe and discuss the intonational pitch features of Chengdu dialect.

3.3. Statement and question intonation analysis

In this paper, the acoustic analysis hypothesis is based on the studies in Standard Chinese by Lin (2006) that assert "Question and statement tune are carried by the boundary syllable of the phrase."

and Chang (1958) in Chengdu dialect that holds "I regard a sentence as having a rising or a falling tune depends on whether, after undergoing perturbation, its final syllable is a rising or falling tone." By investigating the acoustic pitch features of the phonological F_0 contour on the final syllable (character) of the sample sentences, the writer mainly observes whether the statement or question mood are carried by the final character (syllable) and the status of its tonal pattern after undergoing perturbation.

3.3.1 Method and procedure

Participants were 22 undergraduate and postgraduate students who grew up in Chengdu and mainly speak local dialect in their daily lives. The specific recording method is as follows: the reader reads a pair of sentences randomly displayed on the computer screen, and the statement or question mood is determined according to the punctuation (period or question mark). So, the interrogative sentence is like a declarative question in English. The order of the sentence displayed is the statement and then the question. Thus, when the screen displays: "This character is read as *cāi* (guess)", the reader reads it as a declarative statement; and when the screen shows: "This character is read as *cāi*?", the reader reads it as a question. Since all the samples are simple short sentences, we can treat them with only one IP. According to the experimental hypothesis, the intonation will be carried by the final character of the sentence. So, this analysis focuses mainly on the F_0 contour of final character in each sentence.

3.3.2 Pitch features of character with different tones at the end of a sentence

The writer first observed whether the question or statement mood is carried by the final character as well as its pitch features in Chengdu dialect. **Figure 1** shows the F_0 contour of the statement: "This character is read as *zhě* (person)." The final character "*zhě*" has the longest duration (0.3079 sec.) in the sentence. The starting pitch value of "*zhě*" is 12.52 (semitone re 100 Hz), the highest point is 13.25, and the ending is 11.15. The overall contour is relatively flat and the pitch of the starting point is higher than the ending point, and the actual sense of hearing is close to a falling tone. According to AM theory (Ladd, 2008) mentioned before in 3.2, though the pitch transitions in a character (syllable) spans only milliseconds, it still can be analyzed as the nucleus with the pitch accent sequence L*+H L L% (rising-falling).
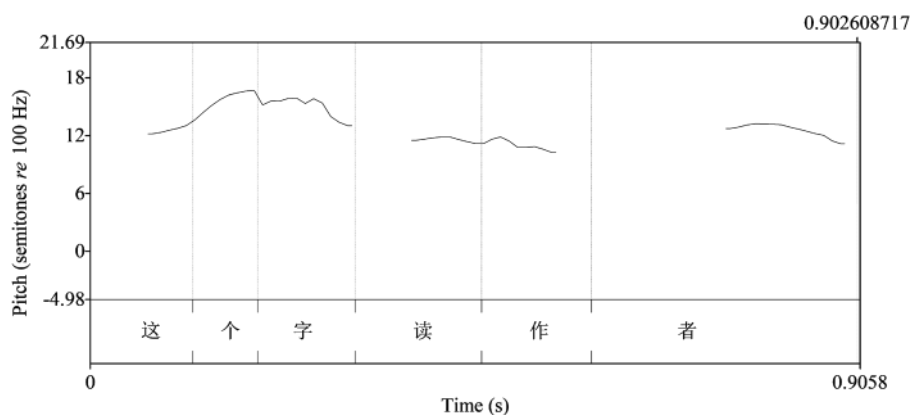

Figure 1. F_0 contour of declarative: This character is read as *zhě*.

Figure 2 is the F_0 contour of the declarative questions: "This character is read as *zhě*?" At the

