Effects of different teaching methods on the production of Mandarin tone 3 by English speaking learners

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This study compared the effectiveness of two teaching methods on the production of Mandarin Tone 3 by English-speaking students. The control group (n=12) received pitch direction-focused instruction in which Tone 3 was introduced as a falling-rising contour tone while the experimental group (n=12) received pitch height-focused instruction in which Tone 3 was introduced as a low level tone. The ability to produce this tone in monosyllabic words, disyllabic words and sentences was assessed after 1 month, 2 months, and 3 months of instruction. The results showed that the pitch height-focused teaching method improved Tone 3 production in connected tonal environments at the sentence level, whereas the pitch direction-focused teaching method was more effective in training students to produce this tone in isolation. More importantly, unlike the pitch direction-focused method, the effectiveness of the pitch height-focused teaching method generalized to new words. It helped L2 learners to develop a self-learning skill for pronouncing unfamiliar words.

Keywords: Chinese tones, production, teaching methods

1. Introduction

Mandarin Chinese is a tonal language. It uses four tones to differentiate lexical meaning. Therefore, mispronouncing the tones is not just a matter of having an accent; it changes the meaning of the words and could cause misunderstanding during communication. A few studies conducted to examine the production of Mandarin Chinese tones by American students found that American students have difficulty pronouncing Mandarin tones accurately (e.g., Chen 1997; He 2014; Miracle 1989; Shen 1989; Wang 2003; Yang 2016; Zhang 2014). For the purpose of improving tone

perception and/or production accuracy, various types of teaching/training methods have been proposed and tested. Perceptual training in a laboratory setting, which asks students to listen to audio recordings of target tones and then identify and/ or discriminate between the tones has been shown to improve perception and/or production of isolated tones by American learners (Wang et al. 2003, Wayland & Li 2008). In addition, audio-visual training in which a visual display of pitch contours of the Mandarin tones was simultaneously presented with audio playback has been shown to improve trainees' tonal production accuracy in connected speech (Wang 2012). Recently, several researchers (Yang 2016; Wen & Yan 2015; Zhang 2014) argued that the teaching method in which Tone 3 is introduced as a falling-rising tone in a classroom setting may have been responsible for production errors of Tone 3 in coarticulated tonal environments in disyllabic words or in sentences, and proposed an alternative teaching method with Tone 3 being introduced to students as a low tone. However, empirical evidence attesting to the effectiveness of this novel pedagogical method on Tone 3 production accuracy among English-speaking learners in a classroom setting is currently lacking. This pioneering study aimed to fill this research gap. It compared and contrasted the efficacy of two teaching methods on Tone 3 production accuracy in monosyllables, disyllables, and sentences. In one method, students' attention was drawn to Tone 3's pitch contour, whereas the other method stressed its pitch height characteristics.

1.1 Phonological and phonetic features of Tone 3 and its description in textbooks

Isolated Tone 3 is described as a low dipping tone (falling-rising) with pitch values of 214 according to Chao's tone letters, where 1 represents the speaker's lowest pitch range and 5, the highest (Chao 1930). However, the pitch contour of Tone 3 undergoes changes conditioned by neighboring tones, a phenomenon known as tone sandhi. There are two sandhi patterns involving Tone 3. In a phrase or a sentence-medial position, its full pitch contour [214] is truncated to a half Tone 3 with a falling pitch contour [21], but changes to a rising tone [35] or Tone 2 before another Tone 3 (Duanmu 2000). Interestingly, Zhang and Lai (2010) found that Mandarin speakers produced Tone 3+Tone 3 disyllabic non-words less accurately than disyllabic containing Tone 3 and any other tones, suggesting that, due to its stronger phonetic basis, the 214→21 sandhi rule is more accurately applied than the 214→35 rule. Recently, Shi and Ran (2011) argued that the underlying representation of Tone 3 is a low level tone [11] and that the surface falling [21] and falling-rising [214] tones are both allophones of Tone 3. They claimed that the initial pitch value of 2 in the 214 contour represents an on-glide due to physiological adjustment whereas the ending pitch value of 4 is a boundary off-glide.

