

Kazakh Learners' Production of Mandarin Tones in Colloquial Contexts

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Abstract

This study investigates Kazakh learners' production of Mandarin tones in ten colloquial contexts. Four acoustic parameters—mean F0, F0 range, F0 slope and duration were measured and analyzed. The acoustic and statistical analysis indicate nativelike duration and F0 slope in the learners' production but non-nativelike F0 height. F0 range differs in tones—nativelike Tone 4, nonnative Tone 1 and better Tone 3 than Tone 2. The results reveal that the prosodic system of learners' L2 Russian did not affect their tone production of L3 Mandarin as much as that of their L1 Kazakh did.

Index Terms: Mandarin tones, F0, duration, Kazakh, L3

1. Introduction

L2 speech research has found that it is difficult for non-tone language speakers to acquire tones in a tone language. Mandarin, as a typical tone language with four lexical tones—Tone 1 (high-level), Tone 2 (rising), Tone 3 (dipping) and Tone 4 (falling), has been learned as an L2 by speakers of many non-tone languages. Previous studies on L2 speech perception reveal that, unlike native Mandarin speakers, who are sensitive to pitch contour, English speakers are more sensitive to pitch height than pitch contour and therefore rely more on pitch height to discriminate and identify Mandarin tones [1, 2, 3, 4, 5, 6]. Further studies of So and Best [7] found that both English and French speakers assimilated Mandarin tones to their L1 intonation categories and English speakers' perception of Mandarin tones was affected by English word stress while French did not. This study indicates that both lexical and sentential prosody in non-tone L1 may influence the perception of L2 Mandarin tones; however, speakers of different non-tone languages may demonstrate different prosodic effects on the perception of Mandarin tones.

On the other hand, studies on L2 Mandarin tone production found that learners' perception and production were highly related and English speakers produced contour tones more confusable than the level tone [8, 9]. However, the errors in Mandarin tone production of English speakers are not simply the confusion of tone types but also the register errors (i.e., pitch height), the contour errors (i.e., pitch slope), duration and turning point of Tone 3 [10]. Previous studies on L2 Mandarin tone production mostly designed the stimuli in syllables with tonal contrasts [8], disyllabic or polysyllabic words or phrases [11, 12, 13], text reading [9, 14], or designed short sentences in different tonal contexts [15]. The study of non-native Mandarin tone production in colloquial context or spontaneous speech remains scarce.

Moreover, previous studies of tone acquisition were mainly restricted in Mandarin as L2. For learners who were raised in a societal bilingual situation, Mandarin has been learned as L3. When learning L3, the L1 or L2 interacts with the L3 in the

learning process. The potential influence in L3 acquisition differs from those in L1 and L2 acquisition. The cross-linguistic transfer from L1 and L2 that occurs during L3 acquisition is a complex process in which the L1 and L2 can affect L3 acquisition either separately or jointly [16]. Hammarberg and Hammarberg [17] and Wrembel [18] reveal that learners who are at the initial stages of L3 development will possibly transfer the phonological features of their L2 into L3 production. However, phonological features of a learner's L1 become more influential as s/he becomes more proficient in the L3. Jessner [19] points out that language acquisition in multilingualism is nonlinear and dynamic and influenced by a variety of factors.

Based on the above reviewed theories and previous studies, the current study investigates tones in colloquial speech in L3 Mandarin produced by speakers of L1 Kazakh and L2 Russian. Three research questions are explored in the present data: (1) Can Kazakh-Russian bilinguals produce native-like Mandarin tones in terms of acoustic features? (2) Which tone and which acoustic parameter can they achieve better than others? (3) How do the prosodic system of their L1 Kazakh and L2 Russian affect their production of L3 Mandarin tones?

2. Methods

2.1. Participants

Ten Kazakhstani students in Nanjing University of Science and Technology were paid to participate in the experiment. They were all born and raised in Kazakhstan, speak Kazakh as L1 and Russian as L2, and experienced learners of Mandarin, having passed HSK 4 or stayed in China for more than one year. Their Mandarin proficiency level was high enough to use daily expressions. A control group of ten native Chinese students was also recruited. All native speakers were from the northern part of China. Both groups had four females and six males.

2.2. Stimuli

The stimuli were designed with ten pairs of questions and answers in Mandarin, in which the contexts were described and the answers included declarative sentences, WH-questions, Y/N questions and exclamatory sentences. There were 14 syllables with Tone 1, 13 syllables with Tone 2, 24 syllables with Tone 3 and 26 syllables with Tone 4. Note that the acoustic analysis in the current paper excluded the neutral tone and all syllables with Tone 3 in the target sentences were realized with a surface form of low-falling tone in the audio instruction.

