Postprint of Acoustic Study on Tones of Mengyin Dialect in Shandong

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Abstract

This study investigates the tonal patterns of citation tones and disyllabic tones in the Mengyin dialect through acoustic experiments extracting fundamental frequency parameters. The experimental results reveal that the Mengyin dialect possesses four citation tones: two falling tones, one rising tone, and one dipping tone, with tonal values of 213, 54, 24, and 42 for yinping, yangping, shangsheng, and qusheng, respectively. Disyllabic tones comprise 20 combinational patterns, which are reduced to 16 after tone sandhi neutralization. Tone sandhi occurs in both initial and final positions: yinping mostly becomes falling-only without rising; yangping remains unchanged as the initial character but tends toward a level tone as the final character; shangsheng exhibits the most complex sandhi patterns; qusheng remains unchanged in both positions. Furthermore, the tone sandhi patterns in disyllabic combinations where citation tones are followed by neutral tone are distinctive: the preceding citation tones generally undergo tone sandhi, while the tonal values of the following neutral tone vary.

Full Text

An Acoustic Study of Tones in the Mengyin Dialect of Shandong Province

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Abstract

The experimental results demonstrate that the Mengyin dialect possesses four citation tones: two falling tones, one rising tone, and one contour tone. The tone values for Yinping, Yangping, Shangsheng, and Qusheng are 213, 54, 24,

and 42, respectively. Disyllabic tones exhibit twenty combinational patterns, which reduce to sixteen distinct types after tone sandhi. Tone sandhi occurs in both initial and final syllables: Yinping primarily becomes a simple falling tone without the final rise; Yangping remains unchanged in the initial position but tends toward a level tone in the final position; Shangsheng demonstrates the most complex sandhi patterns; Qusheng remains stable in both positions. Furthermore, the tone sandhi patterns involving a citation tone followed by a neutral tone in disyllabic words are particularly distinctive in Mengyin dialect, with the preceding tone generally undergoing change and the following neutral tone displaying varied values.

Keywords: Mengyin dialect; monosyllabic tones; disyllabic tones; acoustic analysis

1. Introduction

Tone is a linguistic concept that integrates multiple factors including pitch, phonation type, and timbre (Kong Jiangping 2015)[1]54, and represents a significant feature of the Sino-Tibetan language family. While traditional auditory methods of tone identification have laid a solid foundation for describing tones across languages, such approaches inevitably suffer from individual listener variation and excessive reliance on discriminative ability. Since the 19th century, the rise of experimental phonetics has yielded numerous methods for quantifying the physical properties of tone. Zhao Yuanren advocated for experimental approaches to tone research in his "Experimental Methods for Studying Chinese Speech Tones" [2] and, in 1930, devised the five-point scale for tone notation. Liu Fu' s 1924 "Experimental Record of the Four Tones" [3] also demonstrated using a kymograph that the acoustic basis of tone lies in fundamental frequency (F0) variation. In recent years, with continuous technological advancement, an increasing number of researchers have adopted experimental phonetic methods to investigate tone systems in Chinese dialects.

This study examines monosyllabic and disyllabic tones in the Mengyin dialect. According to the 1992 *Annals of Mengyin County*[4]516, Mengyin is a county under the jurisdiction of Linyi City in Shandong Province. During the Spring and Autumn Period, areas west of the county seat belonged to the State of Lu, eastern areas to the State of Ju, and northern areas to the State of Qi, situating it at the intersection of three dialect zones. The 1960s dialect survey *An Overview of Shandong Dialect Phonology*[5] classified the Linyi dialect into the Eastern Dongwei sub-group (Jiao-Liao Mandarin) and the Western Xilu sub-group (Central Plains Mandarin), placing Mengyin in the Eastern group. Investigations by Zhang Quanzhen (1998)[6] and Li Li (2015)[7] concur with this classification. However, Ma Jing and Wu Yonghuan' s (2003)[8]57 *A Gazetteer of the Linyi Dialect* argues that dialects where Middle Chinese Zhi-series initials split into two groups belong to the Eastern group, while others belong to the Western group, thereby assigning Mengyin to the Western group. The *Language Atlas of China*[10] categorizes Mengyin as part of the Northern Mandarin area with Cen-

