

ACOUSTIC INVESTIGATION OF NEUTRAL TONE IN BRUNEI MANDARIN

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ABSTRACT

This study provides an acoustic analysis of the neutral tone in Brunei Mandarin. Recordings were made of a short text by 20 Bruneian (BN) and 20 Beijing Chinese (CN) speakers. F_0 contours and duration of three categories of disyllabic words for the BN and CN data were compared. It was found that the BN data tends to have a neutral tone on grammatical morphemes such as *le* (perfective) and *de* (possessive) but not on the second syllable of other words that would have a neutral tone in Standard Mandarin such as *yīfu* ('clothes') or reduplicates such as *māma* ('mother'). In addition, it was found that the F_0 contour shows a clear distinction between BN and CN for the reduplicated kinship term *māma* ('mother'), but duration is a better indicator of the presence of a neutral tone for the other categories.

Keywords: Neutral tone; Brunei Mandarin; F_0 contour; duration.

1. INTRODUCTION

Mandarin Chinese has a rich system of lexical tones. In addition to the four distinctive tones (high, rising, low, and falling), there is a neutral tone that occurs in various contexts. Appearing in non-initial position preceded by at least one syllable with a full tone, the neutral-toned syllables in Standard Mandarin can be found in three basic categories: 1) grammatical morphemes such as *de* (possessive), *le* (perfective), and *ma* (question particle); 2) the second syllable of some disyllabic words such as *bōli* ('glass') and *yīfu* ('clothes'); 3) the second syllable of reduplicated words such as *mèimei* ('sister') and *xiǎngxiang* ('to think') [3]. Here, we will refer to these three categories as Type 1, Type 2 and Type 3.

It is generally accepted that the pitch contour depends on the preceding syllable [5, 10], as the neutral tone is realized as 'half low' after a high level tone, 'mid' after a rising tone, 'half high' after a low tone, and 'low' after a falling tone [2]. However, the F_0 curve of the neutral tone becomes more complicated and hard to predict when considering focus in sentences and the tonal patterns following it, so the neutral tone has a less predictable F_0 than the four lexical tones. Though F_0 is the primary cue for tonal differ-

ences, other factors such as duration may also be essential to differentiate lexical tones and neutral tones [8, 10], so a range of measurements are needed to fully explain the tonal contrast.

Neutral-toned syllables are always unstressed, relatively short in duration, with reduced vowel quality [10], and their pitch range is narrow [6].

So far, most of the studies concerning neutral tone have focused on Standard Mandarin; other varieties of Mandarin have been mentioned less frequently and the distribution of the neutral tone is less clear than for Standard Mandarin. In Taiwan Mandarin, Huang [7] reports that the neutral tone of Standard Mandarin tends to behave like a lexical tone that it is not shortened or reduced. However, this study just focused on Type 1 syllables and the rest of categories are hardly mentioned.

Brunei Mandarin refers to the variety of Mandarin spoken in Brunei, a small country located on the northern coast of Borneo, where about 11% of the population are ethnically Chinese [4]. Just like other southern varieties of Mandarin such as Taiwan Mandarin and Singapore Mandarin, Brunei Mandarin seems to have relatively infrequent use of the neutral tone.

The current study examines the occurrence of neutral tones and their form in Brunei Mandarin by comparing with them with neutral tones in Standard Mandarin spoken in Beijing. It will look at F_0 patterns and the duration of unstressed syllables that typically have a neutral tone in Standard Mandarin.

2. METHODS

2.1. Subjects

40 tertiary students in Brunei and Beijing were recruited in this study, 10 females and 10 males in each place. At the time of the study, the Brunei speakers had a mean age of 21 years, ranging from 19 to 23 years, while the Beijing speakers had a mean age of 24 years, ranging from 20 to 30 years. Of the 20 Brunei speakers, 12 were from Universiti Brunei Darussalam (UBD), seven were from Institut Teknologi Brunei (ITB), and one was from Kolej IGS Brunei Darussalam (IGS), a private tertiary institution in Brunei. The 20 Beijing students were all from Beijing Language and Culture University (BLCU). Apart from two speakers from Beijing, the 18 others were

from different provinces: Inner Mongolia, Heilongjiang, Jilin, Liaoning, Shandong, Henan, Hebei, Hubei, Guizhou and Zhejiang. They all speak standard Mandarin with little accent from their home dialect. In this study, we will refer to the Brunei speakers as BN and the speakers from China as CN. Specific speakers are referred to using initials plus numbers. For example, 'BF1' refers to 'Brunei female number 1'.

