Production of Mandarin Tones by Non-native Language Learners

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ABSTRACT

This study examined how non-native language learners of Mandarin language produce the four conventional Mandarin tones. Speech samples were collected from 13 volunteer participants reading a list of 11 disyllabic Mandarin words. Based on the audio recording and pitch curves created with the acoustic software *Praat*, the tones produced by the participants were analyzed and tabulated to explore the accuracy of the tones produced. Participants' perceptions on the most difficult Mandarin tones were explored through a structured interview conducted after the recording. Based on the analysis of the oral data, this study confirmed the difficulty of Tone 3 production among the learners. The fact that Tone 3 was perceived by the participants as the most difficult Mandarin tone, has further consolidated the finding from the oral data. It was interesting though to note that Tone 2 and Tone 4 were produced the most among the four tones, owing to the fact that these are the most familiar tones for the participants as they bear strong similarities with the sounds in their first language. As such, the results signify the effect of L1 interference. The fact that these participants are speakers whose native language is non-tonal might have contributed to their lack of sensitivity to tonal categories in Mandarin language.

INTRODUCTION

An abundance of research on Mandarin language learning conducted among non-native Mandarin speakers [1-3] has confirmed the difficulty of learning lexical tones, as far as the acquisition of Mandarin Chinese is concerned, which explains why tone production is one of the most researched variables in the field. As Mandarin is a tonal language, when it comes to preparing the learners to communicate sufficiently in the target language, producing correct Mandarin tones is of crucial importance. A mispronounced lexical tone, particularly in a connected speech might affect the delivery of the intended message. This is because each Mandarin tone has its own distinguishable lexical meaning and thus it is difficult for Mandarin speakers to tolerate a tone which is mistakenly pronounced.

Unfortunately, for beginners, producing correct Mandarin tones is in itself a very challenging task, even at the word level. The challenge of teaching non-native Mandarin learners is thus made obvious, particularly in tonal production. While a great deal of research has been conducted on non-native Mandarin learners, such as native English speakers [3, 4] to explore the difficulty of acquiring Mandarin tones, research conducted on Malay Mandarin learners remains relatively scarce, owing to the fact that in a multilingual society, the speech community tends to resort to their shared languages whenever there is a need to

communicate while Mandarin, which is more often than not, a third or a fourth language for the particular speech community, will not be chosen as the preferred language choice, even when communicating with Mandarin native speakers. Thus, as Mandarin is not an important means of communication for the target community, exploration into its acquisition among the learners does not receive the proper attention from the researchers in the field.

However, though Mandarin is rarely used as a means of communication for the target community, it does not mean that we can overlook the importance of Mandarin tone acquisition. In order for the particular group of learners to function adequately in the target language, there is a need for them to learn as how to produce the correct Mandarin tones. Furthermore, with a non-tonal first language, it is possible to foresee the problems which might be faced by these learners when they first approach Mandarin tones.

As such, this study attempts to explore non-native Mandarin learners' tonal production at the word level. The specific objectives of the study were:
• to identify the accuracy rate of the production of Mandarin tones among non-native Mandarin learners
 • to describe Mandarin tonal production among non-native Mandarin learners

The results of this study will provide insights into the difficulties faced by non-native Mandarin learners when it comes to tonal production. As for pedagogical significance, the educators can better understand the problems faced by non-native Mandarin learners and hence devise more useful activities to facilitate the acquisition of Mandarin tones among non-native Mandarin learners so as to improve their speech communication accordingly.

Difficulties in Tonal Production among Non-native Mandarin Learners

Studies conducted on tonal acquisition among non-native Mandarin learners have concluded that Tone 2 and Tone 3 are significantly more difficult than Tone 1 and Tone 4 for the target learners [5, 6]. Similarly, in Guo and Tao's study [3], the non-native Mandarin learners were found to produce Tone 1 and Tone 4 with the greatest accuracy while Tone 3 was produced with the least accuracy, although the production of Tone 3 was significantly more frequent than the other three tones.

Tonal error analyses conducted thus far have unearthed First Language (L1) interference [7] as one of the main causes of Mandarin tonal misproduction. When the first language and the target language do not share the same mechanism of stress, the non-native speakers might adhere to the mechanism of stress in their first language when they produce Mandarin tones. Besides, the inability of non-native speakers to differentiate the Mandarin tones is also one of the factors contributing to the difficulties in tonal production as it was revealed that most of the non-native speakers were confused with the distinction between Tone 2 and Tone 3 [8].

