

# Tone Sandhi Patterns of Zhenjiang Dialect

ChunAn Qiu

School of Foreign Languages, Jiangsu University of Science and Technology, China

chunanqiu@163.com

## Abstract

This study presents an acoustic analysis of the citation tones and tone sandhi patterns of bisyllables in Zhenjiang dialect with an attempt to provide an empirical data for the theoretical study of tone sandhi patterns of Zhenjiang dialect. The results demonstrate that this dialect has five citation tones, i.e., Tone1 (42), Tone2 (35), Tone3 (32), Tone4 (55) and Tone5 (5). The acoustic realization of the first syllable, a falling tone, exhibits a more complex pattern than the one previous study has found. This study also examines neutral tone syllables, and proposes that the neutralization of the second syllables results from the assimilation effect of the preceding syllable.

**Index Terms:** Zhenjiang dialect, citation tone, tone sandhi, neutral tone

## 1. Introduction

Zhenjiang is situated on the south bank of the Yangtze River, with Changzhou to the east and Nanjing to the west. On the north bank across the Yangtze River, lies the city of Yangzhou. Based on the traditional dialectal classification of Mandarin, Zhenjiang dialect belongs to the Lower Yangtze Mandarin [1]. It is also notably located at the intersection between Mandarin dialects and Wu dialects. Historically, Zhenjiang dialect, a subgroup of Wu dialects, merged into Mandarin dialects during the Six Dynasties due to the political and economic factors [2].

Previous studies indicate that Zhenjiang dialect has five citation tones: T1 (Yinping), T2 (Yangping), T3 (Shangsheng), T4 (Qusheng), and T5 (Rusheng). But these studies differed in the specific tone value, as shown below in Table 1 [3, 4].

Table 1: Citation tone inventory of Zhenjiang dialect.

	Zhang [3]	Da [4]
T1 (Yinping)	42	21
T2 (Yangping)	35	35
T3 (Shangsheng)	31	313
T4 (Qusheng)	55	54
T5 (Rusheng)	5	4

One of the main differences between these two studies is that Da [4] posited a dipping tone in Shangsheng, in contrast, Shangsheng is realized as mid-falling tone in Zhang [3]. Zhang [3] also investigated the tone sandhi patterns of Zhenjiang dialect and found that only the phrase-initial tones undergo tonal changes in bisyllables, as can be seen below in Table 2. The phrase-initial tones are in the first column and phrase-final tones are in the first row. The tones undergoing a change are indicated with italics and red fonts, similarly hereinafter.

Table 2: Tone sandhi patterns of bisyllables in Zhenjiang dialect [3].

	T1	T2	T3	T4	T5
T1	<i>35</i> + 42	<i>33</i> + 35	<i>35</i> + 31	<i>33</i> + 55	<i>33</i> + 5
T2	35+ 42	35+ 35	35+ 31	<i>22</i> + 55	<i>22</i> + 5
T3	<i>35</i> + 42	<i>22</i> + 35	<i>35</i> + 31	<i>22</i> + 55	<i>22</i> + 5
T4	55+ 42	55+ 35	55+ 31	55+ 55	55+ 5
T5	5+ 42	5+ 35	5+ 31	5+ 55	5+ 5

Zhang [3] also examined the patterns of neutral tones and found that the citation tones of phrase-final syllables become neutralized, and those syllables which appear after Yangping, Qusheng, and Rusheng are realized as high tones, whereas those syllables which appear after Yinping and Shangsheng are realized as low tones.

Zhang's study of Zhenjiang dialect aroused great interest of some scholars, who applied some phonological theory to explain the tone sandhi of this dialect. Bao [5] observed that the non-even tones become even before the high even tone 55, and he treated this case as contour assimilation. He [6] explained the tone sandhi process of Zhenjiang dialect within the framework of Government Phonology.

Previous studies of the tones of Zhenjiang dialect mostly describe its tonal values and tone sandhi through perception. The theoretical analysis is also conducted based on the intuitive data. However, the present study aims at supplementing the previous studies by systematically investigating the patterns of citation tones and tone sandhi of Zhenjiang dialect through experimental means.