2.2. Data

Recordings were conducted in a quiet office at UBD, ITB and BLCU using a high-quality dynamic microphone positioned a few inches from the mouths of the speakers. Subjects read a passage called *The East Wind and the Sun* (the EWS text; see Appendix). The speech was recorded directly onto a Sony laptop computer at a sampling frequency of 44,100 Hz.

Five disyllabic words were selected from the passage to represent the three categories of neutral tone respectively (see Table 1). All the words were in non-final position. These words are usually considered as carrying neutral tones on the second syllable for the CN speakers, but it is not clear if it is the same for the BN speakers, especially for Types 2 and 3.

Table 1: Experimental materials for neutral tone.

Type	Word	Meaning
1) Grammatical morpheme	<i>láile</i> <i>tāde</i>	'came' 'her'
2) 2 nd syllable of disyllabic word	<i>yīfu</i> <i>běnsi</i>	'clothes' 'skill'
3) 2 nd syllable of reduplicated word	<i>māma</i>	'mother'

If there is no neutral tone on the second syllable of Types 2 and 3 in BN, the three words are *yīfú*, *běnsi*, and *māmā*, with a rising, falling and high tone on the respective second syllables.

2.3. Perceptual judgements

200 tokens of disyllabic words were extracted manually using Praat [1], one token of each word by each speaker. Then these words were listened carefully to repeatedly in order to identify the occurrence or absence of neutral tone.

2.4. F₀ extraction

All the syllables in these five words have a CV structure. Since some of the consonants such as [d] and [f] are obstruents, which have no pitch contours, we only measure the F₀ of the vowels. The F₀ was measured using a Praat script at ten points from the vowel onset

to the end of the visible formant structure. Some tokens with vowel reduction in the CN data were excluded in the plotting of F₀ patterns as there was no clear vowel. Of the excluded tokens, there were one token of *láile*, two tokens of *yīfu* and 12 tokens of *běnsi*. No tokens were excluded from the BN data.

Using R, the mean normalized F₀ contours of the BN and CN were plotted for visual comparison.

2.5. Duration

The duration of each segment was measured using Praat. Bar graphs with length of time were prepared for visual comparison. In addition to investigating the actual duration of the neutral-toned syllables, we will compare the duration ratios between the two syllables of each token for the BN and CN data, as speaking rate affects absolute duration.

3. RESULTS

3.1. Perception

Impressionistically, CN tended to exhibit a neutral tone on the second syllable of all the five words, while BN tended to have a neutral tone on the second syllable of *láile* and *tāde* and full tones on both syllables of *yīfu*, *běnsi* and *māma*. Table 2 shows the detailed results of the perceptual judgments.

Table 2: Perceptual results.

Words	BN		CN	
	neutral	full	neutral	full
<i>láile</i>	18	2	20	0
<i>tāde</i>	17	3	20	0
<i>yīfu</i>	4	16	20	0
<i>běnsi</i>	1	19	16	4
<i>māma</i>	8	12	20	0

Although grammatical morphemes such as *le* and *de* in this study have no tone marking in a Chinese dictionary, two Brunei speakers (BM9 and BM10) showed a relatively long low falling tone for the second syllable of *láile* and *tāde*, and one Brunei speaker (BF5) showed a relatively long high level tone for the second syllable of *tāde*.

Although most BN speakers had a full tone on the second syllable of *māma*, eight had a neutral tone, just like all the CN speakers.