tral Plains Mandarin characteristics. The controversy surrounding Mengyin' s dialect classification stems from contact and mutual influence between different dialect zones. While neighboring dialects in Yishui, Feixian, and Yinan have received relatively mature research attention, including numerous experimental phonetic explorations such as studies by Li Shanpeng and Gu Wentao (2014)[11] and Zhao Aimin and Zhai Honghua (2017)[12], research on the Mengyin dialect remains limited across lexical, grammatical, and phonological levels, receiving only brief mention in provincial, municipal, and county-level dialect gazetteers or comprehensive studies of the Linyi dialect. Consequently, this paper employs acoustic experimental methods to investigate and describe the tone system of the Mengyin dialect, providing foundational data for Mengyin dialect research and supplementing the broader study of Shandong dialect tones.

2. Dialect Point Introduction

2.1 Overview of the Mengyin Dialect Point

Mengyin County is located in southeastern Shandong Province, in the hinterland of the Taiyi Mountains, on the northern slope of Mengshan Mountain. It borders Yishui to the east and Pingyi to the west, spanning longitudes 117°45 - 118°15 E and latitudes 35°27 -36°02 N. The county extends a maximum of 65.4 kilometers from north to south and 45.8 kilometers from east to west, covering a total area of 1,601.6 square kilometers, which accounts for 9.3% of Linyi City' s total area. Mengyin has a history of over two thousand years since its establishment as a county in the early Western Han Dynasty. By the end of 2013, the county administered one subdistrict office, eight towns, one township, the Mengyin Economic Development Zone, and the Yunmenghu Ecological District, comprising 345 administrative villages. At the end of 2013, the county had 181,200 households and a total population of 553,300. The Han ethnic group comprises 99.83% of the population, with fifteen minority ethnic groups totaling 919 individuals. Among these minorities, the Hui people number 847, accounting for 92.2%. Other minority groups include Manchu, Korean, Mongolian, Yi, Dai, Miao, Li, Zhuang, Yao, Bai, Hani, Mulao, Xibe, and Bouyei. Regarding dialect classification, this study adopts the classification from *A Gazetteer of the Linyi Dialect* and the *Language Atlas of China*, considering Mengyin dialect as belonging to Northern Mandarin with Central Plains Mandarin characteristics.

[Figure 1: see original paper] Linyi Administrative Map
[Figure 2: see original paper] Mengyin County Dialect Classification

2.2 Phonological System of Mengyin Dialect

2.2.1 Initial System The dialect comprises 25 initials. The initials and example characters are presented in a table (not fully reproduced in the source text). Footnotes for this section indicate: Initials are limited to literary pronunciation; Articulation is relatively fronted; Articulation is slightly backed; Dotted underlines in example characters indicate literary pronunciation, while

solid underlines indicate colloquial pronunciation.

2.2.2 Final System The dialect comprises 37 finals, including 9 monophthongs, 13 diphthongs, 8 nasalized finals, and 7 nasal-coda finals. The finals and example characters are presented in a table (not fully reproduced in the source text). Footnotes for this section indicate: Limited to literary pronunciation; The back tongue position is relatively high and backed; Labialized finals carry lip-rounding after certain initials; In zero-initial syllables, the pronunciation is ; Dotted underlines in example characters indicate literary pronunciation.

2.2.3 Tone System The dialect has four citation tone classes, excluding neutral tone: one rising tone, one contour tone, and two falling tones. The tone classes, values, and example characters are as follows:

- Yinping: 214 (examples: poem, clothing, one)
- Yangping: 53 (examples: time, move, flute)
- Shangsheng: 45 (examples: use, chair, small)
- Qusheng: 21 (examples: is, sun, moon)

Tone sandhi patterns for disyllabic words are shown in Table 1 .

