

# Post-Focus Compression in Second Language Mandarin

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## Abstract

Post-focus compression (PFC) of F0 and intensity is found in Beijing Mandarin and has been claimed not to easily transfer in language contact. Two experiments were conducted to investigate the presence of PFC in second language (L2) Mandarin as a function of learners' language experience. Five groups of L2 Mandarin learners were investigated: older, mid-age and younger Quanzhou Southern Min learners, and American Chinese-heritage and non-Chinese-heritage learners. Findings were that older speakers of Quanzhou Southern Min did not show PFC in their Mandarin, but younger speakers did perhaps because of more extensive Mandarin use. Non-Chinese-heritage American learners did not produce PFC in their Mandarin, but Chinese-heritage learners did, perhaps because they had been exposed to Mandarin at an earlier age.

**Index Terms:** prosodic focus, post-focus compression, L2 Mandarin, language experience

## 1. Introduction

Post-focus compression refers to the decrease of F0 and intensity on the non-focus constituents after the focused ones in a sentence. Along with the expansion of duration, intensity and F0 on the focused constituents, PFC of F0 and intensity has been found in English [15], Dutch [5], Japanese [6], Korean [7] and other non-tone languages. Some Chinese languages, like Beijing (BJ) Mandarin [13] and Nanchang Dialect [10], have PFC; others, like Cantonese [12], Taiwan Southern Min (TW SM) and Taiwan (TW) Mandarin [1], do not.

Chen and colleagues [1] found that PFC was absent in the Mandarin production of bilingual speakers of TW SM and Mandarin. Like in Taiwan, Quanzhou Southern Min (QZ SM) speakers learn Mandarin in early childhood and use it at school and other social occasions, but speak Southern Min at home. However, the amount of Mandarin use varies by age: younger speakers use more Mandarin than older speakers. Unlike TW SM-Mandarin bilinguals, QZ SM-Mandarin bilinguals have been exposed to Beijing Mandarin or to Beijing-like Mandarin since early childhood. Since the amount of L1/L2 use was found to impact L2 speech production [2, 3], the bilingual situation in Quanzhou led us to investigate (1) whether QZ SM-Mandarin bilinguals produce PFC in their L2 Mandarin, and (2) whether younger speakers produce more PFC than older speakers in their Mandarin due to greater use of Mandarin.

As previously noted, and in contrast to Southern Min, English is reported to have PFC in F0 and duration [15]. This fact led us to wonder whether American English-speaking learners of Mandarin might be more likely than QZ SM speakers to produce PFC in their L2 Mandarin. Since age of L2 learning (AOL) was found to significantly affect L2 speech production [4, 8, 9], an investigation of American English-speaking learners of Mandarin also allows us to investigate whether AOL might affect the acquisition of PFC in

Mandarin. For these reasons, the current study investigated focus production in advanced American learners of Mandarin who differed their AOL via heritage. Specifically, we investigated (1) whether Chinese-heritage (CH) and non-Chinese-heritage (NCH) learners produce PFC in their L2 Mandarin, and (2) whether CH learners produce more PFC in Mandarin than NCH learners due to an earlier AOL.

## 2. Experiment 1

### 2.1. Methods

#### 2.1.1. Subjects

Three groups of QZ SM-Mandarin speakers were recruited. One group, the youngest one, had a mean age of 19.9 years at the time of test. These speakers self-reported a mean daily use of Mandarin of 63%. A second, mid-age group, had a mean age of 39.6 years at the time of test, and reported a mean daily use of Mandarin of 43%. The final, oldest group, had a mean age of 58.4 years and reported a mean daily use of Mandarin of 25%. Each group included four male and four female speakers.

#### 2.1.2. Stimuli

The target sentence was borrowed from [1] (see Table 1).

Table 1. Stimuli for Quanzhou Southern Min-Mandarin bilinguals.

	Initial	Medial	Final
Character	妈妈	摸	猫咪
Gloss	'mom'	'pet'	'kitty'
Mandarin	/ma55ma3/	/mo55/	/mau55 mi55/
QZ SM	/ma22ma24/	/mɔ33/	/niau33mi24/

In both languages, subjects produced the target sentences as answers to precursor questions for different foci: "what do you see in the picture" for no focus, "who is petting the kitty" for initial focus, "what is Mom doing to the kitty" for medial focus, and "what is Mom petting" for final focus.

#### 2.1.3. Recording

The experimenter, a native bilingual Quanzhou-Mandarin speaker, asked precursor questions in each language to elicit focus in that language. Each question was asked five times in a blocked random order. Participants were presented with a picture illustrating "Mom is petting the kitty" and were told to answer the precursor questions using the target sentence. Recording was conducted in a quiet room, using a Marantz professional solid state recorder PMD660 with a sampling rate of 44,100 Hz and a Shure professional unidirectional head-worn dynamic microphone.