All stimulus sentences and their contexts are shown as follows. However, the English glosses were not shown in the experiment.

(1) 早上你去教室的路上遇到张老师。怎么说?

zao3 shang4 ni3 qu4 jiao4 shi4 de0 lu4 shang4 yu4 dao4 zhang1 lao3 shi1. zen3 me0 shuo1?

'You meet Mr. Zhang on the way to your classroom.

- What will you say?
张老师，早上好!
zhang1 lao3 shi1, zao3 shang4 hao3!
'Good morning, Mr. Zhang!'
- (2) 下课后你去餐厅遇到中国朋友刘梅。怎么说?
xia4 ke4 hou4 ni3 qu4 can1 ting1 yu4 dao4 zhong1 guo2 peng2 you3 liu2 mei2.
zen3 me0 shuo?
'You meet your Chinese friend Liu Mei at the cafeteria after class. What will you say?'
最近怎么样？忙什么呢？
zui4 jin4 zen3 me0 yang4? mang2 shen3 me0 ne2?
'How's it going? What are you busy with?'
- (3) 你觉得这是个好主意，怎么说?
ni3 jue2 de0 zhe4 shi4 ge4 hao3 zhu2 yi4, zen3 me0 shuo1?
'You think this is a good idea. What will you say?'
太好了!
tai4 hao3 le0!
'Very good!'
- (4) 谈到你朋友的汉语水平，你很佩服，怎么说?
tan2 dao4 ni3 peng2 you3 de0 han4 yu3 shui3 ping2, ni3 hen3 pei4 fu2, zen3 me0 shuo1?
'Talking about your friend's Chinese proficiency, you really admire it. What will you say?'
他真了不起!
ta1 zhen1 liao3 bu4 qi3!
'He's awesome!'
- (5) 谈到饭菜，你非常满意。怎么说?
tan2 dao4 fan4 cai4, ni3 fei1 chang2 man3 yi4. zen3 me0 shuo1?
'Talking about the food, you're very satisfied. What will you say?'
今天的饭菜特别好吃。
jin1 tian1 de0 fan4 cai4 te4 bie2 hao3 chi1.
'The food today was especially delicious.'
- (6) 朋友的孩子向你问好，你怎么说?
peng2 you3 de0 hai2 zi0 xiang4 ni3 wen4 hao3, ni3 zen3 me0 shuo1?
'Your friend's child says hello to you. What will you say?'
这孩子真讨人喜欢。
zhe4 hai2 zi0 zhen1 tao3 ren2 xi3 huan1.
'This child is really adorable.'
- (7) 你想请主人开车送你。怎么说?
ni3 xiang3 qing3 zhu3 ren2 kai1 che1 song4 ni3. zen3 me0 shuo1?
'You want to ask the host for a ride. What will you say?'
能麻烦您送我们一下儿吗?
neng2 ma2 fan2 nin2 song4 wo3 men0 yi2 xia4 er2 ma2?
'Can we trouble you for a ride home?'
- (8) 你去老师的办公室问问题。怎么说?
ni3 qu4 lao3 shi1 de0 ban4 gong1 shi4 wen4 wen4 ti2. zen3 me0 shuo1?
'You go to the teacher's office to ask a question. What will you say?'
您现在方便吗？我有个问题想请教您。
nin2 xian4 zai4 fang1 bian4 ma? wo3 you3 ge4 wen4 ti2 xiang3 qing3 jiao4 nin2.
'Are you available now? I have a question for you.'
- (9) 你不小心说错了话，对方很生气。怎么说?

- ni3 bu4 xiao3 xin1 shuo1 cuo4 le0 hua4, dui4 fang1 hen3 sheng1 qi4. zen3 me0 shuo1?*
'You accidentally said something wrong and the other person is angry. What will you say?'
都是我不好，我向你道歉。
dou1 shi4 wo3 bu4 hao3, wo3 xiang4 ni3 dao4 qian4.
'That's completely my fault. I apologize.'
- (10) 朋友邀请你参加他的晚会，你谢绝。怎么说?
peng2 you3 yao1 qing3 ni3 can1 jia1 ta1 de0 wan3 hui4, ni3 xie4 jue2. zen3 me0 shuo3?
'Your friend invites you to his party and you decline. What will you say?'
实在不好意思，我已经另有安排了。
shi2 zai4 bu4 hao3 yi4 si0, wo3 yi3 jing1 ling4 you3 an1 pai2 le0.
'I'm sorry. I've already got plans.'