Table 1 Tone Sandhi Patterns in Mengyin Dialect Disyllabic Words

Following/Preceding	Yinping 214	Yangping 53	Shangsheng 45	Qusheng 21
Yinping 214	24+214 sky, center, towel, same class	53+214 scallion, teacher, start work, sweet potato	45+214 hear say, succeed, ordinary, strike	21+214 airplane, safe, scallion, start work
Yangping 53	214+53 heaven, middle age, insert door, surroundings, help	53+53 childhood, reunion, wool, latrine, climb wall	214+53 minor cold, unlucky, actor, call roll, maintain	21+53 landmine, large oil, earn money, waver, build ships
Shangsheng 45	214+45 natural principle, noon, wool spinning, copper plate	53+44 chief examiner, ideal, start work, floor	53+45 East China Sea, wool spinning, doze, emphasis	21+45 clap hands, flee, miss, rice straw

Following/Preceding	Yinping 214	Yangping 53	Shangsheng 45	Qusheng 21
Qusheng 21	24+21 daybreak, squad, wool pants, agree	53+21 small bean, chronic illness, get angry, boundary	45+21 quiet, agree, fight, lose direction	21+21 weight, gather, wait, criminal
Neutral Tone	21+24 Zhang family, knife, wife' s family, stove	24+21 chair, wife' s family, shop, lid	214+53 knife, wife' s family, like, sweet potato	53+21 Zhang family, stove, wife' s family, aunt

When Yinping precedes Shangsheng, the actual ending does not reach 4, and is treated as unchanged.

When Yangping precedes Yinping, the tone sometimes falls without rising, with a value of 21, and is treated as unchanged.

3. Experimental Methods

3.1 Recording Conditions

Recordings were conducted in a quiet indoor environment using Cool Edit recording software, a Sony microphone, a Thinkpad laptop, an external sound card, and a mixing console. The sampling frequency was 22,050 Hz with 16-bit sampling precision.

3.2 Speakers

Four speakers were selected for this experiment: two males and two females. All were native speakers of Mengyin dialect who had grown up in Mengyin County, Linyi City, Shandong Province, and had never left Mengyin for more than one year. The two female speakers were aged 36 and 40, while the two male speakers were aged 31 and 35.

3.3 Word List

The experimental word list was compiled based on the Chinese Academy of Social Sciences' *Dialect Survey Character Table* (1981)[12], Zhang Quanzhen (1998)[6], and Ma Jing and Wu Yonghuan (2003)[8]. The selection principle prioritized unaspirated stops and zero initials for both monosyllabic words and the final syllables of disyllabic words to facilitate data extraction. Additionally, prior communication with participants ensured selection of common, familiar characters to minimize recording errors.

For monosyllabic tones, five characters were selected for each tone category, totaling 20 characters. Each speaker read each character twice, yielding 160 monosyllabic tone samples. The selected characters are:

- Yinping 214: poem, clothing, middle, stretch, knife
- Yangping 53: time, hair, same, mother, throw
- Shangsheng 45: use, small, old, early, female
- Qusheng 21: is, move, cover, vinegar, road

Theoretically, Mengyin dialect should have 4$×$4=16 disyllabic tone combinations, plus a neutral tone following each citation tone, totaling 20 combinations. Five example words were selected for each combination, yielding 100 lexical items. Each speaker read each word twice, producing 800 disyllabic tone samples. The selected words are:

Table: Disyllabic Tone Word List

Preceding/Following	Yinping	Yangping	Shangsheng	Qusheng
Yinping	sky, center, hear, towel, airplane	classmate, cement, succeed, chat, safe	keep warm, palm, ordinary, teacher, scallion	arrive home, overcoat, strike, engage, start work
Yangping	heaven, middle age, insert door, surroundings, help	childhood, reunion, wool, latrine, climb wall	minor cold, unlucky, actor, call roll, maintain	landmine, large oil, earn money, waver, build ships
Shangsheng	natural principle, waist drum, East China Sea, clap, noon	forenoon, deposit, wool spinning, flee, apple	timid, conservative, doze, miss, chief examiner	start work, floor, emphasis, rice straw, suffer
Qusheng	quiet, weight, marry off, egg, cut trees	agree, gather, longevity, level ground, wool pants	fight, wait, after, happy event, transform	lose direction, criminal, passive, get angry, travel expenses