In comparison to Tone 2 which also has a falling-rising pitch shape despite being transcribed as a rising [35] tone, Tone 3 has a lower onset, a lower offset, a lower and later turning point (Xu 1997) and a larger decrease in fundamental frequency (F0) from the onset of the tone to the turning point (Moore & Jongman 1997).

In the three most popular Chinese textbooks, Integrated Chinese (Liu et al. 2010), New Practical Chinese Reader (Liu 2010) and Chinese Link (Wu et al. 2011), used in North America for novice learners to study beginning Chinese, Tone 3 is introduced as a tone with a pitch value of 214 as illustrated in Figure 1 below.
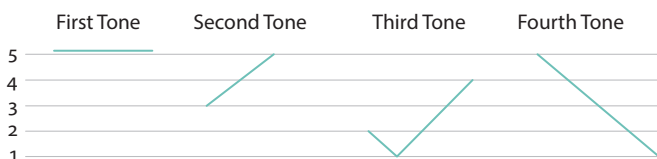

Figure 1. Diagrammed lexical tones in the textbook *Integrated Chinese*, Level 1 Part 1; page 8

In these textbooks, Tone 3 exhibits an early turning point with a longer rising portion than the falling portion (shown in Figure 1 above). Xu (1997), on the other hand, describes Tone 3 with a turning point in the middle of the tonal duration. Despite a note made in the textbooks to indicate that Tone 3 is produced as a half tone [21] in connected speech, the visual representation of the full pitch shape shown in the textbooks gives students the impression that the rising portion is the most salient feature of this tone and, therefore, needs to be fully produced. In addition, the high offset pitch value [4] of Tone 3 as displayed in Figure 1 obscures its main characteristic as a low register tone.

1.2 The studies on the production of Tone 3 by L2 learners and the implications for teaching pedagogy

A few studies found that Tone 3 is often mispronounced by English speaking learners as Tone 2 both in isolation (Wang 2003) and in coarticulated tonal environments where tones are produced in connected discourse (Chen 1997; He 2013; Miracle 1989; Shen 1989; Wen & Yan 2015; Yang 2016; Zhang 2014). As described earlier, in isolation, both Tone 2 and Tone 3 are similar in their overall pitch shape, namely falling-rising contour. However, the rising portion of the tone is always maintained in the production of Tone 2, but it is truncated in connected speech for Tone 3. Therefore, the mispronunciation of Tone 3 as Tone 2 in connected speech might have stemmed from explicit instruction that emphasizes the rising portion of the Tone 3 as shown in the textbooks. It was also found by Zhang (2014) and

Yang (2016) that American learners often produce Tone 3 as the full Tone 3, rather than the half Tone 3 according to the tonal sandhi rule discussed above. Based on the analysis of errors of Tone 3 in previous studies, "a low tone" teaching method, where the pitch shape at the onset portion of the tone is highlighted, was proposed to facilitate acquisition of Tone 3 in coarticulated tonal environments (Yang 2016; Wen & Yan 2015; Zhang 2014).

1.3 Research question

Previous studies have reported that English speakers often mispronounce Mandarin Tone 3 as Tone 2. A teaching method that emphasizes the pitch shape of citation Tone 3, particularly its rising portion, may be responsible for this production difficulty. This description of Tone 3 fails to capture variations of its contour in isolation and in the coarticulatory context of connected speech. Agreeing with Yang (2016), Wen and Yan (2015), and Zhang (2014) that the traditional teaching method may have contributed to production errors of Tone 3 among learners, we decided to compare an alternative teaching approach, in which Tone 3 is described as a low tone, to the traditional, citation method which emphasizes the falling-rising shape of its pitch contour. Our research question is: How do different phonetic representations of Tone 3 used in the classroom teaching affect its acquisition by English speaking learners?

2. Methodology

2.1 Participants

Twenty-four students participated in the study. All were taking a three-credit beginning Chinese course at a major public university in Canada. The twelve students in the experimental group (EG) received pronunciation training with an explicit description of Tone 3 as a low level tone, whereas the 12 students in the control group (CG) received pronunciation training with Tone 3 being described as a falling-rising tone as shown in the textbook *Integrated Chinese*.