## 2. Methodology

### 2.1 Materials

The word list consists of 120 monosyllabic CV words, with 12 samples for each citation tone, which cover Yin Sheng rhymes (also monophthongs), Yang Sheng rhymes, and Entering tone rhymes. Zero-initials syllables are also included in the list. In the list of bisyllables the study selected five samples for each tonal composition. Meanwhile, three bisyllabic phrases, beginning with each citation tone and ending in *tsə*, *tʰə*, *kə*, are selected to analyze the tone sandhi involving neutral tones. All the words are frequently used items in Zhenjiang dialect. Thus, the study obtained 60 samples for the analysis of citation tone, 125 samples for the analysis of bisyllables, 15 samples for the analysis of neural tones.

### 2.2 Subjects

The participants in the study are a male and a female native speakers of Zhenjiang dialect. Both of them, in their fifties, are born and raised in the urban area (Da Xi Road, where

local people speak the standard Zhenjiang dialect) of Zhenjiang city. One of them is a retired college teacher, and another is a retired worker. They both can speak *Putonghua* (standard Chinese).

### 2.3 Recording procedures and F0 extraction

Recording was conducted in a quiet room with the yawp lower than 200db. All the selected data were randomly listed in the recording schema. The randomized stimuli were presented one by one in simplified Chinese characters on a computer screen. The participants were asked to read the stimuli in Zhenjiang dialect. Praat 5.2.40 was used for all segmentation and measurements. ‘Textgrid’ files and ‘Pitchtier’ files were further checked by hand to ensure the accuracy of the data. A custom-written script was used for F0 extraction and smoothing. The F0 values of the tone contour of each syllable were obtained by taking 10 equidistant points, resulting in a time-normalized F0. The conversion formula of the pitch values to five-scale values is as follows:

$$T = 5 \times (\lg x - \lg b) / (\lg a - \lg b) [7]$$

Within the formula, ‘x’ is the target pitch value, ‘a’ is the maximum pitch value, and ‘b’ is the minimum pitch value in the pitch range.

## 3. Results

### 3.1 Tonal patterns of mono-syllabic constituents

As mentioned in Part 1, previous studies [3, 4] have revealed that the Zhenjiang dialect has five citation tones, and their tonal values are: Yinping 42/21, Yangping 35, Shangsheng 31/313, Qusheng 55/54, and Rusheng 5/4. Fig. 1 displays the normalized values of the citation tones of Zhenjiang dialect in the present study.

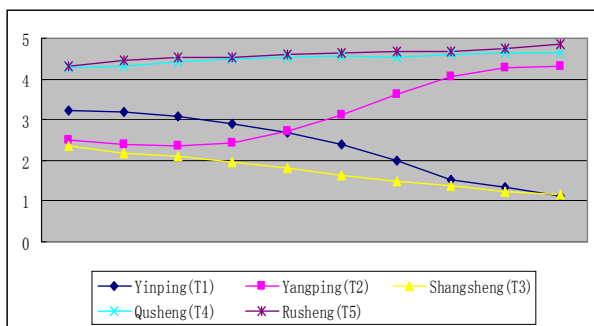


Figure 1: Citation tones of Zhenjiang dialect.

The five scales of each tone can be shown in the above figure, specifically, Tone 1 (Yinping) performs as ‘42’, Tone 2 (Yangping) as ‘35’, Tone 3 (Shangsheng) as ‘32’, Tone 4 (Qusheng) as ‘55’, Tone 5 (Rusheng) as ‘5’. The specific tonal values roughly correspond with those of Zhang [3], except for a minute difference in Tone 3. In terms of the tonal features of each tone, results of the data demonstrate that there are two falling tones, i.e., mid-falling T1 and low falling T3, one high rising tone T2, one high even tone T4, and one entering tone T5. It’s also worth noting that there is no dipping tone in the dialect.

### 3.2 Tone sandhi patterns of bisyllabic constituents

This section will systematically examine the tone sandhi patterns of bisyllables in Zhenjiang dialect. All the five tonal compositions, ‘T1 + TX’, ‘T2 + TX’, ‘T3 + TX’, ‘T4 + TX’, ‘T5 + TX’, will be discussed in this part.

The following figure shows the tonal patterns of T1 + T1, T1 + T2, T1 + T3, T1 + T4, T1 + T5.

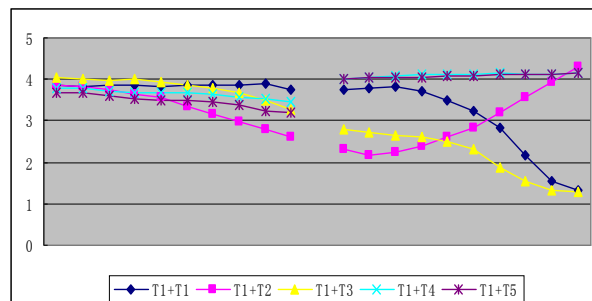


Figure 2: Tone sandhi patterns of T1 + TX.

