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## DECLARATIVE INTONATION IN MALAYSIAN MANDARIN: AN EXPLORATORY ACOUSTIC STUDY

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### Abstract:

This study adopts an experimental-phonetic approach to conduct a small-scale exploratory acoustic comparison of declarative intonation in Malaysian Mandarin and Mainland Mandarin. The participants consisted of two male Malaysian Chinese speakers and two male Mainland Chinese speakers. Four declarative sentences with controlled focus positions were used as speech materials, each representing one of the four Mandarin lexical tones. The analysis examined sentence pitch range, prosodic-word pitch range, syllable-level pitch range, and the in-sentence realization of lexical tones. Fundamental frequency data were extracted using Mini-Speech-Lab and converted from hertz into semitones and normalized percentage values. The results show that, in the present sample, the Malaysian Chinese speakers display a relatively narrower overall pitch range than the Mainland Chinese speakers, mainly due to a lower upper pitch limit, while the lower pitch limit differs less between the two groups. The two groups pattern similarly in the location of the lower pitch limit, but differ in upper pitch alignment and pitch fluctuation patterns. Malaysian Chinese speakers generally preserve the basic characteristics of the four lexical tones, although some tonal weakening and local deviation can be observed in connected speech. These findings should be interpreted as preliminary observations based on a small, controlled dataset.

### Keywords:

Acoustic Analysis; Declarative Intonation; Malaysian Mandarin; Pitch Range; Tone Realization



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## Introduction

Intonation is an important manifestation of sentence-level pitch organization and a key entry point for understanding prosodic structure and spoken expression (Ladd, 2008; Xu, 2005; Hirschberg, 2016). In Mandarin Chinese, the study of intonation involves not only the lexical tone system, which distinguishes word meaning, but also the sentence-level intonational system, which reflects syntax, mood, and information structure. These two systems overlap and interact in connected speech. As Chao (1933/2002, 1968) observed, Chinese contains both the “small waves” of lexical tones and the “large waves” of sentence intonation, and the two interact continuously in actual discourse. Examining pitch range, pitch fluctuation, and the in-sentence realization of lexical tones in Mandarin declarative sentences therefore helps clarify how tone and intonation jointly shape Mandarin prosody.

Declarative sentences are among the most basic and frequently used sentence types in Chinese. Because of their relatively stable syntactic function and comparatively unmarked intonational status, they have long served as important materials for investigating Mandarin intonation and tone-intonation interaction (Chao, 1933/2002; Cao, 2002). Previous studies have examined pitch movement, sentence-level pitch range, prosodic-word pitch range, syllable-level pitch range, and their relations in Mandarin declaratives (Shen, 1994; Shi et al., 2009; Wang et al., 2013). These studies provide an important baseline for understanding sentence-level pitch organization in Mainland Mandarin and offer a useful reference for comparison with Mandarin varieties produced in other linguistic environments.

Previous research has also shown that Mandarin intonation may vary across speakers from different linguistic backgrounds. Such variation may be reflected in pitch range, pitch control, sentence-final movement, tonal range, tonal shape, and the realization of lexical tones in connected speech (Wang et al., 2003; Gu & Liu, 2015; Gao, 2021). However, Mandarin speakers in overseas Chinese communities should not be treated simply as second-language learners. Their Mandarin use is often shaped by family language, school language, community language, and the broader multilingual ecology. As a result, their sentence-level pitch organization may display characteristics that differ from those of Mainland Mandarin speakers. Malaysian Mandarin is a particularly relevant case in this respect. The Chinese community in Malaysia has long existed in a multilingual contact environment in which Mandarin coexists with various Chinese dialects, Malay, and English. This complex linguistic ecology may influence the phonetic and prosodic realization of Mandarin. Existing studies have examined several phonetic and tonal features of Malaysian Mandarin, including citation tones, tone sandhi, and related phonological phenomena. However, much of the existing acoustic research remains focused on word-level tones or specific tonal processes. Limited empirical comparison has been made between Malaysian Mandarin and Mainland Mandarin at the sentence level,

particularly with respect to declarative intonation, pitch range, pitch fluctuation, and the in-sentence realization of lexical tones.

To address this gap, the present study adopts an experimental-phonetic approach to conduct a small-scale exploratory acoustic comparison of declarative intonation in Malaysian Mandarin and Mainland Mandarin. Drawing on Shi's (2013) analytical framework of sentence pitch range, prosodic-word pitch range, and syllable-level pitch range, the study examines four controlled declarative sentences produced by two Malaysian Chinese speakers and two Mainland Chinese speakers. The analysis focuses on sentence pitch range, pitch fluctuation across prosodic positions, and the in-sentence realization of the four Mandarin lexical tones. Given the limited sample size, the study does not aim to generalize to all Malaysian Mandarin speakers. Rather, it seeks to provide preliminary acoustic evidence for understanding Mandarin prosodic variation in a multilingual Malaysian context.