Only students who had no prior background in learning Chinese (fewer than 50 hours) were placed into this very introductory level class. They were in a non-heritage track as they grew up in a non-Chinese-speaking environment, and their parents did not speak Chinese or any other dialect of Chinese.

2.2 Instructor

One experienced female instructor who is a native speaker from China taught both groups.

2.3 Instruction

Two different instructional methods, namely the pitch direction-focused method and the pitch-height-focused method were designed and implemented. The control group received the pitch-direction method of instruction whereas the experimental group received the pitch height-focused instruction.

In the pitch direction-focused method, Tone 3 was introduced to learners as a falling-rising contour tone as illustrated in Table 1 and Figure 2. Whenever a word with Tone 3 was mispronounced as a different tone, the students were instructed to think about its citation contour. The instructor drew the falling-rising pitch shape in the air and modeled the pronunciation of the word again.

In the pitch height-focused teaching method, Tone 3 was described as having a low-level pitch shape, where the pitch starts at the speaker's lowest pitch range and remains low throughout the syllable as shown in Table 2 and Figure 3. In other words, the students were explicitly taught to focus on Tone 3's pitch height rather than its pitch contour. When an error was made, the students' attention was drawn to pitch height and reinforced by the teacher's modeled pronunciation accompanied by a low-level hand gesture.

Table 1. Description of Tone 3 in pitch direction-focused method

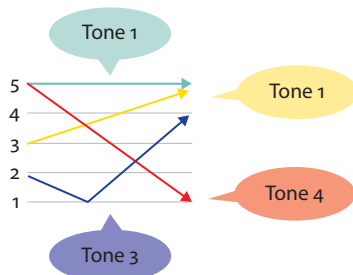| Tones	Mks	Descriptions	Examples
Tone 1	ā	Flat and high	mā 妈 (mother)
Tone 2	á	Low to high	má 麻 (hemp)
Tone 3	ǎ	**Falling and rising**	mǎ 马 (horse)
Tone 4	à	Go all the way down	mà 骂 (to scold)

Figure 2. Visualized Tone 3 in pitch direction-focused method

Table 2. Description of Tone 3 in pitch height-focused method

Tones	Mks	Descriptions	Examples
Tone 1	ā	Flat and high	mā 妈 (mother)
Tone 2	á	Low to high	má 麻 (hemp)
Tone 3	ǎ	**Low (start low and keep low)**	mǎ 马 (horse)
Tone 4	à	Go all the way down	mà 骂 (to scold)
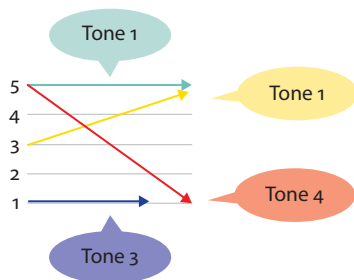
Figure 3. Visualized Tone 3 in pitch height-focused method

2.4 Test stimuli

Students in both groups were administered 3 tone production tests throughout the semester: 1 month, 2 months, and 3 months after instruction.

A total of 33 stimuli were used in each test (See the Appendix). Of these, 15 were monosyllabic words, 12, disyllabic words, and 6, sentences. For the 15 monosyllabic words, 6 were tested words and 9 were fillers. Among the 6 tested words, 3 were learned words and the other 3 were new words. Among the 12 disyllabic words, 6 were learned and the remaining 6 were new; and half were produced with Tone 3 on the first syllable with Tones 1, 2, and 4 on the second syllables, whereas the other half were produced with Tone 3 on the second syllable and Tones 1, 2, and 4 on the first syllable. For the 6 sentence stimuli, 3 were learned and the other 3 new, and the target words carrying Tone 3 were placed at the beginning, middle, and final positions of the sentence respectively.

2.5 Test

Stimuli were provided in pinyin and in Chinese characters. All participants were asked to read each stimulus twice and their second production was used for analysis. The production tests were assigned as part of their oral homework or part of their midterm/final oral examination.