Preceding/Following	Yinping	Yangping	Shangsheng	Qusheng
Neutral Tone	knife, Zhang family, pigsty, water-melon, fly	wife' s family, stove, neck, snake, male dog	like, wife' s family, chair, ant, mouse	sweet potato, aunt, moon, sun, shop

3.4 Data Processing

This study extracted fundamental frequency (F0) values using Praat software. WAV format sound samples were imported into Praat, and the "Annotate" function was used to exclude "onset and offset effects" from the recordings. The vowel segment with relatively stable intensity and a stable, well-balanced second formant structure was selected for annotation (Kong Jiangping 2015)[1]61. As Mengyin dialect lacks entering tones and consists solely of smooth tones, a Praat script from the Phonetics Laboratory at Peking University was subsequently employed to extract 20 equidistant F0 points within the annotated range and calculate averages across the four speakers. Current international research on tone and intonation predominantly employs the semitone method. Compared to purely physical acoustic parameters such as F0, semitone values better correspond to human auditory perception because semitone relationships reflect perceptual relationships (Liu Fu 1924)3[1]64. Therefore, this study converted F0 to semitone values using the formula: semitone = $12 \times \log_2(f / f\ )$, where f is the minimum value in the pitch range and f is the measured F0 at each point. When f represents the maximum value in the pitch range, the resulting semitone value defines the speaker' s pitch range. After obtaining the pitch range and semitone values, these were converted to five-point scale values using the formula: five-point value = $[(\lg f - \lg\ ) / (\lg\ - \lg\ ) \times 4] + 1$ (Li Hongyan et al. 2006)[13], where f is the maximum value in the pitch range.

4. Monosyllabic Tone Parameter Analysis

Based on F0 extracted from the four speakers'recordings, the maximum F0 value in the male pitch range was 177 Hz and the minimum was 74 Hz. For female speakers, the maximum was 210 Hz and the minimum was 131 Hz. The male pitch range spanned approximately 8 semitones, while the female pitch range spanned approximately 15 semitones. After averaging the F0 values for male and female speakers separately and converting them to five-point scale values, the monosyllabic tones for male and female speakers are shown in Figure 3 [Figure 3: see original paper].

[Figure 3: see original paper] Monosyllabic Tones of Mengyin Dialect (Male and Female)

Figure 3 reveals minimal overall differences between male and female speakers.

Comparing the Yangping curves, female speakers show a tendency toward a high level tone, while male speakers exhibit a slight decline at the end. For Yinping, male speakers' ending point is approximately one degree higher than female speakers. Shangsheng and Qusheng show virtually no differences between male and female speakers.

After further averaging the F0 and five-point scale values across male and female speakers, the monosyllabic tone F0 data for Mengyin dialect are presented in Table 2 , with F0 contours and five-point scale curves shown in Figure 4 [Figure 4: see original paper].

Table 2 Average F0 Data for Male and Female Speakers

[Measurement points and values would be presented here]

[Figure 4: see original paper] Average Monosyllabic Tones of Mengyin Dialect

Figure 4 shows that Yangping is the highest tone with a slight fall at the end, assigned a value of 54. Yinping is the lowest tone, a contour tone where the ending point is extremely close to the starting point at approximately 3, with the ending slightly higher than the beginning and the lowest midpoint reaching 1; therefore, Yinping is assigned a value of 313. Qusheng is a high falling tone, starting slightly lower than Yangping at 4 and ending slightly lower than Shangsheng at 2, resulting in a value of 41. Shangsheng is a mid rising tone, beginning at the same point as Yinping at approximately 2 and ending slightly lower than Yangping at approximately 4, yielding a value of 24.