Based on these aims, the study addresses the following research questions:

1. What similarities and differences can be observed between Malaysian Chinese speakers and Mainland Chinese speakers in the pitch range characteristics of Mandarin declarative sentences?
2. What differences can be observed between the two groups in pitch fluctuation patterns across different prosodic positions in Mandarin declarative sentences?
3. What characteristics are evident in the in-sentence realization of the four lexical tones in Mandarin declarative sentences produced by Malaysian Chinese speakers?

The scope of this study is limited to a small-scale comparison of Mandarin declarative intonation based on a controlled dataset. The participants consisted of two male Malaysian Chinese speakers and two male Mainland Chinese speakers, and the speech materials included four declarative sentences with controlled focus positions, each representing one of the four Mandarin lexical tones. The study focuses on sentence pitch range, prosodic-word pitch range, syllable-level pitch range, and the acoustic realization of lexical tones in sentences. It does not address other sentence types, such as interrogatives or exclamatives, nor does it examine broader sociolinguistic variation. The findings should therefore be interpreted primarily as exploratory observations based on a specific dataset and a small sample.

## Literature Review

### *Research on Declarative Intonation in Mandarin Chinese*

Mandarin Chinese is a tone language with both a lexical tone system that distinguishes word meaning and an intonational system that reflects sentence-level functions such as syntax, mood, and information structure. In connected speech, these two systems jointly shape sentence-level pitch organization and interact closely with one another. Chao (1933/2002, 1968) characterized the relationship between lexical tones and sentence intonation as the interaction between “small waves” and “large waves,” emphasizing that Chinese intonation cannot be understood independently of the tone system. Research on Mandarin intonation must therefore consider not only the overall intonation contour but also the superimposition of sentence intonation and lexical tones within an utterance.

Declarative sentences have long been regarded as an important domain for investigating sentence-level pitch organization in Mandarin. Shen (1994) identified declaratives as a key object for the study of Chinese sentence intonation, while Cao (2002) demonstrated acoustically that tone and intonation coexist and mutually constrain one another in connected speech. Building on this line of work, Shi (2013) proposed that Mandarin intonation should be analyzed in terms of sentence pitch range, prosodic-word pitch range, syllable-level pitch range, and the relations among these domains. Empirical studies by Shi et al. (2009) and Wang et al. (2013) further described fluctuation patterns in Mandarin declaratives and the relation between sentence-level and prosodic-word pitch range. More broadly, studies by Ladd (2008), Xu (1997, 2019), and Wang et al. (2020) have shown that tonal realization in Mandarin is closely related to prosodic structure and focus distribution. Taken together, these studies provide an important baseline for understanding pitch organization in Mandarin declarative sentences.

### ***Studies on Mandarin Intonation Across Different Linguistic Backgrounds***

A growing body of research has shown that speakers from different linguistic backgrounds often produce Mandarin intonation differently from speakers in Mainland China. Chen (2006), for example, showed that the native intonational system may strongly influence the acquisition of Mandarin intonation by Vietnamese learners. Shi and Wen (2012), in their study of American learners of Mandarin, likewise found differences in intonation range, pitch fluctuation, and intonation realization in connected speech across learners from different language backgrounds. Later studies by Li and Zhou (2019, 2020) and by Yi et al. (2021) further demonstrated that learners from Russian, Italian, and Thai backgrounds differ in pitch organization and intonation realization in Mandarin declarative sentences.

Cross-linguistic phonetic research has also shown that language contact and cross-linguistic transfer may affect the organization of a speaker's phonetic system as well as second-language speech perception and production (Best & Tyler, 2007; Makarova & Zhou, 2006; Wang et al., 2020). Overall, previous research has made it clear that linguistic background is an important factor in the realization of Mandarin intonation. However, most of these studies focus on second-language learners, while relatively little attention has been paid to overseas Chinese communities that have long lived in multilingual environments, particularly the Chinese community in Malaysia.

### ***Malaysian Mandarin and Related Phonetic Research***

Research on Malaysian Mandarin has approached the topic from at least two directions. On the one hand, studies of language contact and community language use have noted that the Malaysian Chinese community has long existed in a multilingual environment in which Mandarin coexists with various Chinese dialects, Malay, and English (Wang, 2016). On the other hand, phonetic studies have examined its segmental features, tone system, and specific sandhi-related phenomena. Ng Boon Sim (2005) provided an early overview of several phonetic features of spoken Malaysian Mandarin, laying an initial foundation for later work. Huang (2016) subsequently offered a more systematic account of Malaysian Mandarin from phonetic and phonological perspectives, identifying features in the realization of consonants, vowels, and tones.