2.3. Recording

The recording took place in the sound-attenuated booth in Language Cognition and Speech Sciences Lab at Nanjing University of Science and Technology. A Marantz PMD661 professional recorder and a Shure SM10A-CN head-worn microphone were used to record the stimuli in a mono channel with 44,100 Hz sampling rate. The sounds were digitized on an SD card to save on the computer. The recording was set in a delayed-repeating task, a conventional method in second language speech. Chinese characters, *pinyin* and gloss of the stimuli were also displayed on the computer screen via PowerPoint. The contexts and the questions were recorded by a male native Mandarin speaker and the answers by a female speaker. All participants were required to listen to the context, the questions and the answer first, then the question was repeated, and the participant followed to answer the question. The recording was repeated three times.

2.4. Analysis

Acoustic measurements were made on all three recording of sentences produced by Kazakhstani students, in order to examine the differences among three repetitions. The current data only include the first repetition of the native speakers as the control group. Acoustic data were extracted by ProsodyPro, a Praat script for prosody analysis [20], including duration (ms), mean F0 (Hz), F0 range (semitone) and F0 slope on each syllable (excluding obstruents). MANOVA and independent-samples *t*-tests were used in the current paper to compare duration, mean F0, F0 range and F0 slope in four tones between the control group and the learners' repetitions, collapsing sentence type, phonetic context and gender.

3. Results

The overall data were first examined by MANOVA. Duration, mean F0, F0 range and F0 slope were set as dependent variables and tone (Tones 1-4) and group (control and learners' three repetitions) as fixed factors. Results show no interaction between tone and group but significant main effects of tone [$F(12, 8099)=31.994, p<0.001$] and group [$F(12, 8099)=21.953, p<0.001$]. Although there was no interaction between tone and group, we care more about comparisons between learners' production and native speakers' production than comparisons across tone types. Therefore, independent-samples *t*-tests were then conducted to compare duration, mean F0, F0 range and F0 slope of each tone between any two groups.

3.1. Duration comparisons

The *t*-test results of duration showed no significant difference in the production of Tones 1-4 between the learners' three repetitions and the control group and there was also no significant difference in the four tones among the learners' repetitions. Figure 1 indicates the results.

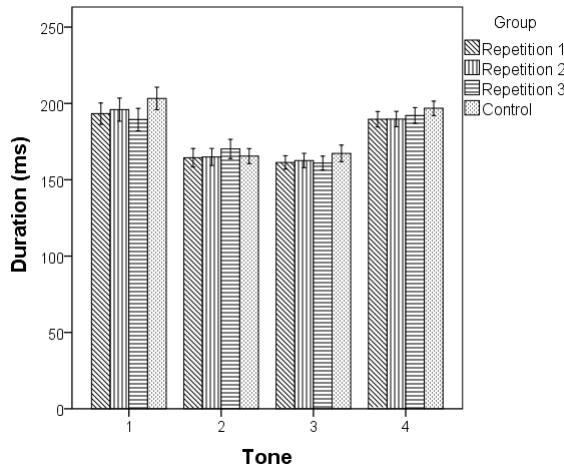


Figure 1: Duration comparisons between control group and learners' repetitions.

3.2. Mean F0 comparisons

The *t*-test results of mean F0 in all tones show significant differences between the control group and each repetition of the learners. All *p* values are lower than 0.001. Table 1 shows the values of *t* and *df*, comparing respectively learners' repetitions to the control group. Figure 2 indicates these results.

Table 1. Learners' repetitions of mean f0 compared with the control group's production

	Repetition 1		Repetition 2		Repetition 3	
	<i>t</i>	<i>df</i>	<i>t</i>	<i>df</i>	<i>t</i>	<i>df</i>
Tone 1	6.095	262	6.207	254	6.758	278
Tone 2	5.286	244	5.873	242	5.966	258
Tone 3	10.231	385	9.661	378	10.171	375
Tone 4	6.836	491	7.177	491	6.911	504

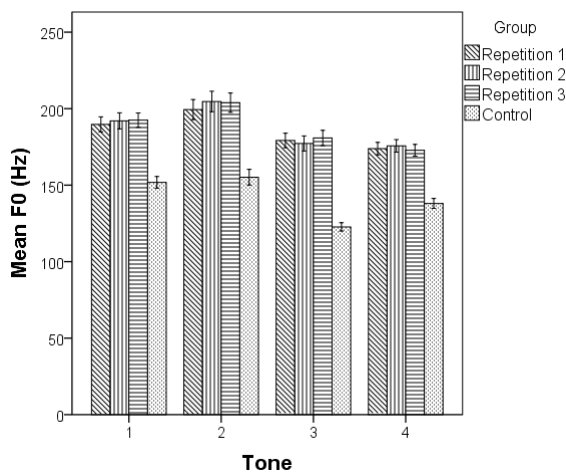


Figure 2: Mean F0 comparisons between control group and learners' repetitions.