As can be shown in Fig.2, all the word-final syllables remain unchanged in this tonal composition. There are two tone sandhi patterns in the word-initial syllables. In pattern 1, the word-initial syllable is changed into a sub-high level tone in the combination of T1 + T1, T1 + T4, and T1 + T5. In all these phrases, the mid-falling tones (42) become even, i.e., ‘44’, before the mid-falling tone (42) or the high even tone (‘55’ or ‘5’). In pattern 2, the word-initial syllable becomes a falling tone in two combinations, i.e., T1 + T2 and T1 + T3. T1 (‘42’) is realized as ‘43’ before T2 (‘35’), therefore, the end of T1 is slightly raised from ‘2’ to ‘3’, whereas, T1 is realized as ‘54’ before T3 (32), hence the raise of the entire pitch range of T1. In summary, the tone sandhi patterns of ‘T1+TX’ are as follows: 42+42→44+42; 42+35→43+35; 42+32→54+32; 42+55→44+55; 42+5→44+5.

The following figure shows the tonal patterns of T2 + T1, T2 + T2, T2 + T3, T2 + T4, T2 + T5.

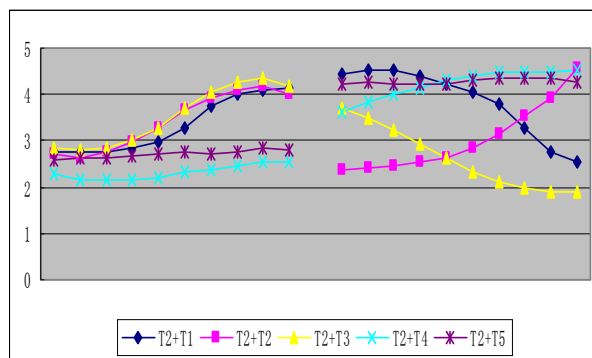


Figure 3: Tone sandhi patterns of T2 + TX.

The word-initial syllable T2 is a high rising tone. As can be indicated in Fig. 3 the combination of ‘T2 + TX’ exhibits two patterns. In pattern 1, the first syllable undergoes no change when it occurs before T1, T2, and T3. In pattern 2, the first syllable becomes mid-even tone ‘33’ when it occurs before T4 and T5. A change has taken place in the word-final syllable of two combinations, i.e., T2 + T1 and T2 + T3, in which T1 (‘42’) is realized as ‘53’, and T3 (‘32’) is realized

as ‘42’. The two second syllables exhibit similar tone contour as their citation tones, since they are all falling tones. The sole combination that involves no change is T2+T2. In summary, the tone sandhi patterns of ‘T2 + TX’ are as follows: 35+42→35+53; 35+35→35+35; 35+32→35+42; 35+55→33+55; 35+5→33+5.

The following figure shows the tonal patterns of T3 + T1, T3 + T2, T3 + T3, T3 + T4, T3 + T5.

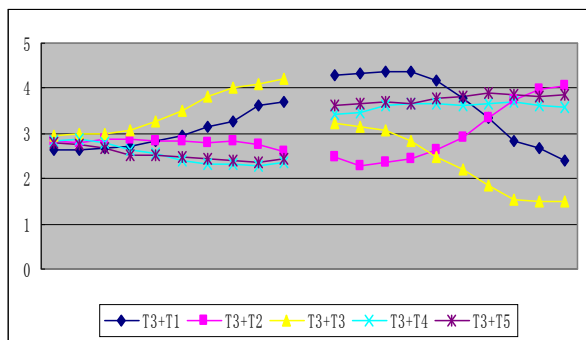


Figure 4: Tone sandhi patterns of T3 + TX.

The word-initial syllables T3 show two sandhi patterns. In pattern 1, the first syllable is changed into a mid-even tone in the combination of T3 + T2, T3 + T4, and T3 + T5. The word-initial syllable ‘32’ is a mid-falling tone, which becomes mid-level tone ‘33’ when it appears before T2 (‘35’), a rising tone, or before high-level tone (‘55’ or ‘5’). In pattern 2, T3 is changed into a rising tone. It performs as ‘34’ before T1 (‘42’), and as ‘35’ before T3 (‘32’).