More recently, research has begun to move toward experimental acoustic analysis. Chiew (2021) conducted a preliminary study of Tone 3 sandhi in Malaysian Mandarin, while Ren & Chiew (2024) examined the citation tones acoustically. These studies suggest that Malaysian Mandarin displays identifiable phonetic and tonal characteristics. However, most existing work still focuses on word-level phenomena or specific tonal processes. Systematic experimental research on sentence-level declarative intonation, pitch fluctuation, and prosodic organization remains limited.

In sum, previous studies have provided an important baseline for understanding pitch organization in Mandarin declarative sentences and have shown that linguistic background may influence Mandarin intonation and tone realization. However, much of the existing research on cross-background Mandarin intonation has focused on second-language learners, while overseas Chinese communities in multilingual environments have received comparatively less attention. In the case of Malaysian Mandarin, previous studies have mainly examined phonetic features, citation tones, or specific tonal processes such as tone sandhi. Sentence-level declarative intonation in Malaysian Mandarin remains underexplored, particularly with respect to sentence pitch range, pitch fluctuation across prosodic positions, and the in-sentence realization of lexical tones. The present study addresses this gap through a small-scale exploratory acoustic comparison of declarative intonation produced by Malaysian Chinese speakers and Mainland Chinese speakers.

## **Methodology**

### ***Research Design***

This study adopts an experimental-phonetic design. Drawing on Shi's (2013) analytical framework of sentence pitch range, prosodic-word pitch range, and syllable-level pitch range, it conducts an exploratory comparison of declarative intonation produced by Malaysian Chinese speakers and Mainland Chinese speakers. Based on a small, controlled dataset, the study examines the acoustic performance of the two groups in terms of sentence pitch range, prosodic-word pitch range, syllable-level pitch range, and the in-sentence realization of lexical tones. The speech materials consisted of four declarative sentences with controlled focus positions. After recording, fundamental frequency data were extracted using Mini-Speech-Lab and analyzed through semitone conversion and normalization. Given the limited sample size, the study relies primarily on descriptive acoustic comparison rather than inferential statistical testing. The purpose is to identify observable acoustic tendencies within the present dataset, rather than to make broad generalizations about Malaysian Mandarin as a whole.

### ***Participants***

The study included four male speakers: two Malaysian Chinese speakers and two Mainland Chinese speakers. The two speakers in the Malaysian group had both lived in the Kuala Lumpur metropolitan area for an extended period. They were undergraduate students aged 25 and 20 and are referred to here as MH1 and MH2. The two speakers shared similar linguistic backgrounds. Both were native Cantonese speakers who had long lived in a multilingual environment and were proficient in Mandarin, Cantonese, English, and Malay in daily communication. More specifically, they mainly used Cantonese at home, Malaysian Mandarin within the Chinese community, and English or Malay in other social contexts.

The two male speakers in the Mainland Chinese group served as the reference group and are referred to as PT1 and PT2. Both were 24 years old, held bachelor's degrees, and had attained Level 2-A on the Putonghua Proficiency Test. They were able to use Putonghua consistently in daily communication. The Malaysian group constituted the target group of the present study, while the Mainland Chinese group served as the reference group. All speakers provided informed consent before the recordings were made. Ethical approval for the study was granted by the Research Ethics Committee of Universiti Putra Malaysia.

The small sample size was adopted because the present study was designed as a pilot acoustic investigation rather than a large-scale sociophonetic survey. The comparison was controlled in terms of gender, sentence type, syllable number, syntactic structure, and prosodic pattern. The Malaysian Chinese speakers were selected as the target group, while the Mainland Chinese speakers served as a reference group for controlled comparison. Therefore, the findings are intended to identify preliminary acoustic tendencies within the present dataset rather than to generalize to all Malaysian Mandarin speakers.

### ***Speech Materials***

The speech materials consisted of four declarative sentences with controlled focus positions, in which the default focus fell on the final object prosodic word. The sentences were designed with reference to Shen's (1985) framework and were simplified and adjusted to fit the aims of the present study. These adjustments were intended to increase structural control, reduce syntactic complexity, and minimize the influence of additional focus manipulation on sentence-level pitch organization.

All four sentences had a six-syllable structure and followed a subject-verb-object (SVO) pattern. The subject was a disyllabic noun, the predicate a monosyllabic verb, and the object a trisyllabic compound, yielding an overall prosodic pattern of 2+1+3. This design was intended to keep the materials comparable in syllable count, syntactic structure, and prosodic pattern. The four sentences represented the four Mandarin lexical tones, as shown below:

Tone 1: 张中 / 修 / 收音机。

Tone 2: 陈林 / 回 / 红旗园。

Tone 3: 小美 / 写 / 演讲稿。

Tone 4: 赵丽 / 种 / 纪念树。

### ***Experimental Procedure and Acoustic Processing***

The experimental procedure consisted of three stages: recording, fundamental frequency extraction, and semitone conversion with normalization.