The summarized monosyllabic tone categories and values are presented in Table 3 . Comparison with previous research reveals no change in the overall trends of tone categories, only adjustments in specific values. Yinping and Yangping show minimal changes, while Shangsheng and Qusheng values have generally decreased by one degree.

Table 3 Tone Categories and Values in Mengyin Dialect

Tone Class	Previous Transcription	Current Experimental Study
Yinping	214	313
Yangping	53	54
Shangsheng	45	24
Qusheng	21	41

5. Disyllabic Tone Parameter Analysis

Analysis of the 20 disyllabic tone combinations averaged across the four speakers was processed into five-point scale values. The results are presented below, arranged by the tone type of the initial syllable, with measurement points on the horizontal axis and five-point values on the vertical axis.

5.1 Initial Syllable as Yinping

As shown in Figure 5 [Figure 5: see original paper], among the four tone combinations with Yinping as the initial syllable, three distinct sandhi patterns emerge.

When the following syllable is Yinping or Qusheng, the initial Yinping changes from a falling tone to a rising tone, with similar values assigned as 34. Additionally, when the following syllable is Yinping, the tail no longer rises and becomes a simple falling tone with a value of 21. When the following syllable is Qusheng, its value is raised by one degree under the influence of the preceding rising tone, becoming 42. When the following syllable is Yangping or Shangsheng, the initial Yinping remains a falling tone, but under the influence of the high following tone, the tail no longer rises and the falling amplitude becomes more gradual, with a value of approximately 32. Moreover, when the following syllable is Yangping, its value decreases from the citation form to approximately 44, while the following Shangsheng remains unchanged at 24. When the following syllable is neutral tone, the neutral tone value is approximately 21, and the initial Yinping remains a falling tone but with a significantly raised overall value, becoming a high falling tone at approximately 42.

Summary of Yinping-Initial Disyllabic Tone Sandhi:

- Yinping 213 + Yinping 213 → 34 + 21
- Yinping 213 + Yangping 54 → 32 + 44
- Yinping 213 + Shangsheng 24 → 32 + 24
- Yinping 213 + Qusheng 42 → 34 + 42
- Yinping 213 + Neutral Tone → 42 + 21

5.2 Initial Syllable as Yangping

As shown in Figure 6 [Figure 6: see original paper], among the four tone combinations with Yangping as the initial syllable, two distinct sandhi patterns emerge. Only when the following syllable is neutral tone does the initial Yangping change from a high falling tone to a rising tone with a value of approximately 24, while the neutral tone becomes 42. When the following syllable is Yinping, Yangping, Shangsheng, or Qusheng, the initial syllable remains unchanged. However, the following Yinping becomes a simple falling tone without the final rise, with a value of approximately 21; following Yangping and Shangsheng both lower and tend toward level tones, assigned values of 44 and 33 respectively; and following Qusheng remains unchanged.

Summary of Yangping-Initial Disyllabic Tone Sandhi:

- Yangping 54 + Yinping 213 → 54 + 21
- Yangping 54 + Yangping 54 → 54 + 44
- Yangping 54 + Shangsheng 24 → 54 + 33
- Yangping 54 + Qusheng 42 → 54 + 42
- Yangping 54 + Neutral Tone → 24 + 42

5.3 Initial Syllable as Shangsheng

As shown in Figure 7 [Figure 7: see original paper], among the four tone combinations with Shangsheng as the initial syllable, the sandhi patterns are the most complex, with the initial syllable undergoing changes in nearly all cases. These can be divided into three categories. When the following syllable is Yangping or neutral tone, the initial Shangsheng becomes a low tone similar to Yinping, with a value of approximately 32, while the following Yangping and neutral tone both have values of approximately 44. When the following syllable is Yinping or Qusheng, the initial Shangsheng remains a rising tone but lowered by one degree to approximately 34, with following Yinping at approximately 21 and following Qusheng at approximately 42. When the following syllable is also Shangsheng, the initial syllable becomes a high falling tone with a value identical to Yangping at approximately 54, while the following Shangsheng becomes a mid level tone at approximately 33.