end of the sentence, the character *zhě* can be clearly marked as the intonation-bearing syllable with the longest duration of 0.2285 sec. The initial pitch of *zhě* is 14.41, the highest point is 20.82, and the ending point is 12.11. We can find out that the mean pitch value of *zhě* in question is higher than that of statement, but the duration is almost same. The pitch accent sequence of the final character "*zhě*" in question is L+H* L L% (rising-falling). The contour curve of question (rising-falling) remains similar to the statement, but we can find the difference in the way of phonetic realization. Since Chinese characters are of monosyllable, we can observe a very rapid F_0 movement on the final character with slightly different accent sequence. For "*zhě*" in statement, the accent sequence is: it is accented at the beginning and followed a rising phrase, then falling to L boundary tone. For that of question, the accent sequence is: the real accent H* on the top of the contour after the initial L, and then also falling to L% boundary tone.
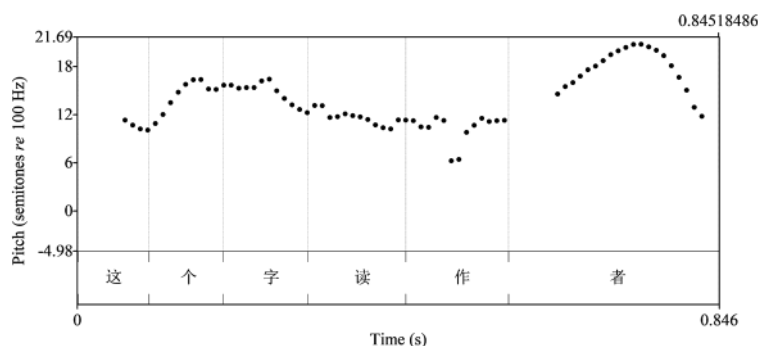

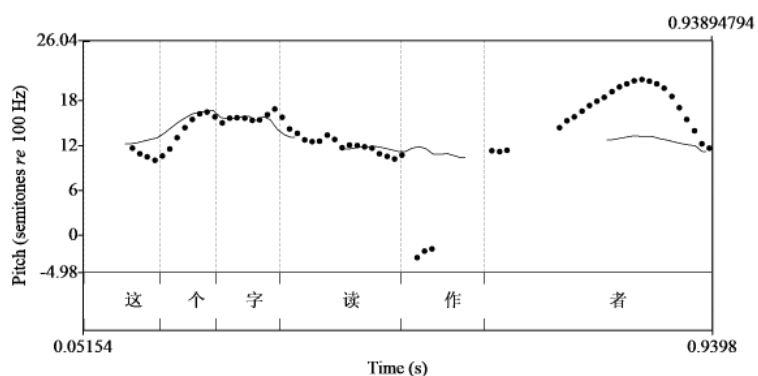**Figure 2.** F_0 contour of interrogative: "This character is read as *zhě*?"

Figure 3. F_0 contour of declarative overlap with interrogative: "This character is read as *zhě*".

In order to compare the pitch features of the two F_0 contours, the writer overlaps the two contours together as **Figure 3**. We can see that the pitch level of the two contours before the character *zhě* are lower or higher than each other. But the overall pitch level of the final character *zhě* in question is obviously higher than that of statement, especially at the highest point of the two contours. Figure 3 illustrates clearly, like Standard Chinese, the question or the statement mood is conveyed at the final character of the sentence or IP. The intonational pitch feature of question shows that its F_0 contour has a bigger slope at both rising and falling phrases compared with the statement sentence. And it clearly demonstrates that the two F_0 contour patterns retain relatively with the F_0 contour shape of syllable's lexical tone, which let the hearer be able to identify the lexical meaning of the character no matter whether there are differences in the pitch accent sequences due to the statement or question mood indication.

Addition to the tune of *shǎng* sample discussed above, the writer also observes the overlapped contours of which the final characters with other 3 lexical tones. **Figure 4** shows the overlapped sample contours of the sentence "This character is read as *zhē* (cover over)." The lexical tone of final character is *yīn* and its F_0 contours in both sentences are a mid-rising, but the question has bigger slope. The accent sequence of statement is L* L H%, while the question is L* H H%.

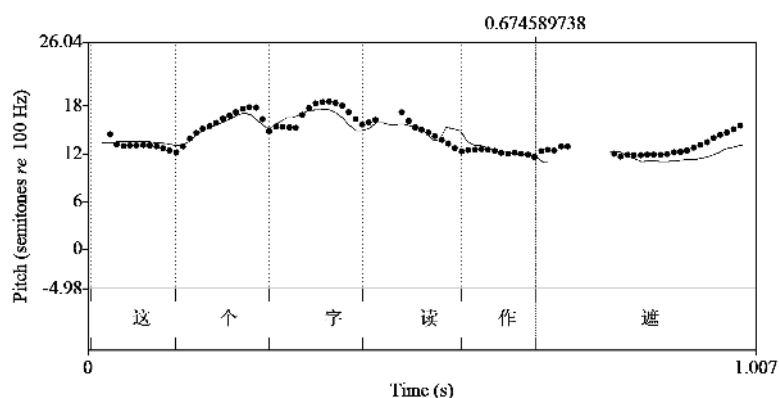**Figure 4.** F_0 contour of declarative overlap with interrogative: "This character is read as *zhē*".