#### ***Recording***

The recordings were made in a relatively quiet indoor environment with no substantial background noise. Cool Edit was used for recording, with the parameters set at a sampling rate of 11,025 Hz, 16-bit quantization, and mono recording, mainly to ensure compatibility with Mini-Speech-Lab. Before the formal recording session, the speakers familiarized themselves

with the sentences and read them aloud at a natural and steady speaking rate. Each speaker produced each of the four sentences three times, with an interval of approximately three seconds between utterances, yielding a total of 48 speech samples. To reduce possible effects of conscious monitoring, the speakers were not informed of the specific research purpose. Since the study focuses on fundamental frequency patterns and normalized relative pitch distributions rather than segmental spectral details, these recording parameters were considered sufficient for the exploratory acoustic analysis.

### ***Fundamental Frequency Extraction***

After recording, the audio files were imported into Mini-Speech-Lab. Individual pitch-tracking errors were manually checked and corrected where necessary by comparing spectrograms and F0 contours. Fundamental frequency values in hertz were then extracted at nine equally spaced sampling points for each syllable in order to capture within-syllable pitch variation. These values were used for subsequent semitone conversion and normalization.

### ***Semitone Conversion and Normalization***

After F0 extraction, the three repetitions of each sentence produced by the same speaker were averaged, yielding mean F0 values (in Hz) for the nine sampling points of each syllable. These values were then converted into semitones and further normalized so that pitch performance could be compared across speakers at the sentence, prosodic-word, and syllable levels.

The semitone conversion followed Shi (2013) and used the following formula:

$$St = 12 \times \lg(f/fr) / \lg 2$$

where  $f$  is the pitch value to be converted and  $fr$  is the reference frequency. Following common practice in studies of Chinese intonation, the reference frequency for male speakers was set at 55 Hz.

Based on the semitone values, normalization was further carried out using percentage values calculated as follows:

$$Ki = 100 \times (Gi - Smin) / (Smax - Smin)$$

$$Kj = 100 \times (Gj - Smin) / (Smax - Smin)$$

$$Kr = Ki - Kj$$

Here,  $Gi$  represents the upper semitone value of the prosodic-word pitch range,  $Gj$  the lower semitone value of the prosodic-word pitch range,  $Smax$  the upper semitone value of the sentence pitch range, and  $Smin$  the lower semitone value of the sentence pitch range.  $Ki$  and  $Kj$  represent the normalized upper and lower percentage values of the prosodic-word pitch range, while  $Kr$  represents its percentage span and reflects the relative degree of pitch fluctuation within that domain. Based on these measures, the study compares the two groups in terms of sentence pitch range, prosodic-word pitch range, syllable-level pitch range, and the in-sentence realization of lexical tones.

## Results

### *Sentence Pitch Range Characteristics*

To compare the overall pitch range of Mandarin declarative sentences produced by Malaysian Chinese speakers and Mainland Chinese speakers, this section examines sentence pitch range and the distribution of its upper and lower limits. Following Shi (1999, 2013), sentence pitch range is defined as the difference between the maximum and minimum semitone values within an utterance. In the present study, fundamental frequency values were converted from hertz into semitones, and the maximum and minimum semitone values were identified for each speaker. Table 1 presents the sentence pitch range values for the Malaysian Chinese and Mainland Chinese speakers.

**Table 1. Comparison of Sentence Pitch Range Values Between Malaysian Chinese and Mainland Chinese Speakers**

Speaker	Maximum (st)	Minimum (st)	Sentence Pitch Range (st)
MH1	21.46	6.91	14.55
MH2	19.74	4.35	15.39
PT1	26.21	5.83	20.39
PT2	24	6.49	17.51

As shown in Table 1, the sentence pitch ranges of MH1 and MH2 are 14.55 st and 15.39 st, respectively, whereas those of PT1 and PT2 are 20.39 st and 17.51 st. These values indicate that, within the present dataset, the Malaysian Chinese speakers exhibit a comparatively narrower sentence pitch range than the Mainland Chinese speakers. This difference appears to be associated primarily with the upper pitch limit rather than the lower pitch limit, since the maximum values differ more clearly across the two groups than the minimum values.

To further examine the distribution of sentence pitch range, Table 2 shows the locations of the upper and lower pitch limits within the sentences.

**Table 2. Distribution of the Upper and Lower Limits of Sentence Pitch Range in Malaysian Chinese and Mainland Chinese Speakers**

Speaker	Upper Limit Location	Lower Limit Location
MH1	Second syllable of the sentence-initial prosodic word	Final syllable of the sentence-final prosodic word
MH2	First syllable of the sentence-final prosodic word	Final syllable of the sentence-final prosodic word
PT1	First syllable of the sentence-initial prosodic word	Final syllable of the sentence-final prosodic word
PT2	First syllable of the sentence-initial prosodic word	Final syllable of the sentence-final prosodic word