Summary of Shangsheng-Initial Disyllabic Tone Sandhi:

- Shangsheng 24 + Yinping 213 → 34 + 21
- Shangsheng 24 + Yangping 54 → 32 + 44
- Shangsheng 24 + Shangsheng 24 → 54 + 33
- Shangsheng 24 + Qusheng 42 → 34 + 42
- Shangsheng 24 + Neutral Tone → 32 + 44

5.4 Initial Syllable as Qusheng

As shown in Figure 8 [Figure 8: see original paper], among the four tone combinations with Qusheng as the initial syllable, only when the following syllable is neutral tone does the initial Qusheng raise to a value of 54, with the neutral tone at 31. When the following syllable is Yinping, Yangping, Shangsheng, or Qusheng, the initial Qusheng remains extremely stable in both contour and value. The following Yinping becomes 21, following Yangping lowers and levels to 44, following Shangsheng remains unchanged at 24, and following Qusheng is slightly lower than the initial Qusheng at approximately 31.

Summary of Qusheng-Initial Disyllabic Tone Sandhi:

- Qusheng 42 + Yinping 213 → 42 + 21
- Qusheng 42 + Yangping 54 → 42 + 44
- Qusheng 42 + Shangsheng 24 → 42 + 24
- Qusheng 42 + Qusheng 42 → 42 + 31
- Qusheng 42 + Neutral Tone → 54 + 31

6. Disyllabic Tone Sandhi Rules

The preceding data on disyllabic tone sandhi reveal relatively systematic patterns for each tone category in Mengyin dialect.

The citation tone value of Yinping is 213. In disyllabic contexts, whether in

initial or final position, Yinping in most cases becomes a simple falling tone without the final rise, accompanied by either a lowering of the tone value or a reduction in falling amplitude, resulting in values of 32 or 21. Li Xiaofan (2004) identifies three primary types of tone sandhi: first, simplification-type sandhi, which simplifies the contour of the tone sequence to reduce articulatory effort; second, dissimilation-type sandhi, which differentiates adjacent syllables within a word; and third, neutralization-type sandhi, which reduces the total number of tone sequences to construct a simplified tonal system. Based on the above discussion, Yinping sandhi conforms to the first principle, simplifying the "rising" portion of the citation tone tail to facilitate articulation. Previous research indicates that contour tones in most Shandong Mandarin dialects generally become non-contour tones or exhibit reduced falling amplitude during connected speech (Li Xiaofan 2004)[14]. We can follow previous studies in treating this as unchanged (Ma Jing and Wu Yonghuan 2003)[8]58. Additionally, when the following syllable is Yinping or Qusheng, Yinping follows the "dissimilation-type" rule and becomes a rising tone 34, either to differentiate from the following syllable or to facilitate smoother connection.

Qusheng demonstrates the greatest stability, with a citation tone value of 42. Whether serving as the initial or final syllable, Qusheng shows no changes in contour or value in disyllabic combinations. Yangping has a citation tone value of 54 and remains relatively stable without change when in the initial position. When in the final position, it generally lowers its value under the influence of the preceding tone, tending toward a level tone 44. The simplification of falling tones often manifests as leveling or reduced falling amplitude (Li Xiaofan 2004)[14], which precisely describes the behavior of Yangping and Qusheng in Mengyin dialect.

Shangsheng has a citation tone value of 24 and exhibits the most complex sandhi patterns in disyllabic contexts. When Shangsheng appears as the final syllable, it remains unchanged after Yinping and Qusheng, but after Yangping and Shangsheng it tends toward a level tone 33, following the same simplification rule for falling tones described above. When Shangsheng appears as the initial syllable followed by other tones, its value changes substantially. When followed by Yangping, Shangsheng becomes a falling tone 32, representing a "neutralizing sandhi" —a phenomenon that emerges at advanced stages of tone sandhi development where tones merge with citation tones or generate new values (often lower level or falling tones) (Li Xiaofan 2004)[14]. This pattern has not been documented in previous traditional transcriptions or studies and may represent the result of language evolution. When followed by Yinping and Qusheng, Shangsheng shows minimal change, merely raising slightly to 34. When two Shangsheng tones combine, the pattern becomes 54+33, constituting "dissimilation-type sandhi" driven by the need to differentiate adjacent syllables.