3.3. F0 range comparison

The *t*-test results of F0 range in Tone 1 show significant differences between the control group and Repetition 1 [$t(264)=-2.648, p=0.009$], Repetition 2 [$t(278)=-2.188, p=0.03$], and Repetition 3 [$t(278)=-2.206, p=0.028$]. However, in Tone 2, there was no significant difference between the control group and Repetition 1. The differences between the control group and Repetition 2 [$t(233)=2.049, p=0.042$] and between the control group and Repetition 3 [$t(223)=2.114, p=0.036$] are significant. Tone 3 shows no significant difference between groups but one between the control group and Repetition 1 [$t(418)=2.141, p=0.033$]. However, in Tone 4, there was no significant difference in F0 range between any two groups. Figure 3 illustrates these results.

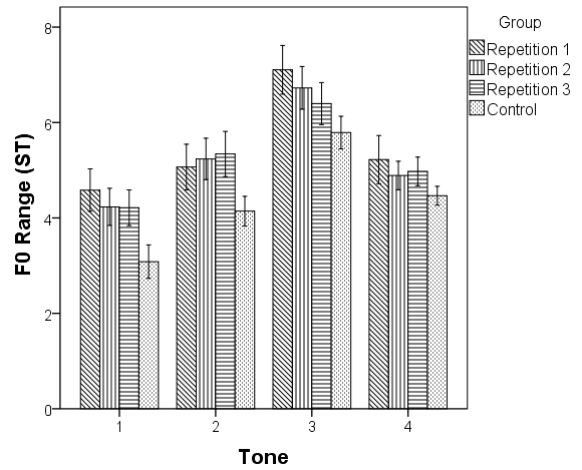


Figure 3: F0 range comparisons between control group and learners' repetitions.

3.4. F0 slope comparisons

The *t*-test results of F0 slope show no significant difference in Tones 1, 2 and 4 between the control group and learners' three repetitions. However, Tone 3 indicates a significant difference between the control group and Repetition 2 [$t(478)=2.099, p=0.036$]. Figure 4 illustrates these results.

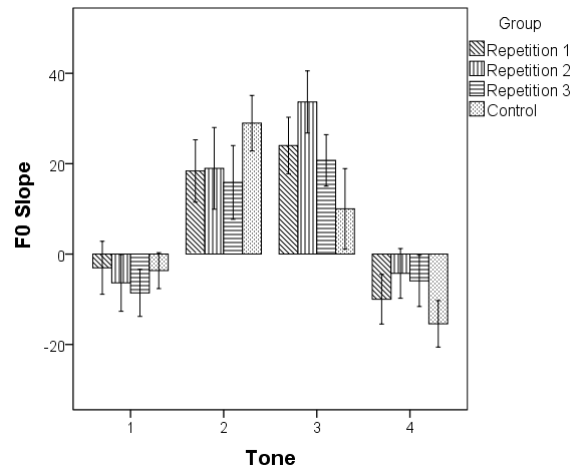


Figure 4: F0 slope comparisons between control group and learners' repetitions.

4. Discussion

The current data indicate no significant difference in duration between the control group and learners' repetitions, suggesting the duration pattern of the learners' tone production is native-like. Previous studies on L2 speech have found that the overall speech rate in L2 is slower than native speech [21, 22]. L2 speech normally presents longer syllable duration than native speech [23, 24]. Guion and colleagues [22] found that the differences in sentence duration were largely due to vowel duration rather than the duration of obstruents. The current study analyzes tonal duration of vowels and sonorants in the syllables in L2 Mandarin. However, it does not differ from native speech. This may be due to that previous works mostly took English as the target language and English is a stress-timed language whereas Mandarin is a syllable-timed language. In contrast to the current results, Yang [15] found that English speakers produced longer syllable duration in Mandarin sentences than native Mandarin speakers. Since English, Kazakh and Russian are all intonation languages with pitch accents [25, 26], the different results of syllable duration may be attributed to that the stimuli in the current study were contextual colloquial speech and the stimuli in Yang [15] were designed lab speech.