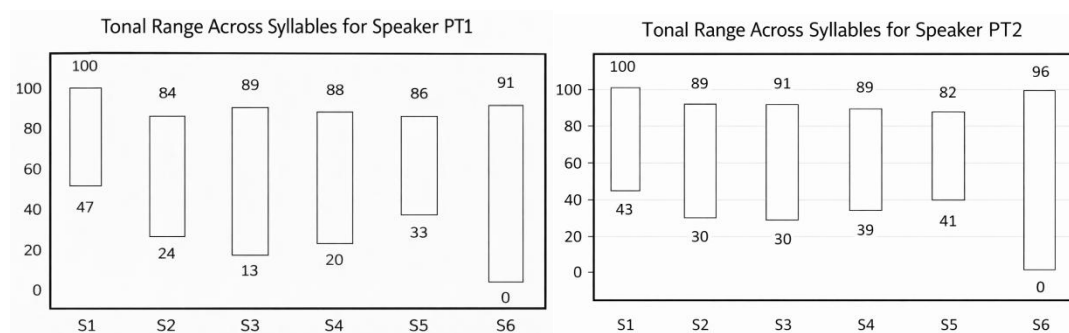
As shown in Table 2, the lower pitch limit occurs on the final syllable of the sentence-final prosodic word for all four speakers. This suggests that both groups share a similar pattern of sentence-final lowering in the present data. By contrast, the upper pitch limit shows different

alignment patterns across the two groups. For the two Mainland Chinese speakers, the upper pitch limit occurs on the first syllable of the sentence-initial prosodic word. For the Malaysian Chinese speakers, however, the upper pitch limit is not consistently aligned with the sentence-initial position: for MH1, it occurs on the second syllable of the sentence-initial prosodic word, whereas for MH2, it occurs on the first syllable of the sentence-final object prosodic word.

Overall, the comparison suggests that, in the present sample, the two groups differ mainly in the width of sentence pitch range and in the alignment of the upper pitch limit, while sharing a similar pattern in the placement of the lower pitch limit. This pattern indicates that the observed group difference lies less in sentence-final lowering than in the configuration of higher pitch targets within the sentence.

### *Pitch Fluctuation Across Different Prosodic Positions*

According to Shi's (1999, 2013) account of intonation patterns and prosodic hierarchy, pitch variation within a sentence is reflected not only in overall sentence pitch range but also in prosodic-word and syllable-level pitch ranges. This section therefore examines pitch fluctuation across different prosodic positions, especially the alignment of pitch peaks and the distribution of upper and lower pitch limits across syllables.



**Figure 1. Pitch fluctuation across syllables in Mandarin declarative sentences produced by the Mainland Chinese speakers**

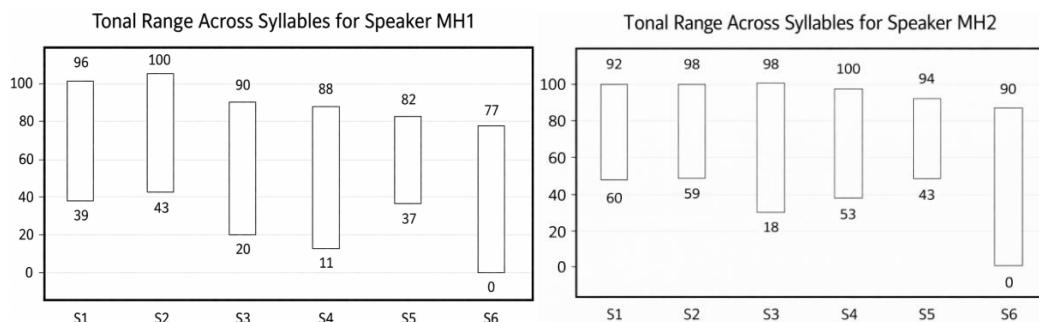
**Table 3. Syllable-Level Pitch Range Values for the Mainland Chinese Speakers**

Speaker	Measure	Syllable 1	Syllable 2	Syllable 3	Syllable 4	Syllable 5	Syllable 6
PT1	Upper limit	100	84	89	88	86	91
	Lower limit	47	24	13	20	33	0
	Span	53	60	76	68	53	91
PT2	Upper limit	100	89	91	89	82	96
	Lower limit	43	30	30	39	41	0
	Span	57	59	61	50	41	96

**Table 4. Prosodic-Word Pitch Range Values in Sentence-Initial and Sentence-Final Position for the Mainland Chinese Speakers**

Speaker	Measure	Sentence-initial prosodic word (Syllables 1–2)	Sentence-final prosodic word (Syllables 3–6)
PT1	Upper limit	100	91
	Lower limit	24	0
	Span	76	91
PT2	Upper limit	100	96
	Lower limit	30	0
	Span	70	96

Figure 1 and Tables 3–4 show that the two Mainland Chinese speakers display highly similar pitch fluctuation patterns. For both PT1 and PT2, the maximum upper-limit value occurs on the first syllable of the sentence-initial prosodic word, while the minimum lower-limit value occurs on the final syllable of the sentence-final prosodic word. At the prosodic-word level, the sentence-final prosodic word shows a larger pitch span than the sentence-initial prosodic word. For PT1, the spans of the sentence-initial and sentence-final prosodic words are 76% and 91%, respectively; for PT2, they are 70% and 96%, respectively. This pattern suggests a relatively stable configuration in which the pitch peak is aligned with the sentence-initial position and the pitch range gradually closes toward the sentence-final position.