### 2.1.4. Analysis

Target sentences were analyzed using ProsodyPro, a Praat script [14]. F0 values at 10 points were extracted from each syllable in the target sentences. Due to the occurrence of neutral tone in Mandarin and tone sandhi in QZ SM, the in-focus, pre-focus and post-focus changes of mean F0, intensity and duration were calculated only for the first syllable of each word in the target sentences. The relevant syllables were /ma55/, /mo55/ and /mau55/ in Mandarin. In-focus change was calculated by the measured value of the focused syllables /ma55/, /mo55/ and /mau55/ minus that of their non-focus counterparts. Post-focus change was calculated by the measured value of /mo55/ and /mau55/ after initial and medial foci minus that of their non-focus counterparts. There were 40 tokens (5 repetitions by 8 speakers) in each focus type. The current paper examined only the presence of PFC of F0 and intensity in L2 Mandarin in Experiment 1.

### 2.2. Results

Time-normalized F0 contours in the QZ SM speakers' Mandarin productions are plotted by focus type and age group in Figure 1. Each curve is an average of the 40 tokens under the same focus condition. Syllable boundaries are marked with vertical dash lines.

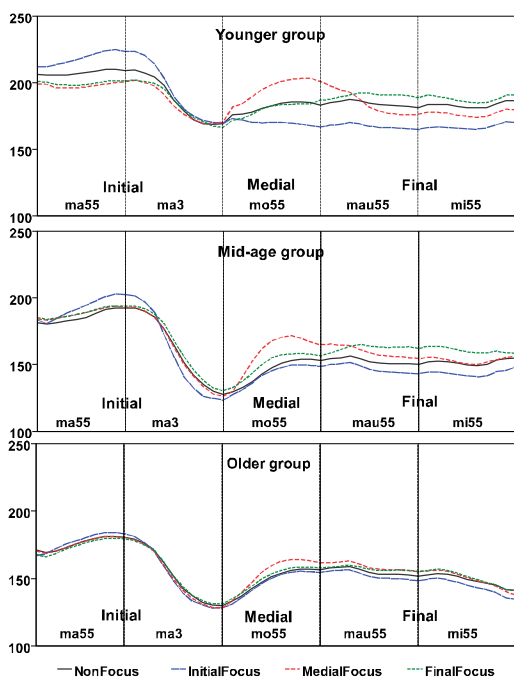


Figure 1: Time-normalized F0 (Hz) contours in Mandarin across the three age groups of Quanzhou Southern Min-Mandarin bilinguals.

Figure 1 shows that the younger group produced noticeable F0 increase on the in-focus words and F0 decrease on the post-focus words and the older group produced almost no F0 expansion and PFC. However, the mid-age groups produced an intermediate pattern between the other two age groups; in particular, there was PFC of F0 after initial focus but no PFC of F0 after medial focus.

In-focus and post-focus mean F0 changes were converted to semitones. A two-way ANOVA on the semitone values

indicated no effect of group on in-focus F0 change but significant effect on post-focus F0 change [ $F(2,21) = 4.162, p = 0.030$ ]. This result can be seen in Figure 2.

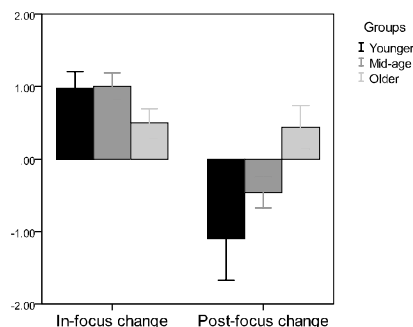


Figure 2: In-focus and post-focus mean F0 change (semitone) in Mandarin by the age three groups of Quanzhou Southern Min-Mandarin bilinguals.

Figure 2 indicates that an in-focus F0 increase occurred in all the three groups. PFC of F0 was found in the younger and mid-age groups, whereas the older groups had a slight increase in F0 in the post-focus position.

A two-way ANOVA on intensity revealed a similar pattern. Again, there was no effect of group on in-focus intensity change, but a significant effect on post-focus intensity change [ $F(2,21) = 3.856, p = 0.037$ ].

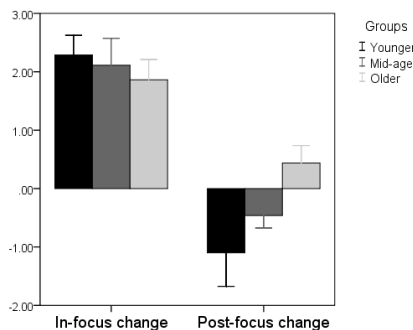


Figure 3: In-focus and post-focus mean intensity (dB) changes in Mandarin by the three age groups of Quanzhou Southern Mi-Mandarin bilinguals.