In exploring factors affecting Second Language (L2) acquisition on suprasegmental level, such as the pitch and tones, issue concerning L2 linguistic experience is also one of the highlights. Among which, a lack of communication with native speakers as well as the absence of a long-time exposure to the target language [9] were identified as factors affecting learners' language performance.

Mandarin Tones and Tonal Phonology

Mandarin is a tonal language which consists of four main tones, i.e Tone 1, Tone 2, Tone 3 and Tone 4. Each tone is distinguishable acoustically (refer to *Figure 1*). In fact, each Mandarin tone is characterized by different pitch levels and contours. There are two primary acoustic parameters, namely, pitch height and pitch movement [10, 11].

Tone 1 is characterized by its high and level pitch. Tone 2 has a rising pitch. It starts with a mid-pitch and then rises to a high pitch. The shift in pitch is noticeable at 0.4 second. Tone 3 is recognized by a dipping contour. It starts with a falling pitch and at 0.35 second, there is a shift in pitch whereby a rising pitch is noted. Tone 4 is a short, sharply falling tone. It starts with a high pitch and falls sharply within 0.4 second.

Figure 1 shows the pitch contour of all the four Mandarin tones explored in this study. Each tone has its own distinctive shape, characterized by different internal pattern of rising and falling pitch, which is also known as contour.
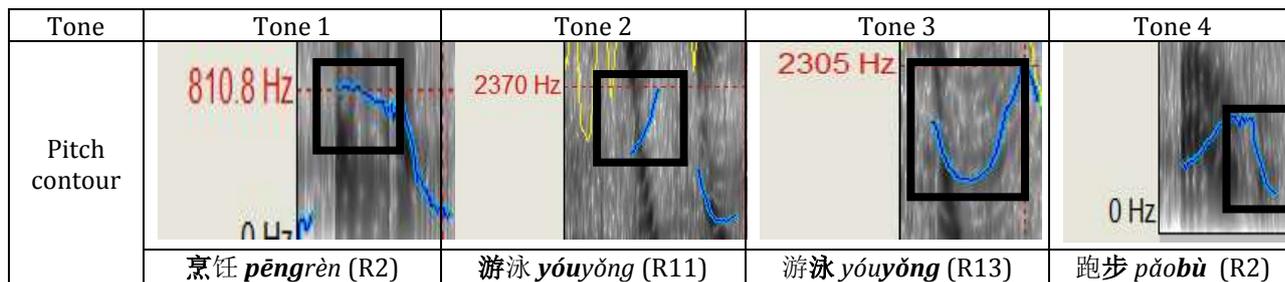
Tone	Tone 1	Tone 2	Tone 3	Tone 4
Pitch contour				
	烹饪 *pēngrèn* (R2)	游泳 *yóuyǒng* (R11)	游泳 *yóuyǒng* (R13)	跑步 *pǎobù* (R2)

FIGURE 1. Pitch contour of the four Mandarin tones extracted from the speech samples

Participants

The participants, aged between 18 and 19 years, were 13 Malaysian Mandarin learners whose native language is Malay language. They were in their second semester of Mandarin Course and have been learning Mandarin in formal contexts for a period of more than 6 months. Only volunteer participants were involved in this study as the data collection requires the participants to audio-record their speech production. Thus, participants need to have a certain level of self-confidence to have agreed to participate in this study.

DATA COLLECTION AND ANALYSIS

Speech samples were collected from 13 volunteer participants reading a list of 11 disyllabic Mandarin words (see *Table 2*). Besides, all the participants were also interviewed to find out their perceptions on the most difficult Mandarin tone. All the data were collected during the June session, academic year of 2014.

In considering that the participants in this study are only beginners who do not have much exposure to the target language, only the common Mandarin tone combinations were chosen, to the exclusion of tone sandhi. Tone sandhi is characterized by the three sandhi rules [10] which suggest that there is a need to address the changes of the tone in the following tone combinations, which are T3-T3, T1-T2-T2 and T1/ T2/ T3/ T4- T0, in which T0 denotes a neutral tone in Mandarin language.