2.6 Judges

Two native speakers of Mandarin who were Chinese language instructors tran-scribed the tones produced by participants based on their perception. Answer sheets were provided. The stimuli were printed with no tonal diacritics. Judges were requested to put down a tonal diacritic according to the tone they heard (Wang 2003). The production of Tone 3 was identified as correct pronunciation if it was categorically correct. If the two judges did not reach an agreement on a stimulus, a third judge was brought in to transcribe the tone of the stimulus and the judgment of the majority would rule. Accuracy rates were calculated and sub-mitted to further statistical analyses.

3.   Results

A four-way mixed-design ANOVA was conducted to analyze the differences be-tween the two groups' production accuracy rates. The Group (experimental and control) served as the between-subject factor, while the Tonal Environment (mono-syllabic words, disyllabic words, sentences), Lexical Context (learned words, new words), and Test (Test 1 after one month of instruction, Test 2 after two months of instruction, Test 3 after three months of instruction) were within-subject factors.

The analysis yielded non-significant main effects of Group [$F(1,12)=0.010$, $p=0.923$] and Tonal Environment [$F(2,24)=0.133$, $p=0.876$] indicating that nei-ther group performed significantly better than the other in general and there was no significant difference in accuracy rates among the three tonal environments. In contrast, a significant main effect was found for Lexical Context [$F(1,24)=11.445$, $p=0.003$] and Test [$F(2,24)=4.666$, $p=0.014$]. For Lexical Context, the follow-up t-test revealed, not surprisingly, that learners were significantly more accurate in producing Tone 3 in learned words (90.2%) than in new words (83.4%) ($p=0.000$). Post-hoc pair-wise comparisons (Bonferroni adjusted, $p<.05$) indicated that stu-dents' production accuracy significantly improved after 3 months of instruction in comparison to the first 2 months (Test 3, 90.3% vs. Test 1, 84.1% vs. Test 2, 85.9%).

More interestingly, a marginally significant Tonal Environment × Group inter-action (F (2, 21) $=3.144$, $p=0.064$) was found, and follow-up t-tests showed that, for monosyllabic words, the control group was more accurate than the experimen-tal group (92.1% vs. 82.8%) ($p=.000$). For disyllabic words, there was no signifi-cant difference between the two groups (84.5% vs 85.1%) ($p=.611$). For sentences, learners in the experimental group were significantly more accurate than learners in the control group (89.8% vs. 82.4%) ($p=.003$).
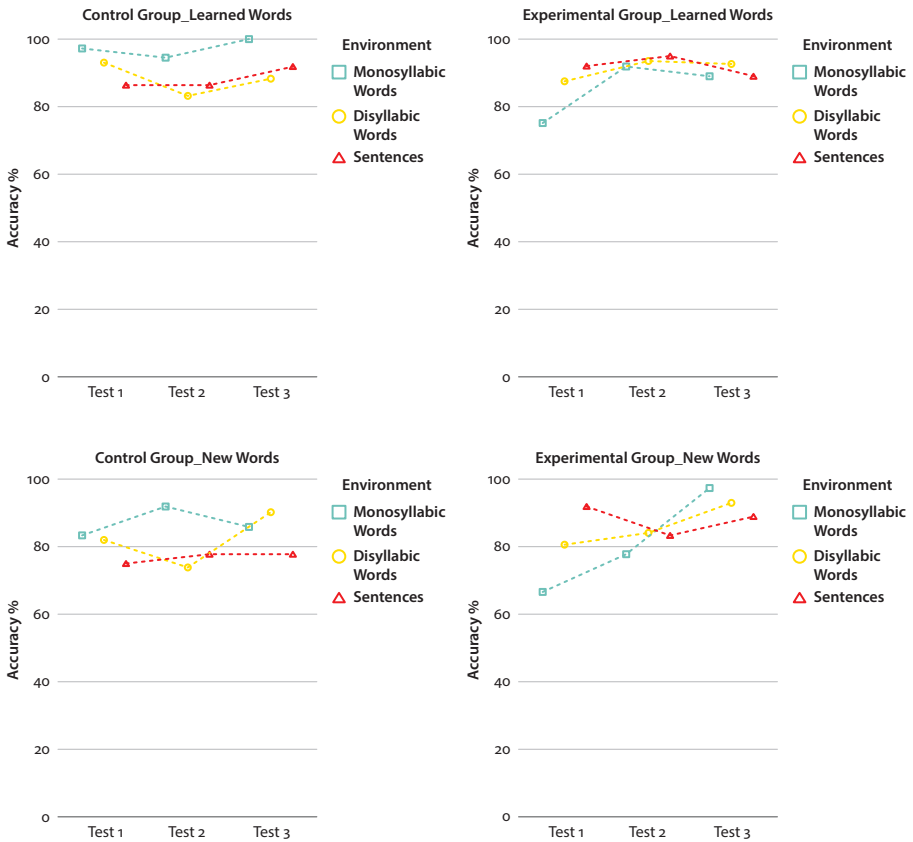
Figure 4. The mean accuracy percentages for Tone 3 in the two different lexical contexts, three tonal environments and three tests by two groups of learners