Figure 5 shows the overlapped sample contours of which the final character of the sentences is *cái* (just) with the lexical tone of *yáng*. The F_0 contour of *cái* in statement is marked as a mid-falling, but the question is regarded as a mid-level. Differ from other 3 tunes, the F_0 contour of question has a little bit small slope than that of the statement. The accent sequence of statement is H* L L%, while the question is close to L* L H% which is indicated by Ladd (2008: 91) as "low rise (narrow pitch range)".
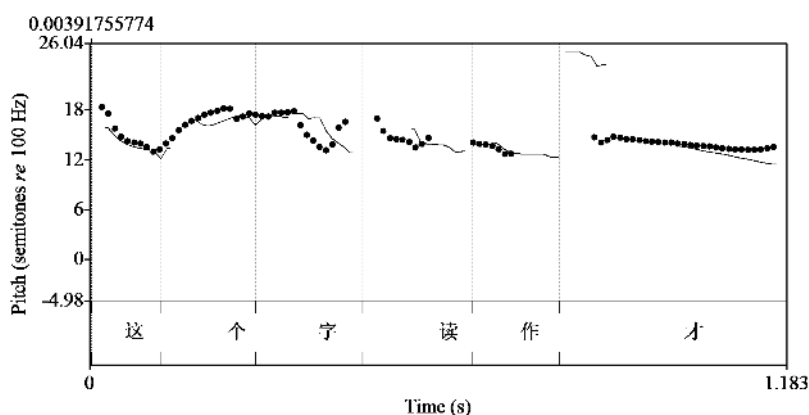

Figure 5. F_0 contour of declarative overlap with interrogative: "This character is read as *cái*".

Figure 6 shows the overlapped sample contours of which the final character of the sentences is *tào* (knot) with the lexical tone of *qù*. The F_0 contours of *tào* in statement can be regarded as a falling-rising tone, and the accent sequence is H* L H%, and the question is marked as a rising tune with the accent sequence L+H* H H% which is indicated by Ladd (2008: 91) as "high rise (with low head)".

From the above figures, the sample contours show more pitch movements on last character than that of the previous characters (syllables), regardless of its lexical tone types, and the duration of them are longer significantly in the sentence. The F_0 contour patterns of question almost remained
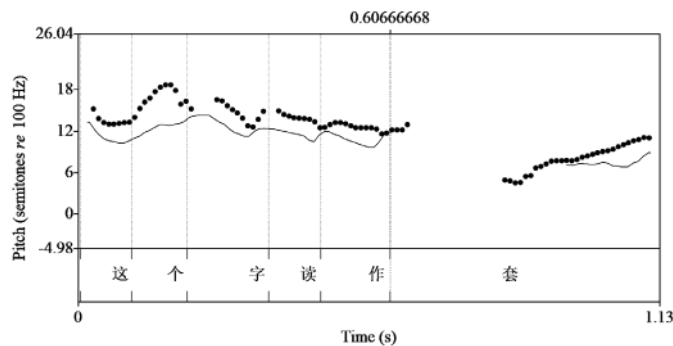
Figure 6. F0 contour of declarative overlap with interrogative: "This character is read as *tào*".

similar to that of the statement, but the overall pitch level of the boundary tones (%) or top point of the contours are usually higher than that of the statement. The F_0 contours of the question also have a bigger slope (rising or falling phrase) than that of the statements.

3.3.3 Identification test

In order to confirm that the question or statement mood is conveyed by the last character of the sentence, the writer invited 7 students to an identification test. 24 sentences were randomly selected from all the sample sentences, in which the declarative and interrogative sentences were half to half. The main stimuli are the last character in each sentence and these characters cover the four lexical tones of Chengdu dialect. Testing procedures: the subjects hear each sentence for three times in a random manner, allowing them to determine if they heard a declarative or interrogative sentence. The statistical results show that the overall recognition accuracy of the 7 subjects reached 89.58%, and the tunes with lexical tone of *shǎng* and *qù* are all correctly identified; the *yīn* had 2 failures of identification, accounting for 4.76% of all the *yīn* samples; the failures on *yáng* recognition are the highest, reaching 8 cases with the ratio of 19.05%. From figure 5 we can find that the pitch value of the two contours at final character have very slight differences, which also indicates that the question mood of *yáng* samples are relatively weak.