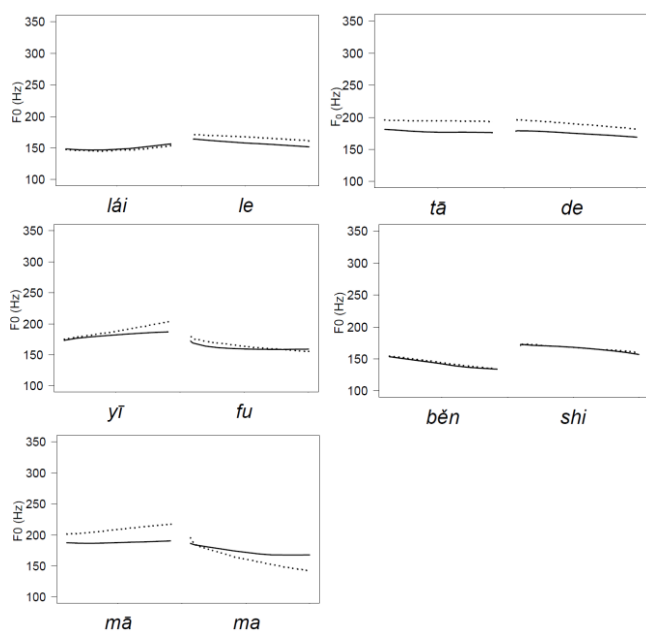
Four CN speakers unexpectedly had a full tone on the second syllable of *běnsi*.

3.1. F₀ contours

The F₀ contours were evaluated to determine the extent to which neutral tone exists in Brunei

Mandarin. Figure 1 shows the averaged F_0 contours of the five words.

Figure 1: F_0 contours of *láile*, *tāde*, *yīfu*, *běnsi* and *māma*. (BN solid line; CN dotted line)



Overall, the F_0 contours for the BN and CB data are rather similar for all words except for *māma*.

For Type 1 tokens (the first row of Figure 1), the F_0 movements of each word are nearly identical, with the only difference being a slightly lower pitch for BN compared to CN in the second syllable of *láile*. In addition, both syllables of *tāde* are on a lower pitch for BN.

For Type 2 (the second row of Figure 1), for *yīfu* there may be some variability in the F_0 trajectories between BN and CN. There is less evidence of a rising F_0 at the end of *yī* for BN, so the contrast between the end of the first vowel and the start of the second in this word seems to be a little smaller for BN. However, the average jump in F_0 between the end of the first vowel and the start of the second vowel in BN is 18.0 Hz, while for CN it is 30.0 Hz, and this difference is not significant ($t=1.39$, $df=36$, ns), so it is not clear if there really is a difference or not.

However, for *běnsi*, the F_0 trajectory is identical for BN and CN. One issue here is that the data of 6 females and 6 males from CN were excluded due to the absence of a F_0 contour for the second syllable of this word. No tokens were excluded for BN, so for these tokens at least, there is a contrast between CN and BN.

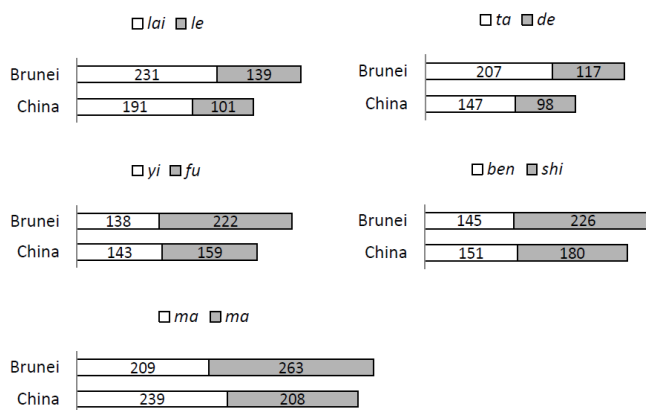
For Type 3 *māma*, there is a clear contrast between the contours. For CN, the first syllable is high, and the second syllable has falling F_0 , but there is less evidence of this contrast in the BN data. For CN, the average fall in F_0 between the end of the first syllable and start of the second syllable is 34.7 Hz, while for

BN there is actually a small rise of 6.6 Hz, and the difference between BN and CN is highly significant ($t=4.96$, $df=38$, $p<0.001$). In addition, for CN there is an average fall in F_0 of 40.9 Hz during the course of the second syllable, while the average fall for BN is just 16.2 Hz, and this difference between BN and CN is significant ($t=3.02$, $df=38$, $p<0.01$).

3.2. Duration

It is generally agreed that the length of a neutral-toned syllable is substantially short [2, 8], often just half as long as a full-toned syllable. However, the results vary with different types of neutral-toned syllables. Figure 2 shows the average duration of the two syllables of the five words in the current study.