In addition, a marginally significant Lexical Context × Test × Group interaction effect [F (2, 21) =3.432, p = 0.051] was found. Independent t-tests revealed that learners in the experimental group produced learned words and new words with a comparable accuracy rate during Test 1 (p = .259; 84.7% vs. 79.6%) and Test 3 (p=.219; 90.1% vs. 93%), but their production of learned words was significantly more accurate than new words in Test 2 (p = .002, 93.2% vs. 81.7%). On the other hand, the control group produced learned words more accurately than new words in all 3 tests: Test 1 (p =.000; 92.1% vs. 80.1%), Test 2 (p = .016; 87.9% vs. 81.1%) and Test 3 (p = .013; 93.3% vs. 84.7%). More interestingly, the experimental group produced new words more accurately than the control group in Test 3 (p = .028; 93.0% vs. 84.7%). No other significant difference was found in other comparisons between the two groups across Lexical Context and Test.

4.   Discussion

This study was designed to explore the effectiveness of two teaching methods, namely the pitch direction-focused method and the pitch height-focused method on production accuracy of Mandarin Tone 3 among American English-speaking students. The results suggested that the pitch direction-focused teaching method improved learners' production of Tone 3 in monosyllabic words at a significantly higher accuracy rate (CG, 92.1% vs. EG, 82.4%), whereas the pitch height-focused teaching method led to better performance of Tone 3 in sentences (CG, 82.8% vs. EG, 89.8%). We hypothesized that the pitch direction-focused teaching method which drew learners' attention to the falling-rising pitch contour of isolated Tone 3 may have led to students' conscious attempt to always produce the tone's entire pitch contour even in coarticulated contexts at the sentence level, where the rising portion is often truncated. In addition, the production of Tone 3 with an initial short falling pitch followed by a longer rising portion, as typically illustrated in textbooks, caused native speakers to perceive it as Tone 2 in connected speech. In contrast, the pitch height-focused teaching method makes it easier for students to distinguish Tone 3 from the other three high tones by simply lowering their pitch level in a string of tones in a sentence. However, realizing Tone 3 as a low level tone is relatively difficult in monosyllabic contexts without the pitch level of other tones for comparison. On the other hand, given the fact that tones rarely occur in isolation in discourse, the pitch height-focused teaching method is more practical and beneficial for communicative purposes.

The students taught with the pitch height-focused method displayed production errors in both learned (84.7%) and new words (79.6%) when they started learning the tone. Two months after instruction, their production of learned words was significantly more accurate than on new words (93.2% vs. 81.7%). However, after three months of instruction, their performance on learned and new words was comparable (90.1 vs. 93%), suggesting that the effectiveness of the instruction was generalized to new words during this time period. In contrast, production accuracy on new words lagged behind that of learned words across all three tests (Test 1, 92.1% vs. 80.1%, Test 2; 87.9% vs. 81.1%; Test 3, 93.3% vs. 84.7%) among students in the control, pitch direction instruction group, suggesting that the effectiveness of this teaching method did not generalize to novel words and novel contexts. The patterns of results reported above suggest that the pitch height-focused method improved students' pronunciation accuracy of Tone 3 and developed students' tonal pronunciation proficiency regardless of the types of lexical context. Therefore, the pitch height-focused instruction method is recommended over the pitch direction-focused approach.