In addition to the sentence identification, the writer also cuts off last character of the 24 sentences to conduct an identification test without any context and allows 4 subjects to hear them in a random manner. Among the total of 96 results, the correct rate reaches 90.63%, even slightly higher than the sentence correctness rate. Only 9 cases of hearing results differ from the actual sentence, of which 3 failures are *yīn*, 4 failures are *yáng*, and 2 failures are *shǎng*. The number of identification failures in characters and sentences are consistent in the tone distribution of these characters. The overall results of the identification test further prove that the question or statement mood in Chengdu dialect is indeed conveyed by the final syllable in simple sentence.

4. Discussion

Acoustic analysis of the F_0 contour on the final character of the sentences highlights the rapid pitch movement and the differences of accent sequence which show the existence of perturbation on the lexical tone, and also proves that the statement or question mood is carried by the final character in the Chengdu dialect. With regard to the issue of the perturbation, we have found that the listener can still identify the lexical meaning of each final character in the sentences, which indicates that most of the final characters retaining the F_0 contour pattern relatively as that of their character's

lexical tone. The writer has also found that after undergoing perturbation, the pitch patterns of final characters with different lexical tones are slightly different as the brief discussion below.

Table 1. A typical pitch value of the final character and its lexical tone with *yīn* samples

Pitch value	Starting	Lowest point	Ending %
Lexical tone	12.5	11.74	14.64
Statement	17.12	11.07	18.49
Question	16.77	11.46	22.52

The final character with *yīn* (161 samples): 83% of the sample contours are rising or falling-rising tune (**Table 3**), which means most of the boundary tone of the two sentence types are as H%. Compared with the intonation pitch pattern of statement, the F_0 contours of question have a bigger slope at the rising phrase of the contour, while the statement has the highest pitch at the starting point than that of question and its lexical tone (**Table 1**). Table 3 also shows that there are no level tone among the samples, which illustrates the difference from the traditional conclusions on the pitch pattern of *yīn* by Chang (1958), Liang (1982), Liang and Huang (1998) and Zhen et al. (1960) of Chengdu dialect.

The final character with *yáng* (121 samples): the F_0 contours of the final character are almost the same as the two sentence types with L% boundary tone, which are as a whole falling or rising-falling (Table 3), and their mean pitch value of contours are very close to each other, which indicates the declarative question sentence with the final character's lexical tone of *yáng* has the weakest question mood. The *yáng* samples show the pitch pattern is close to the traditional conclusions on that of yáng by Chang (1958), Liang (1982), Liang and Huang (1998) and Zhen et al. (1960) to Chengdu dialect.

Table 2. A typical pitch value of the final syllable and its lexical tone with *shǎng* samples

Pitch value	Starting	Highest point	Ending %
lexical tone	11.35	14.31	11.82
Declarative	10.19	15.51	12.15
Question	13.1	20.53	16.0

The final character with *shǎng* (158 samples): about 92% of the sample contours are rising-falling which is not as the same as traditional conclusions by Chang (1958), Liang (1982) Liang and Huang (1998) and Zhen et al. (1960) of the Chengdu dialect, which indicate that the younger generation of Chengdu dialect speakers' tune of *shǎng* changed in some ways. The contour pattern and pitch level of the statement is close to their lexical tone, but the question has the highest pitch point at the contours compared to that of statement as well as their lexical tone. The F_0 contours of question have a larger slope at the both rising and falling phrases of the contour, which also clearly illustrates the perturbation on the accent sequence at the sentence final character. (**Table 2**)

The final syllable with *qù* (196 samples): about 18% of the statement and question sample contours are not the same which indicate an obvious perturbation on the final character (Table 3). Among the *qù* samples, there are about 54% of their tone patterns retained as their lexical tone

Table 3. The F0 contours of intonation with the two sentence samples

Lexical Tone / Contour	*yīn*	*yáng*	*shǎng*	*qù*
Level				5
Falling	17	47	3	23
Rising	30	1	1	10
Falling-rising	84	14	5	106
Rising-falling	11	45	145	23
Falling-rising-falling		14	4	16
Rising-falling-rising	19			13
Contour not the same	**19**	**10**	**6**	**36**
Total samples	**161**	**121**	**158**	**196**

indicated by traditional conclusions on *qù* by Chang (1958), Liang (1982), Liang and Huang (1998) and Zhen et al. (1960) of Chengdu dialect. Since the contour patterns of *qù* are distributed in all of the tune types as illustrated in Table 3, it may indicate that the younger generation of Chengdu dialect speakers' tune of *qù* have changed in some ways.