Furthermore, the tone sandhi patterns of citation tones followed by neutral tone in Mengyin dialect are highly distinctive, with the preceding citation tone generally undergoing change and the following neutral tone displaying varied

values. Specifically, Yinping and Qusheng both raise by one degree to become high falling tones 42 and 54, respectively, followed by low falling neutral tones 21 and 31. In contrast, Yangping and Shangsheng completely reverse their contours: Yangping changes from a falling tone 54 to a rising tone 24, while Shangsheng changes from a rising tone 24 to a falling tone 32, with the following neutral tone raising to 42 and 44, respectively. Hirayama Hisao (1998)[15] noted that many dialects in Shandong Province possess a set of "pre-neutral tone sandhi"patterns, where all or most tone categories adopt values different from their citation forms before neutral tone. His investigation of the Dezhou dialect revealed that this phenomenon resulted from the evolution of "ancient tone values," with pre-neutral tone sandhi preserving an earlier stratum of tonal values than citation tones. Whether the pre-neutral tone sandhi in Mengyin dialect originates from similar historical causes requires further verification and research, though this sandhi pattern may provide valuable material for diachronic studies of tonal evolution.

7. Conclusion

In summary, Mengyin monosyllabic tones comprise four tone classes with the following values:

Table: Mengyin Monosyllabic Tone Classes and Values

Tone Class	Value
Yinping	313
Yangping	54
Shangsheng	24
Qusheng	41

Mengyin disyllabic tone categories exhibit systematic mergers: Yinping and Shangsheng merge when preceding Yinping and Yangping; Yangping and Shangsheng merge when preceding Shangsheng; Yinping and Shangsheng merge when preceding Qusheng. These mergers primarily result from phonological development and evolution, requiring further investigation. Consequently, disyllabic tone combinations reduce to 12 merged patterns plus 4 neutral tone sandhi patterns, with specific values shown in Table 4 .

Table 4 Mengyin Disyllabic Tone Values

Preceding Tone	Following Yinping	Following Yangping	Following Shangsheng	Following Qusheng	Following Neutral Tone
Yinping 213	34+31	32+44	54+33	32+24	34+42

Preceding Tone	Following Yinping	Following Yangping	Following Shangsheng	Following Qusheng	Following Neutral Tone
Yangping 54	54+21	54+44	54+42	24+42	-
Shangsheng 24	42+21	42+44	42+24	42+31	54+31
Qusheng 42	-	-	-	-	-

Overall, tone sandhi in Mengyin dialect occurs in both initial and final syllables: Yinping mostly becomes a simple falling tone; Qusheng remains stable without change in either position; Yangping remains unchanged in initial position but tends toward a level tone 44 in final position; Shangsheng exhibits the most complex patterns, tending toward level tone 33 after Yangping and Shangsheng, becoming falling tone 32 after Yangping, raising slightly to 34 after Yinping and Qusheng, and becoming 54+33 when two Shangsheng tones combine.

Moreover, the tone sandhi patterns of citation tones followed by neutral tone in Mengyin dialect are highly distinctive, with the preceding citation tone undergoing change and the following neutral tone displaying varied values. In-depth investigation of this phenomenon may provide evidence for diachronic phonological development.

Data source: Mengyin County People' s Government official website: http://www.mengyin.gov.cn/

Map source: Linyi Municipal People' s Government official website: http://www.linyi.gov.cn/sq/lygk/dlwz.htm

Screenshot from *Language Atlas of China*

Primarily based on *A Gazetteer of the Linyi Dialect*

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Note: Figure translations are in progress. See original paper for figures.