5. Conclusion, limitation, and future research

The results of this study suggest that the pitch height-focused teaching method works better to teach students to produce tones in coarticulated tonal environments at the sentence level, which is a skill that is more important for L2 learners, given that tones are rarely produced in isolation in discourse. Furthermore, the pitch height-focused teaching method not only improved L2 learners' production accuracy of Tone 3 in learned words, but its effectiveness also generalized to new words.

Pedagogically, describing Tone 3 as a low tone in classroom instruction has three advantages. First, the description of Tone 3 as a low-level tone draws learners' attention to the pitch-height dimension, the main articulation feature of Tone 3, and deemphasizes the rising portion of the tone which is often truncated in connected speech, the misuse of which leads to Tone 2 perception by native speakers of Mandarin Chinese. Second, low tone is not a "foreign" tone to native English speakers. An unstressed syllable in English is produced with a lower pitch than a stressed syllable. As a mnemonic tool, instructors may suggest that students associate Tone 3 with an unstressed syllable in English to facilitate/encourage a positive transfer. Third, since creaky voice often accompanies a low tone, producing Tone 3 as a low tone will also lead students to discover this articulatory feature and to use it in their production to enhance the perception of Tone 3 by native Mandarin listeners (Belotel-Grenié & Grenié 1994). In addition to the acoustic information of pitch, this articulatory feedback may also serve as an additional tool in student's attempt to distinguish Tone 3 from other tones in their production and perception.

Future research needs to be conducted to compare the effects of instructions based on the two proposed phonological representations, namely "a low falling tone" vs. "a low flat tone," on the acquisition of Tone 3 by L2 learners. Furthermore, the effects of various teaching methods on Tone 3 production accuracy in sandhi context, for example, when Tone 3 precedes another Tone 3, should be explored. As this study examined tonal production accuracy in read speech during a three-month study period, future research should be extended to spontaneous speech, and for a longer instruction period. Finally, to see if the results of the current study generalize to other student populations, learners from different L1 backgrounds other than English should be tested.

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Appendix

Test 1: Test tokens

Monosyllabic: 15 in total
Six targets: three learned: wǔ 五, hǎo 好, wǒ 我; three new: suǐ髓, tuǒ妥, jiǎng 奖
Nine fillers: three T1: qiē切, rēng扔, tōng通; three T2: chuáng床, guó国, yún云; three T4: lüè
略, xiè谢, zhuàn赚
Disyllabic: 12 in total.
Contexts: T3+Tx or Tx+T3
T3+Tx: 6 tokens
Three learned words: T3T1:lǎo shī 老师; T3T2: jiǔ shí九十; T3T4: qǐng wèn请问
Three new words: T3T1:wěizhuāng伪装; T3T2:wǎnglái往来; T3T4: měi lì 美丽
Tx+T3: 6 tokens
Three learned words: T1T3: hēi bǎn 黑板; T2T3: shíwǔ 十五 T4T3: bù dǒng 不懂
Three new words: T1T3: wēi xiǎn 危险, T2T3: huí lái 回来, T4T3: qì chǎng 气场
Sentences: 6 in total; 3 learned words and 3 new words.
Contexts: T3 at the beginning, middle, end.
Three learnt sentences:
T3 beginning: Dǎ kāi shū. 打开书。
T3 middle: "Exam" Zhōngwén zěnme shuō? Exam中文怎么说？
T3 end: Duì bu qǐ. 对不起。
Three new sentences:
T3 beginning: zhǎo dào ta！找到他！
T3 middle: 6. "Jennifer" shì nǎ gè rén？Jennifer是哪个人？
T3 end: 4. Tā hén kě. 他很渴。