Mandarin words which were chosen carefully from the chapters covered in the Mandarin classes served as the target words. Thus, basically these words are familiar vocabulary items for the participants. These words were then presented to the participants with their respective phonetic conventions. All the recorded audio files were then transferred to a computer. Since the mandarin tones can be distinguished acoustically, a speech data analysis was carried out using speech analysis software (*Praat*) to further characterize the Mandarin tones.

Based on the audio recording and tone contour, the tones produced by the participants were identified and categorized into four traditional tonal categories, which are Tone 1, Tone 2, Tone 3 and Tone 4. A total of 286 speech samples (22 syllables x 13 participants) were collected and analyzed for the accuracy of the tone production. The analysis of the acoustic representation of Mandarin tones is based on Tone Nucleus Model [12, 13], owing to the fact that acoustic features are context-dependent. For instance, voice/voiceless initials, word boundary and prosodic features, such as stress will result in contour variations. Tone Nucleus Model posits that the contour of a tone can be divided into three main parts, namely, onset course, tone nucleus and offset course. The main pitch tone lies in the tone nucleus of a tone, which is the middle part of a tone pattern. Onset course and offset course are optional due to the fact that they are easily influenced by the contexts. According to Tone Nucleus Model, the confusion caused by intra-speaker variations can be avoided by eliminating the onset course and offset course of a tone. Thus, to ease the process of categorizing the tones produced, the syllable boundary was first identified before a tone was categorized into their respective tonal category. As for the data gathered from interviews, responses were transcribed and qualitatively analyzed.

FINDINGS AND DISCUSSION

The Pronounced Mandarin Tones and Their Accuracy Rate
From *Table 1*, the order of accuracy rate of the four Mandarin tones is displayed as follows: Tone 1 (44.6%), Tone 4 (43.6%), Tone 2 (43.1%) and Tone 3 (19.2%). In general, non-native Malay Mandarin learners have difficulties with all the four Mandarin tones, but Tone 3 was particularly difficult for them, echoing the findings from previous studies [3, 5, 6]. The results have confirmed the difficulty of Tone 3 production among the non-native speakers as the accuracy rate was as low as 19.2%, which was significantly lower than the accuracy rate of the other three Mandarin Tones. This is in line with the findings from the interview as majority of the participants (53.8%) reported that Tone 3 has posed the most difficulties for them. Meanwhile, Tone 1, which has been produced with the greatest accuracy, was reported as the least difficult Mandarin tone by the participants (7.7%). The findings from structured interview have thus further consolidated the analysis of speech samples.

TABLE 1. Pronounced Mandarin tones and their accuracy rate

Mandarin tones	Tone 1	Tone 2	Tone 3	Tone 4
Total no. of syllables given	65	65	78	78
Total no. of syllables pronounced	75	97	37	77
No. of syllables which are pronounced correctly	29	28	15	34
Accuracy rate (%)	44.6	43.1	19.2	43.6

Inability to differentiate the tones has been reported by the participants as the main factor leading to the difficulties. The factors highlighted by Højen [9], which are the lack of communication with native speakers and the absence of a long-time exposure to the target language can be used to explain the confusion among the learners, owing to the fact that this group of learners does not have rich exposure to the target language as real communication with native speakers does not take place. Outside of the language classroom, the participants could barely have the opportunities to speak the target language.

An example of Tone 1 contour is demonstrated in *Figure 2*. Theoretically, a high and level pitch is expected for the realization of Tone 1. However, from *Figure 2*, it was observed that Tone 1 was generally produced with a lower tone. Although the pitch contour does not differ much from the typical Mandarin Tone 1 as it was almost flat as well, its height was somehow beyond expectation as it was relatively lower in comparison with other Mandarin tones produced. Interpersonal variation is not the issue here as the comparison was made with the tones produced by the same speaker. However, pitch height alone might not result in miscommunication. It is the different tonal categories which will result in misunderstanding as different meaning is carried by different Mandarin tone. As demonstrated in Figure 2, the intended meaning has been altered or mispresented when 检查 *jiǎnchá was mispronounced as* 煎茶*jiānchá* (R12). Therefore, this example has further reinforced the importance of Mandarin tone acquisition.
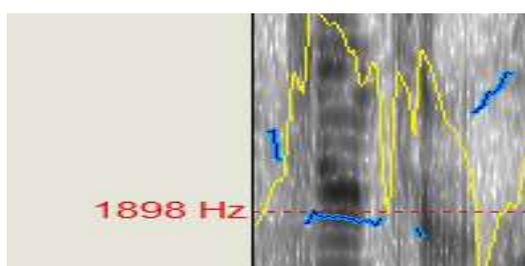

FIGURE 2. The pitch contour of 煎茶*jiānchá* (R12)

The Most Frequently Produced Mandarin Tones
The fact that Tone 2 (97 syllables), Tone 4 (77 syllables) and Tone 1 (75 syllables) were produced relatively frequent in comparison with Tone 3 (37 syllables) has also signified the effects of L1 interference (refer to *Table 1*). As these tones are the basic tones that the participants can associate with their first language, the participants displayed a preference of transforming Tone 3 to these tones.