**Figure 2. Pitch fluctuation across syllables in Mandarin declarative sentences produced by the Malaysian Chinese speakers****Table 5. Syllable-Level Pitch Range Values for the Malaysian Chinese Speakers**

Speaker	Measure	Syllable 1	Syllable 2	Syllable 3	Syllable 4	Syllable 5	Syllable 6
MH1	Upper limit	96	100	90	88	82	77
	Lower limit	39	43	20	11	37	0
	Span	57	57	70	77	45	77
MH2	Upper limit	92	98	98	100	94	90
	Lower limit	60	59	18	53	43	0
	Span	32	39	80	47	51	90

**Table 6. Prosodic-Word Pitch Range Values in Sentence-Initial and Sentence-Final Position for the Malaysian Chinese Speakers**

Speaker	Measure	Sentence-initial prosodic word	Sentence-final prosodic word
		(Syllables 1–2)	(Syllables 3–6)
MH1	Upper limit	100	90
	Lower limit	39	0
	Span	61	90
MH2	Upper limit	98	100
	Lower limit	59	0
	Span	39	100

Figure 2 and Tables 5–6 show that the Malaysian Chinese speakers also exhibit sentence-final lowering, with the minimum lower-limit value occurring on the final syllable of the sentence-final prosodic word. However, their pitch peak alignment differs from that of the Mainland Chinese speakers. For MH1, the highest upper-limit value occurs on the second syllable, whereas for MH2 it occurs on the fourth syllable. This indicates that, within the present dataset, the Malaysian Chinese speakers do not show a consistent sentence-initial pitch peak. Instead, their sentence-internal pitch peaks appear at different prosodic positions.

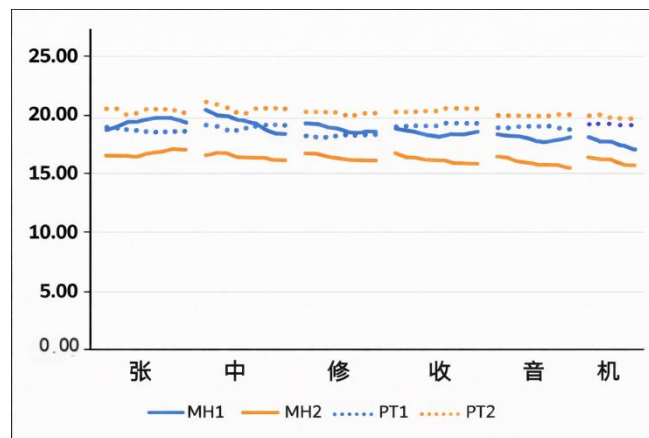
At the prosodic-word level, the sentence-final prosodic word also shows a larger pitch span than the sentence-initial prosodic word for the Malaysian Chinese speakers. For MH1, the spans of the sentence-initial and sentence-final prosodic words are 61% and 90%, respectively; for MH2, they are 39% and 100%, respectively. This suggests that both groups share a tendency toward greater pitch fluctuation in the sentence-final prosodic word. However, compared with the Mainland Chinese speakers, the Malaysian Chinese speakers show more variability in the location of pitch peaks and in sentence-internal pitch movement.

A comparison of the two groups shows that sentence-final lowering is shared by all four speakers, as the lower pitch limit consistently occurs on the final syllable. The main group difference lies in the alignment and stability of pitch peaks. The Mainland Chinese speakers show a consistent sentence-initial peak and relatively similar fluctuation patterns, whereas the Malaysian Chinese speakers show more variable peak locations and less uniform sentence-internal pitch movement. Therefore, the observed difference concerns the internal organization of pitch movement rather than the presence or absence of sentence-final lowering.

### ***Realization of the Four Lexical Tones in Declarative Sentences***

Lexical tones and sentence-level prosody jointly shape pitch organization in connected Mandarin speech. To further examine how lexical tones are realized within declarative sentences, this section compares the in-sentence contour patterns of Tone 1, Tone 2, Tone 3, and Tone 4 produced by the Malaysian Chinese and Mainland Chinese speakers.