Test 2: Test tokens

Monosyllabic: 15 in total
Six targets: three learned: jǐ 几, yǒu 有, nǚ 女; three new words: chǐ 尺, liǔ 柳, shuǎng 爽
Nine fillers: three T1: tuī推, zāi 栽, tuō 托; three T2: hái 还, méi 没, pó 婆; three T4: qià 恰, rù
入, dèng 瞪
Disyllabic: 12 in total.
Contexts: T3+Tx or Tx+T3
T3+Tx: 6 tokens
Three learned words: T3T1: Běi jīng 北京; T3T2: měi guó 美国; T3T4: jǐ gè 几个
Three new words: T3T1: dǎ chē 打车; T3T2: chǒu xíng 丑行; T3T4: wǎn yàn 晚宴
Tx+T3: 6 tokens
Three learned words: T1T3: sān jiě 三姐; T2T3: Lí yǒu 李友; T4T3: Rì běn 日本
Three new words: T1T3: fā zhǎn 发展; T2T3: fó zǔ 佛祖; T4T3: diàn tǒng 电筒
Sentences: 6 in total; 3 learnt and 3 new.
Contexts: T3 at the beginning, middle, end.
Three learnt sentences:
T3 beginning: Nǐ jiào Wáng Péng ma? 你叫王朋吗？
T3 middle: Wǒ gēge yě shì lǎoshī. 我哥哥也是老师。

T3 end: Tāmen dōu xìng Lǐ. 他们都姓李。

Three new sentences:

T3 beginning: Gǒu pà zhīzhū ma? 狗怕蜘蛛吗？

T3 middle: Zhāng shīfu zhǐ hē lǜchá. 张师傅只喝绿茶。

T3 end: Lǎozhāng jiù pà guǐ. 老张就怕鬼。

Test 3: Test tokens

Monosyllabic: 15 in total

Six targets: three learned: zhǐ 只, hěn 很, xiǎo 小; Six new sǎg 嗓, zhǔ 主, qiǎo 巧

Nine fillers: three T1: wāng 汪, huī 灰, shāo 烧; T2*3: dá 达, liú 留, tián 田; T4*3: kuì 溃, lòu 漏, què 却

Disyllabic: 12 in total.

Contexts: T3+Tx or Tx+T3

T3+Tx: 6 tokens

Three learned words: T3T1: xiǎo gāo 小高; T3T2: dǎ qiú 打球; T3T4: kě shì 可是

Three new words: T3T1: wǔ dāng 武当; T3T1: zǒu tái 走台; T3T4: nǎi zhì 乃至

Tx+T3: 6 tokens

Three learned words: T1T3: hē shuǐ 喝水; T2T3: liáng diǎn 两点; T4T3: yìqǐ 一起

Three new words: T1T3: mō cǎi 摸彩; T2T3: yóng yuǎn 永远; T4T3: zhì shǎo 至少

Sentences: 6 in total; 3 learned and 3 new.

Contexts: T3 at the beginning, middle, end.

Three learnt sentences:

T3 beginning: Jiǔ yuè sān hào shì xīng qī tiān ma? 九月三号是星期天吗？

T3 middle: Tā jué de tiào wǔ méi yì sī. 她觉得跳舞没意思。

T3 end: Tā bú kàn zhōng wén diàn yǐng. 她不看中文电影。

Three new sentences:

T3 beginning: Xiě zì liàn xí jiāo shàng qù le ma? 写字练习交上去了吗？

T3 middle: Fáng jiān de hào mǎ bié wàng jì. 房间的号码不能忘记。

T3 end: Tā bù néng shàng tái líng jiǎng. 他不能上台领奖。

摘要

本文研究了两种教学法对英语为母语的中文学习者在中文第三声发音的准确率的影响。控制组中的12名学生接受了传统教学法，即强调第三声为降升调，而在实验组的12名学生则接受了低调教学法，即强调第三声为低调。两组学生分别在中文学习一个月，两个月和三个月的时间段对含有第三声的已学词汇和未学词汇在单音节，双音节词和句子三种不同声调环境中进行了发音测试。实验发现1）低调教学法更好的促进了学生在语流中正确发音第三声。2）低调教学法不仅使学生更好地发准已学词汇中的第三声，而且还能帮助学生在未学词汇中准确发音。低调教学法培养了学生的在第三声发音上的触类旁通的语言能力。

关键词：声调，发音，教学法

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