A closer look at the similarities of both languages might help to explain why the produced Mandarin tones vary as discussed. For Malay words with two syllables, eg, *buku, mahir, dia* etc., the two basic tones are a rising and a falling tone, which correspond to Tone 2 and Tone 4 in Mandarin language. Malay is a non-tonal language because tone is not used to distinguish the meaning of each syllable. As such, the word

buku can be pronounced as *[bú kù]*, or in a questioning tone, *[bū kū?]*. In the former, the sounds correspond to Tone 2 and Tone 4 in Mandarin Language while in the latter; the sounds correspond to Tone 1 in Mandarin language.

However, Tone 3 which consists of both a falling and a rising tone is rarely seen in Malay language. Hence, the participants might face difficulties in producing the tone and therefore, Tone 3 acquisition is adversely affected among the learners.

Furthermore, unlike English, Malay language is syllable-timed in which each syllable is perceived as having the same length and loudness, regardless whether it is a stressed or an unstressed syllable. Word-stress in Malay language is insignificant [14] compared to stress-timed language, like English. This could have caused the learners to develop a lack of sensitivity to tonal changes when it comes to Mandarin language.

As a conclusion, L1 interference [7] could be the reason accounting for the tonal misproduction. As the learners have a non-tonal language as their first language, they might have attached less importance to the contour dimension of Mandarin language, overlooking the fact that Mandarin is a tonal language, in which each tone is distinguishable by different pitch level and contour.

Tone 3 Changing Rule

However, an interesting finding lies in the discovery of Half Third Tones in the speech samples. A closer look at the tone contour that carries Tone 3 has revealed the absence of the dipping contour, which consists of both a falling and a rising pitch. In fact, tones which were produced by the participants were found to constitute only the falling pitch. As demonstrated in *Figure 3*, Tone 3 as in 跑 (*pǎo) [R10]* and 泳 *yǒng [R4]* were both produced without the obvious rising tone. This finding, however, is encouraging as it signifies that the participants were able to adhere to the changing rules of Mandarin Tones because in reality, Tone 3 is rarely pronounced in full, particularly in spontaneous speech.
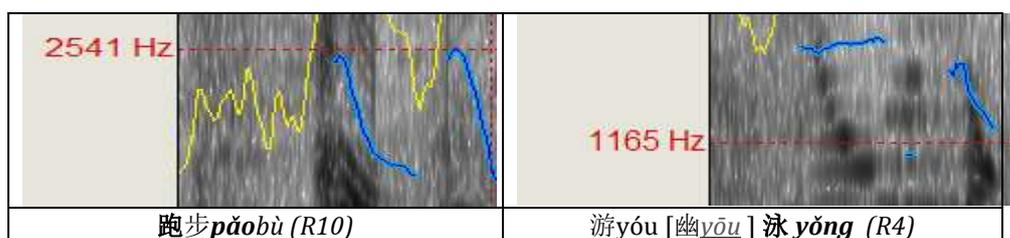

| 跑步***pǎo**bù (R10)* | 游yóu [幽*yōu*] 泳 ***yǒng*** *(R4)* |

FIGURE 3. Half Third Tones (跑 *pǎo,* 泳 *yǒng)*

Identical Tone-combination Patterns

Another interesting finding lies in the identical tone-combination patterns found in the speech samples. From *Table 2*, it was observed that most of the participants (84.6%) have frequently pronounced Mandarin tones in similar ways. In other words, the participants have somehow devised a systematic mechanism in producing Mandarin tones. In particular, at least five (5) identical tone combination patterns were found in the speech samples produced by each participant regardless of the intended tone combinations, suggesting the fact that there was a lack of sensitivity towards the different tonal categories in Mandarin Language.