Figure 2: Duration of three types of neutral-toned syllable (msec).



It can be seen in Figure 2 that the durations of *le* and *de* are much shorter than their preceding full-toned syllables in both BN and CN. The durations of *fu* and *shi* are longer than their preceding syllables, even for CN in which they were perceived as neutral tones. For *māma*, the second syllable is longer than the first in BN but not in CN, confirming the absence of a neutral tone in this word for most speakers in BN.

The overall duration of all words is longer in BN than CN. To eliminate the influence of speaking rate, the duration ratio of the two syllables can be shown. Table 3 shows the percentage of the duration of the second syllable for BN and CN.

Table 3: Mean duration ratio for the second syllable (standard deviation is shown in brackets).

Word	BN (n=20)	CN (n=20)	t	p
<i>láile</i>	37.0% (4.3%)	34.8% (6.7%)	1.1	ns
<i>tāde</i>	35.6% (4.3%)	40.0% (4.0%)	-3.4	<.05
<i>yīfu</i>	61.2% (5.2%)	52.3% (4.6%)	5.8	<.001
<i>běnsi</i>	61.0% (3.6%)	56.2% (6.8%)	2.8	<.05
<i>māma</i>	55.4% (5.2%)	46.3% (5.5%)	5.3	<.001

For the Type 1 morphemes, the results in Table 3 show that there is no distinction for *láile* between BN and CN, confirming the impressionistic finding that, just like CN, BN usually has a neutral tone on *le*. For *tāde*, there is a marginally significant distinction between BN and CN, but BN actually has relatively shorter *de* than CN. The reason for this distinction between BN and CN for *tāde* seems to be because the first syllable of this word is rather longer in BN than CN (see Figure 2 above). It is not clear why this occurs. Note that the duration of both *le* and *de* is less than 40% of the total duration of the word in BN, and this confirms that grammatical morphemes such as these usually have a neutral tone in BN.

For both Type 2 and Type 3 morphemes, the duration of the second syllable is substantially longer in BN than CN for *yīfu* and *māma*, and marginally longer in *běnsi*. This confirms the impressionistic finding that these syllables have a full tone in BN.

4. DISCUSSION

The present study has investigated the ways in which Brunei speakers pronounce syllables that have a neutral tone in Standard Mandarin. The evidence mainly comes from the duration ratios of the neutral-toned syllables. However, we should acknowledge that data from a read passage is insufficient, and further research is needed to consider the occurrence of neutral tones in conversational data, as well as a wider range of words.

Only one reduplicated term has been investigated: *māma*. Other reduplicated kinship terms may have different patterns. Lin [9, p. 272] suggests that, in Taiwan, kinship terms may have a neutral tone on the second syllable but with a long duration, and she also suggests [p. 273] that terms such as *dìdì* ('young brother') may have a Tone 3 + Tone 2 sequence, especially when addressing children. Further research could investigate whether this sequence ever occurs on kinship terms in Brunei Mandarin. However, the evidence of the current study indicates that only some Brunei speakers have a neutral tone on the second syllable of *māma*.

5. CONCLUSION

In summary, this study has investigated the three types of neutral-toned syllables in Standard Mandarin and found that only Type 1 syllables such as *de* and *le* have a neutral tone in Brunei Mandarin, as Brunei speakers tend to have full lexical tones on Type 2 and Type 3 syllables. In addition, the study suggests that duration is the most important cue for identifying neutral tones, though F_0 contours are also important for the reduplicated kinship term such *māma*.

6. REFERENCES

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Appendix: *The East Wind and the Sun* (EWS) text. The investigated words are underlined.

东风和太阳

一天中午，白云听见东风和太阳在那儿你争我吵，都说自己的本事大。这时，从森林的草地里来了一个老公公，一个妈妈和她的女儿，还有一个小王子，全身都穿着破旧的衣服。于是，白云说，只要谁能让这四个人把衣服脱下，就算谁的本事大。然后，东风就张开口，使劲儿地吹。但是，它刮得越用力，他们四个就把衣服拉得更紧。最后，东风累了，也没什么办法了。一会儿，轮到太阳了，他们一看见阳光，热得快快把衣服脱了下来。所以，东风不得不同意，还是太阳比较强。