5. Conclusions

This study, through an acoustic experiment, aims to illustrate that the question or statement mood is carried by the final character in a simple sentence and the existence of perturbation on the final character's pitch contour in the Chengdu dialect. The acoustic experimental results prove two hypotheses of the study. The study also finds that most of the sample contours of *yáng* and more than half of *qù* are close to the traditional conclusions on their pitch patterns of lexical tone in the Chengdu dialect, but there are still some differences in general pitch level and F_0 contour patterns.

The most interesting results in this study are the differences of the F_0 contour patterns of *yīn* and *shǎng* to the traditional conclusions. The writer finds in this acoustic experiment, no matter if there is the lexical tone of a character with *yīn* or the character at the end of the declarative or an interrogative sentence in Chengdu dialect, the large proportion of the samples' F_0 contour patterns are falling-rising or rising tune, rather than the high level tune as determined by the phonological survey to Chengdu dialect by Zhen et al. (1960). Almost all of the sample contours of the character with lexical tone of *shǎng*, no matter if the character is at the end of a declarative or an interrogative sentence, are shown as rising-falling tune which is not as a high falling—the traditional conclusions by Chang (1958), Cui (1994), Liang (1982), Liang and Huang (1998) and Zhen et al. (1960) of Chengdu dialect.

The pitch features of *yīn* and *shǎng* illustrated in this acoustic experiment have shown that the lexical tone pitch patterns of single character in Chengdu dialect is more undulating than that of the Standard Chinese. Regarding to the pitch pattern differences between *yīn* and *shǎng* in this acoustic experiment and their traditional conclusions, we should further study the two tone patterns of Chengdu dialect from diachronic and synchronic dimensions. In addition, although the core of intonation analysis is pitch pattern, for tone languages like Chinese, the preliminary findings from this acoustic experiment may lead to further acoustic analysis on the coordination and marking

effect of tone duration, pitch intensity and pitch on the sentence intonation bearing character. In this way, we may be able to reveal more accurately the pitch features and functions of Chinese intonation (including Standard Chinese and different dialects), which may also guide to future studies in this field.

Conflict of interest

No conflict of interest was reported by the author.

Acknowledgments

References

Chang NC (1958) Tones and intonation in the Chengtu dialect (Szechuan, China). *Phonetica* (2): 59–85.

Cui R (1994) A Review of Studies on Sichuan Dialects. *Studies of the Chinese Language* (6): 419–429.

Ladd DR (2008) *Intonational Phonology* (2nd ed.). Cambridge: Cambridge University Press.

Liang D (1982) *Sichuan Dialect and Standard Chinese*. Chengdu: Sichuan People's Publishing House.

Liang D and Huang (1998) *Chengdu Dialect Dictionary*. Nanjing: Jiangsu Education Press; 1998.

Lin M (2004) Chinese intonation and tone. *Journal of Applied Linguistics* (3): 57–67.

Lin M (2006) Interrogation vs. declarative and the boundary tone in Standard Chinese. *Studies of the Chinese Language* (4): 364–376.

Lin M (2012) *Experimental Study of Chinese Intonation*. Beijing: China Social Science Press.

Ma Q (1988) *A Preliminary Study on the Description of Intonation and Phonology in Standard Chinese*. Tianjin: Tianjin Normal University.

Shi F (2013) *The Intonation Pattern: The Cornerstone of Experimental Linguistics*. Beijing: The Commercial Press.

Wu Z (1990) The basic intonation pattern of Standard Chinese. *Mr. Wang Li Memorial Essays*, Beijing: The Commercial Press.

Wu Z (1996) Zhao Yuanren's contribution to the study of Chinese tones. *Journal of Tsinghua University* (Philosophy and Social Science Edition) (3): 58–63.

Zhao Y (2002) A preliminary study of English intonation (with American variants) and it Chinese equivalent. In: Wu Z and Zhao X (eds) *Linguistic Essays of Y.R. Zhao*. Beijing: The Commercial Press.

Zhen S, et al. (1960) The phonology of Sichuan Dialect. *Journal of Sichuan University* (3): 1–123.