Within this combination, the word-final syllables undergo some changes. In the combination of ‘T3+T1’ and ‘T3+T3’, T1 is realized as ‘53’, and T3 as ‘42’. Note that the changed tones exhibit a similar contour tone, i.e., falling tone, to that of their citation tones. In summary, the tone sandhi patterns of ‘T3 + TX’ are as follows: 32+42→34+53; 32+35→33+35; 32+32→35+42; 32+55→33+55; 32+5→33+55.

The following figure shows the tonal patterns of T4 + T1, T4 + T2, T4 + T3, T4 + T4, T4 + T5.

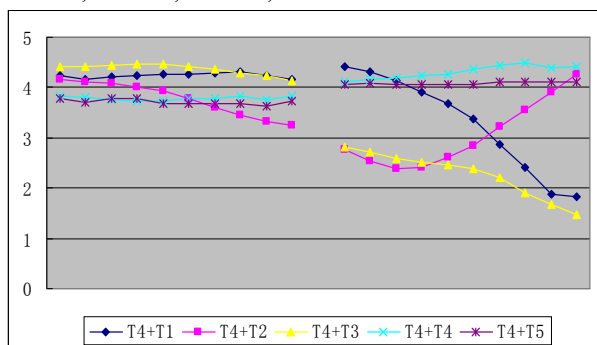


Figure 5: Tone sandhi patterns of T4 + TX.

As we can see in Fig. 5 within this sequence the sandhi patterns of the first syllable show two patterns. In pattern 1, the first syllable, a high even tone, becomes sub-high even tone in the combinations of high even tones ‘T4+T4’ and ‘T4+T5’, in which T4 is changed into sub-high level tone. In

pattern 2, the high level tone is changed into a falling tone in the sequence of ‘T4+T2’, where ‘55’ is realized as ‘54’. Note that the starting point of the second syllable in ‘T4+T1’ has been raised from ‘42’, a mid-falling tone, to ‘52’, a high falling tone. In summary, the tone sandhi patterns of ‘T4 + TX’ are as follows: 55+42→55+52; 55+35→54+35; 55+32→55+32; 55+55→44+55; 55+5→44+5.

The following figure shows the tonal patterns of T5 + T1, T5 + T2, T5 + T3, T5 + T4, T5 + T5.

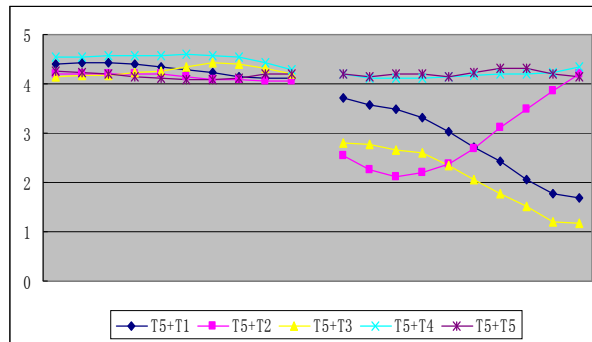


Figure 6: Tone sandhi patterns of T5 + TX.

As can be illustrated in the above figure there is no any change of tonal values in the combination of ‘T5 + TX’. When T5, a high short tone, also called entering tone, occurs before any other tone in Zhenjiang dialect, the first syllable remains a high short tone, meanwhile the second syllables show similar tone contour to their citation counterparts.

### 3.3 Tone sandhi patterns of bisyllables involving neutral tones

The following figure shows the tonal patterns of T1 + T0, T2 + T0, T3 + T0, T4 + T0, T5 + T0. Here, T0 represents neutral tone syllables.

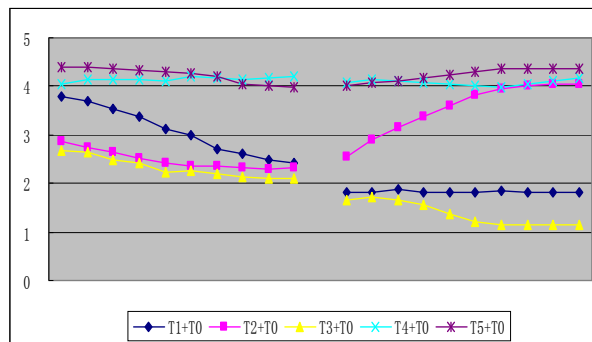


Figure 7: Tone sandhi patterns of TX + T0.