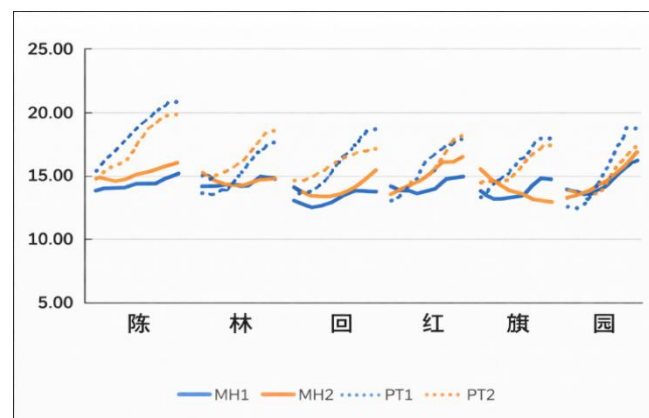
### *Tone 1*



**Figure 3. Tone 1 Contours Across Syllables**

Figure 3 shows the in-sentence realization of Tone 1 across the four speakers. Both groups generally preserve the level contour of Tone 1 in connected declarative sentences. The Mainland Chinese speakers show relatively smooth contours with gradual declination across the sentence, whereas the Malaysian Chinese speakers also maintain the basic level pattern but show more noticeable final lowering in the present data.

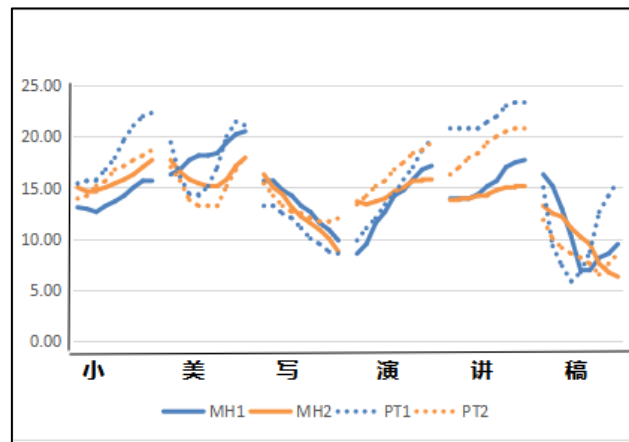
### *Tone 2*



**Figure 4. Tone 2 Contours Across Syllables**

Figure 4 presents the contour patterns of Tone 2. Most relevant syllables retain a rising tendency across the four speakers. However, the rise is less pronounced among the Malaysian Chinese speakers, and MH2 shows a falling tendency on the fifth syllable “旗 /qi/”. This suggests a possible reduction of the Tone 2 rising movement in connected speech within the present sample.

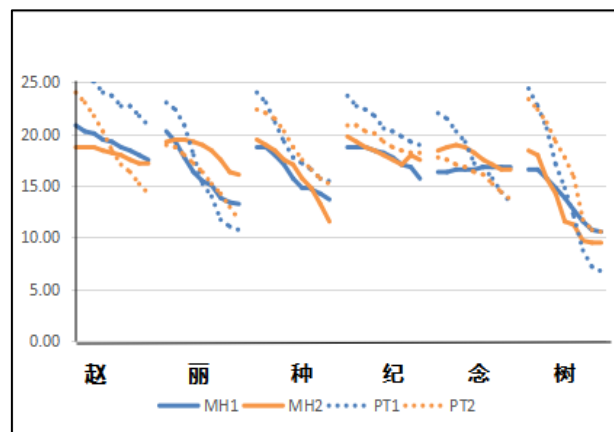
### *Tone 3*



**Figure 5. Tone 3 Contours Across Syllables**

Figure 5 shows the realization of Tone 3. The Mainland Chinese speakers generally preserve the falling-rising characteristic of the relevant syllables. In contrast, MH1 does not show a typical falling-rising contour on the final syllable of the sentence-initial prosodic word, but instead displays a contour closer to a simple rise. This difference appears to be local rather than systematic and should be interpreted cautiously given the limited dataset.

### *Tone 4*



**Figure 6. Tone 4 Contours Across Syllables**

Figure 6 presents the realization of Tone 4. The Mainland Chinese speakers show clear falling contours in the relevant syllables. The Malaysian Chinese speakers, however, display less consistent falling realization in some positions. MH1 shows a contour closer to leveling on one syllable, while MH2 retains a falling tendency but with a smaller degree of fall. These observations suggest local weakening of falling movement rather than a loss of the Tone 4 category.

Overall, the Mainland Chinese speakers display more similar in-sentence realizations across the four tone categories, with contour patterns that generally preserve the expected tonal characteristics. The Malaysian Chinese speakers also broadly maintain the basic contours of

the four lexical tones, but some syllables show reduced pitch movement, local deviation, or a tendency toward leveling. These patterns should not be interpreted as a loss of lexical tone contrasts. Rather, they suggest that, within the present dataset, lexical tone realization in Malaysian Mandarin may be affected by sentence-level prosody, prosodic position, and connected-speech conditions.