Table 2. The tone-combination patterns of the pronounced Mandarin tones

Word		Hanyu Pinyin	Tones	Participants												
				R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13
W1	跑步	*pǎobù*	3-4	2-4	2-4	2-1	2-3	1-4	1-2	2-2	2-4	3-1	3-4	2-4	4-4	2-4
W2	烹饪	*pēngrèn*	1-4	2-4	1-4	1-2	2-3	1-4	2-1	1-2	2-4	3-1	1-2	1-2	1-4	1-2
W3	逛街	*guàngjiē*	4-1	4-1	1-2	4-2	2-4	1-4	1-1	1-2	2-4	3-1	4-4	2-2	4-4	2-4
W4	**出席**	*chūxí*	1-2	4-3	1-2	1-2	1-4	1-4	1-2	1-2	2-4	3-1	3-4	1-2	4-4	1-2
W5	天桥	*tiānqiáo*	1-2	2-4	1-2	1-2	2-3	2-4	2-1	1-2	2-4	3-1	1-3	2-2	4-3	3-3
W6	检查	*jiǎnchá*	3-2	2-3	1-2	1-2	2-2	1-4	2-1	1-2	2-4	3-1	3-4	2-2	1-2	2-3
W7	游泳	*yóuyǒng*	2-3	2-4	1-2	2-4	1-3	1-4	1-2	1-2	2-4	3-1	2-3	2-3	2-3	2-3
W8	打球	*dǎqiú*	3-2	3-4	4-4	1-2	2-3	1-4	1-2	2-2	2-4	3-1	4-4	2-2	4-2	2-4
W9	**稍等**	*shāoděng*	1-3	1-4	1-4	2-4	1-4	1-4	1-2	1-2	2-4	3-1	3-4	2-2	4-2	2-3
W10	对面	*duìmiàn*	4-4	4-4	4-4	4-2	1-4	1-4	1-2	1-2	2-4	1-1	1-3	2-2	4-4	1-3
W11	转告	*zhuǎngào*	3-4	2-4	1-4	1-2	1-4	1-4	3-1	1-2	2-4	3-1	3-4	2-2	4-4	2-3

Since the participants in this study are only beginners who have gained limited language input from the formal Mandarin classes and for a short period of time, the lack of sensitivity towards the different tonal categories of Mandarin Language might stem from their wrong perceptions on how various phonetic features characterizing Mandarin tones are produced. As reported by Yang and Ankenmann [15], there is a close relationship between tone perception and production as the production of Mandarin tones depends primarily on how the speakers read the phonetic conventions. Besides, there is also a possibility of perceptual category crossover as some of the Mandarin tones have shared attributes. With the absence of real practice with native speakers [9], these difficulties were made obvious for the particular group of learners.

In addition, the fact that this particular group of Mandarin learners are far beyond the critical period for tone acquisition has also helped to explain why they found it hard to acquire Mandarin tones. As indicated by Burnham [16], tone acquisition is more difficult for adults compared to children. The plasticity of the adult human brain in the acquisition of Mandarin tone [17] also suggests why non-native Mandarin speakers tend to have difficulties with Mandarin tones. As most of the participants reported that they have difficulties differentiating the Mandarin tones, it is thus fair to conclude that the Mandarin tones could have been mispronounced due to their lack of sensitivity towards the different tonal categories as well as the phonetic features in Mandarin Language.

CONCLUSION

In concluding, this paper has discussed how non-native Mandarin learners produced the four Mandarin tones when reading a list of disyllabic Mandarin words. Obviously, Mandarin tones have presented great difficulties for the participants in this study. Among which, L1 interference and the lack of sensitivity towards the different tonal categories in Mandarin Language are believed to be the influential factors shaping the phenomenon. However, since it was revealed that the most problematic tone was Tone 3 which the learners were most unfamiliar with due to the absence of that particular tone in their first language, more oral practice, focusing on Tone 3 should be done. Reading materials in Mandarin, particularly the simple texts with phonetic conventions, which are viewed as an important means through which the beginners can be led to familiarize themselves with phonetic conventions in Mandarin, should be introduced in Mandarin classes. Besides, as Chun, Jiang and Avila [1] reported that speech analysis software (Praat) can be used to help the Mandarin language learners to improve their tone production, it is thus advisable for Mandarin teachers to incorporate the use of the speech analysis software in their teaching of Mandarin tones, particularly among the non-native language learners.

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