As mentioned earlier, the neutral tone syllables in the present study refer to those syllables appearing in bisyllabic constituents following a lexical tone, i.e., *bə* (*ɒi bə*, cup), *tʰə* (*mə? tʰə*, wood), or serving as a measuring word, i.e., *kə* (*sɛ̃ kə*, three), or a possessive marker, i.e., *tɿ* (*ta tɿ*, big).

As is shown in Fig. 7 the second syllables become neutralized when they appear after T1, T3, T4 and T5. The neutralization of the second syllable exhibits three patterns. In pattern 1, the neutral tone is realized as a low tone ‘2’

when it appears after T1 and T3, both of which are falling tones. In pattern 2, the neutral tone is realized as a high tone ‘5’ when it appears after T4 and T5, both of which are high tones. In pattern 3, the neutral tone is realized as a rising tone when it appears after T2, a rising tone. Note that the first syllable is changed into a low level tone ‘33’ in the combination of ‘T2+T0’ and ‘T3+T0’. In summary, the tone sandhi patterns of ‘TX + T0’ are as follows: 42+T0→**43+2**; 35+T0→**33+35**; 32+T0→**33+2**; 55+T0→**55+5**; 5+T0→**5+5**.

#### 4. Discussion

The tone sandhi patterns of bisyllables of Zhenjiang dialect in the present study are summarized as follows:

Table 3: *Tone sandhi patterns of bisyllables in Zhenjiang dialect.*

	T1	T2	T3	T4	T5
T1	44+42	43+35	54+32	44+55	44+5
T2	35+53	35+35	35+42	33+55	33+5
T3	34+53	33+35	35+42	33+55	33+5
T4	55+52	54+35	55+32	44+55	44+5
T5	5+42	5+35	5+32	5+55	5+5

Of all 25 combinations there are 15 combinations undergoing the change of tonal value of the first syllable. Among these 15 combinations 10 syllables are changed into new tones ‘44’, a sub-high level tone, or ‘33’, a mid-level tone. There are 5 combinations involving the change of tonal value of the second syllable. As can be shown in Table 3, the starting point of these tones have been raised, while they remain the similar contour, i.e., a falling tone.

Zhang [3] gives three rules to derive the bisyllabic sandhi patterns in Zhenjiang dialect as follows:

- A. *Falling* → *Rising* / *Falling*
- B. *Falling* → *Level* / *elsewhere*
- C. *Rising* → *Level* / *Level*

In the present study, when T3, a falling tone, appears before T1, also a falling tone, or before T3, T3 becomes a rising tone (‘34’ or ‘35’). This pattern observes Zhang’s *Rule A*. However, when T1 appears before T1 or T3, T1 is not changed into a rising tone, but a high level tone ‘44’ or a falling tone ‘54’. According to *Rule B*, when a falling tone, T1 or T3 appears before a level tone, it becomes a level tone (‘44’ or ‘33’). As indicated in Table 3, this study supports Zhang’s observation. But when T1 appears before a rising tone, it does not become a level tone, but a falling tone, which is realized as ‘43’. With regard to *Rule C*, this study confirms Zhang’s proposal. In sum, the acoustic realization of the first syllable, a falling tone, exhibits a more complex pattern than the one Zhang [3] has found.

With regard to neutral tones in Zhenjiang dialect, we can see from Fig. 7 that the neutralization of the second syllables results from the assimilation effect of the preceding syllable. In comparison with Zhang [3]’s description of neutral tones, the difference lies in the combination of ‘T2+T0’. The syllable which appears after T2 is not changed into a short high tone ‘5’, but is realized as a rising tone ‘35’.

#### 5. Conclusions

This study adopts acoustic means to systematically examine the mono-syllabic and bisyllabic tonal patterns of Zhenjiang dialect. The results demonstrate that this dialect has five citation tones, i.e., Tone1 (42), Tone2 (35), Tone3 (32), Tone4 (55) and Tone5 (5). The tonal patterns of all 25 combinations of these five tones have been discussed. As shown in the results, the first syllables in 15 combinations have undergone the change of tonal values. Among these 15 combinations 10 syllables are changed into new tones ‘44’, a sub-high level tone, or ‘33’, a mid-level tone. It’s worth noting that when the first syllable is a falling tone, T1(42) or T3(32), the acoustic realization of the first syllable shows a more complex pattern than the one Zhang [3] has found. This study also investigates neutral tone syllables, and proposes that the neutralization of the second syllables results from the assimilation effect of the preceding syllable.

#### 6. Acknowledgements

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#### 7. References

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