## Discussion

The results show that, in the present sample, Mainland Chinese speakers and Malaysian Chinese speakers share certain similarities but also display some differences in the pitch organization of declarative sentences. First, both groups exhibit sentence-final lowering and convergence. The lowest point of the pitch range occurs on the final syllable, and the span of the sentence-final prosodic word is greater than that of the sentence-initial prosodic word in both groups. Together, these patterns suggest that the declarative sentences in the present data show an overall downward movement and progressive closing toward the end of the utterance. This indicates that, although the Malaysian Chinese speakers in this study do not pattern identically with the Mainland Chinese speakers in every detail, they nevertheless retain the basic sentence-final closing pattern of Mandarin declaratives.

Within this shared overall framework, the two groups still differ in the way pitch is organized within the sentence. For the Mainland Chinese speakers, the pitch peak occurs consistently in sentence-initial position, and the overall fluctuation patterns of the two speakers are relatively similar. By contrast, for the Malaysian Chinese speakers, the location of the pitch peak is not consistent and is not always found in sentence-initial position. Their upper and lower limits across the sentence, as well as their fluctuation patterns, are also not entirely identical. This suggests that the main difference between the two groups lies not in whether sentence-final lowering is present, but in how pitch is configured within the sentence.

These differences are also reflected, to some extent, in the realization of lexical tones. The Mainland Chinese speakers show relatively similar in-sentence realizations across the four tone categories, and the syllable-level contour patterns generally preserve the basic characteristics of each lexical tone. By contrast, although the Malaysian Chinese speakers broadly retain the basic characteristics of the four tones, some syllables display reduced rise, insufficient fall, local deviation, or a tendency toward leveling. These patterns are more readily observed in the realization of Tone 2, Tone 3, and Tone 4. This suggests that the realization of lexical tones in sentences may be jointly shaped by sentence-level prosody, prosodic position, and the context of connected speech. In this respect, the present findings are broadly consistent with previous studies showing that linguistic background can affect pitch range and tone realization in Mandarin (Wang et al., 2003; Gao, 2021).

One possible explanation for these differences lies in dialect background and multilingual language contact. The Malaysian Chinese speakers in this study have long been exposed to Chinese dialects, and their realization of Mandarin tones and intonation may therefore be influenced, to some extent, by pre-existing dialect systems. Previous research has suggested that speakers with a Cantonese background may be more likely to diverge from target Mandarin tonal patterns. At the same time, long-term exposure to a multilingual environment in which Mandarin, Malay, and English coexist may also influence sentence-level pitch organization and contribute to individual variation. However, given the limited sample size and narrow scope of the present dataset, these explanations remain tentative. A more cautious interpretation is that

the declarative intonation patterns observed in the Malaysian Chinese speakers should not be treated simply as a one-way deviation from Mainland Mandarin. Rather, they may be viewed as preliminary indications of variation in Mandarin prosodic realization in a multilingual context. Whether such differences can be generalized as more stable localized prosodic features remains to be tested with larger samples and more naturalistic speech data.

## Conclusion

This study compares the pitch organization of Mandarin declarative sentences produced by Malaysian Chinese speakers and Mainland Chinese speakers from three perspectives: sentence pitch range, pitch fluctuation across different prosodic positions, and the in-sentence realization of the four lexical tones. The results show that, in the present sample, both groups share the basic pattern of sentence-final lowering and convergence but differ to some extent in the way pitch is configured within the sentence.

More specifically, the Mainland Chinese speakers show relatively wider sentence pitch ranges, with pitch peaks consistently located in sentence-initial position. By contrast, the Malaysian Chinese speakers in this study show relatively narrower sentence pitch ranges, with pitch peaks occurring at different prosodic positions. At different prosodic positions, both groups display a common tendency for the sentence-final prosodic word to have a larger pitch span than the sentence-initial prosodic word. However, the Mainland Chinese speakers show more similar peak locations and overall fluctuation patterns, whereas the Malaysian Chinese speakers show greater variation in peak alignment, upper-lower limit distribution, and the progression of pitch across the sentence. At the level of lexical tone realization, the Mainland Chinese speakers also show relatively similar contour patterns, while the Malaysian Chinese speakers, although broadly preserving the basic contours of the four tones, show reduced rise, insufficient fall, local deviation, or leveling in some syllables.

Overall, the declarative intonation patterns observed in the Malaysian Chinese speakers should not be interpreted simply as a one-way deviation from Mainland Mandarin. Rather, they may be viewed as preliminary indications of variation in Mandarin prosodic realization in a multilingual environment. Whether such differences can be generalized as relatively stable localized prosodic features remains to be tested with larger samples and more naturalistic speech data.

This study has several limitations. First, the sample size is small, and the dataset is limited in scope, so the findings should be interpreted primarily as preliminary observations. Second, the study examines only declarative sentences, and the data come mainly from controlled reading rather than spontaneous interaction. Future research may expand the sample size, include additional sociolinguistic variables, and incorporate more natural speech data in order to investigate Malaysian Mandarin prosody across different sentence types and pragmatic conditions.

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