The current data also indicate that learners' mean F0 in the four tones are all higher than native speakers'. However, their three repetitions show no significant difference between one another. This may be due to the fact that learners took the task too seriously and thus unconsciously raised their pitch. In contrast to Mandarin tone production of English speakers, Shen [14] and Wang et al. [8] show that mean F0 of Tone 1 and Tone 4 in L2 Mandarin were lower than native speech; however, Tone 2 and Tone 3 was found higher than native speech respectively in Shen [14] and in Wang et al. [8]. The results of overall higher mean F0 in learners' Mandarin tones than native speakers' in the current study, which differ from the Mandarin tones produced by English speakers, may be explained by the findings of Sultangubiyeva et al. [27] that Kazakh speakers produced "high level of tone" in narrative intonation in Kazakh while English speakers produced "a calm tone" in English declarative sentences. The current stimuli were designed in sentential contexts rather than monosyllabic or disyllabic words in isolation. Learner may have produced the stimuli with a high global F0 contour over the sentences. This finding indicates the effect of L1 phonological features on L3 phonological acquisition in Kazakh-Russian bilinguals.

The results of F0 range in Tone 1 indicate all learners' repetitions are wider than native speech and no differences among the repetitions. As a level tone, Tone 1 is not supposed to produce with a wide F0 range. The current result indicates learners' failure in maintaining a stable level pitch in sentential contexts, which is consistent with Gatina's [28] observation. This is similar to English speakers' production of Mandarin Tone 1 [14, 15] and may also be attributed to that both Kazakh and Russian are intonation languages as English is. Repetition 1 of Tone 2 shows no difference in F0 range from native speech while Repetitions 2 and 3 differed from native speech. This also indicates the instability of F0 range acquisition. However, learners' F0 range of Tone 3 (Figure 3) shows an improvement from Repetition 1 to Repetition 3 and gradual native-likeness compared to native speech. Moreover, learners' F0 range of Tone 4 in all repetitions does not differ from native speech, suggesting a stable native-likeness. Compared to studies on L2 Mandarin tones of L1 English speakers [14, 8] and that of L1

Russian speakers [29, 30], which found learners' F0 ranges of Tone 2 and Tone 4 were not wide enough, the current study on L3 Mandarin tones of Kazakh-Russian bilinguals show better results of F0 range of contour tones. This challenges the opinion of Hammarberg and Hammarberg [17] and Wrembel [18] that early-phase learners may transfer the phonological features of their L2 into L3 production; however, learners' in the current study may have passed the initial stage of L3 development. Syntacticians found that L2 transfer to L3 acquisition happens when L2 and L3 are structurally similar [31, 32]. This may be used to explain the current finding of no L2 Russian transfer to L3 Mandarin F0 range because the phonological systems in Russian and Mandarin are very different.

Compared to F0 range, the error bars in Figure 4 reveal great individual differences in both learners and native speakers. The results indicate that the F0 slope of learners' production does not differ from native speech except for the F0 slope of learner's Repetition 2 in Tone 3, which is statistically steeper than native speech. Based on the longer syllable duration [15] and smaller F0 range [8, 14] in English speakers' Mandarin production in previous studies, learners' F0 slope was supposed to be less steep than native speech. However, the current results do not indicate this prediction. Based on the findings of similar duration and mostly wider F0 range in learners' production compared to native speech in the current study, F0 slope should have been generally steeper in learners' production than that in native speech. However, we find this result only in learners' Repetition 2 in Tone 3. The reason plausibly lies in the participants' individual differences in these related acoustic parameters.

The present findings answer the first and second research questions that Kazakh-Russian bilinguals were able to produce Mandarin tones with native-like duration but higher mean F0 for all the four tones. They produced F0 range best in Tone 4, followed by Tone 3 and Tone 2, and worst in Tone 1 but almost native-like F0 slope. These findings and the above discussion reveal the answer to the third research question that the prosodic system of L1 Kazakh affected more L3 Mandarin tones than that of L2 Russian did. In addition, no robust differences among learners' repetitions in most of the acoustic parameters for most of the tones suggest an interlanguage pattern in L3 prosody.

5. Conclusions

The current study examines and analyzes the effect of L1 Kazakh and L2 Russian on the tone production of L3 Mandarin in colloquial speech. The acoustic and statistic data indicate that Kazakh learners were able to produce native-like duration and F0 slope in Mandarin regardless of phonetic context. However, they failed in producing native-like F0 height for all tones and F0 slope for some types of tones. The results reveal more salient effect of L1 Kazakh intonation on L3 Mandarin tones than that of L2 Russian.

Future work may involve retrospective investigation of Kazakh learners' perception of Mandarin tones in various phonetic contexts in order to examine whether their perception and production are correlated.

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