Figure 3 shows the in-focus and post-focus change of mean intensity. All the three groups increased intensity greatly on focused words. The younger group showed more PFC of intensity than the mid-age group while the older group increased the post-focus intensity.

## 3. Experiment 2

### 3.1. Methods

#### 3.1.1. Subjects

Two groups of American English-speaking learners of Mandarin, Chinese-heritage (CH) and non-Chinese-heritage (NCH), participated in the experiment. A control group of native Beijing Mandarin speakers was also included. There were 5 male and 5 female speakers in each group. All participants were undergraduate or graduate students at the University of Oregon. All the NCH learners and eight CH

learners had 5 months to 2 years study-abroad experience in China. The CH Mandarin learners were first exposed to Mandarin between birth to age 6. The NCH Mandarin learners were first exposed to Mandarin in high school or college.

### 3.1.2. Stimuli

Target sentences were similar to Experiment 1 in syntactic structure but varied the tones varied across the phrase (see Table 2).

Table 2. Mandarin stimuli for Advanced American learners of Chinese.

	Initial	Medial	Final
Character	妈	摸	妮拉
	刘妈	挠	妮兰
	李妈	搂	妮美
	魏妈	骂	妮娜
Gloss	‘Wu ma	‘pat	‘Nila
	Liu ma	scratch	Nilan
	Li ma	hug	Nimei
	Wei ma’	curse’	Nina’
Mandarin	/u55 ma55	/mo55	/ni55 la55
	liou35 ma55	nau35	ni55 lan35
	li214 ma55	lou214	ni55 mei214
	uei51 ma55/	ma51/	ni55 na51/

Precursor questions were once again used to elicit focus in the desired position. The pre-focus and post-focus words were always in Tone 1. There were 22 target sentences in total.

### 3.1.3. Recording

Recording took place in a sound booth at the University of Oregon. Target sentences were presented in Pinyin, simplified characters, and traditional characters using PowerPoint. Participants clicked through the slides to play the precursor questions and to answer with the target sentences. Each target sentence was produced three times in three pre-determined different orders. Other recording details were as before.

### 3.1.4. Analysis

Measurements were made on the second recording unless this was damaged, in which case the third recording was used. Data were analyzed by the same software and script as in Experiment 1. Similar to Experiment 1, time-normalized F0 was collected at 10 points in each syllable. Duration, intensity, mean F0 and F0 excursion size were measured for in-focus change of each tone type by collapsing three locations (initial, medial and final) in the target sentences and pre-focus and post-focus changes by collapsing four tone types on initial focus and final focus. Therefore, there were 30 tokens (3 locations by 10 speakers) of in-focus change in each tone, 40 tokens (4 tones by 10 speakers) of pre-focus change and post-focus change in Tone 1. The current paper reports only the mean F0 and intensity of Tone 1 for in-focus /u55, mo55, la55/ and post-focus change /mo55 ni55 la55/.

## 3.2. Results

Time-normalized F0 contours are plotted by focus type, tone type and speaker group in Figure 4. Each curve is an average of 10 tokens produced by the 10 speakers in each group. The

solid curves represent the non-focus production while the dash curves represent the initial-focus production.

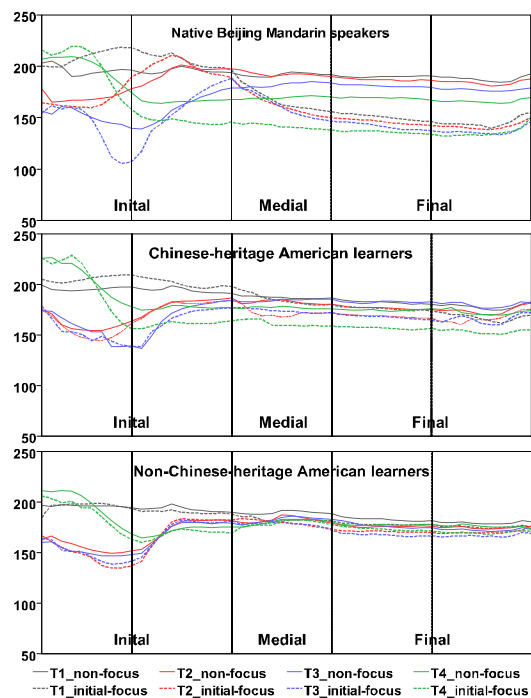


Figure 4: Time-normalized F0 (Hz) contours in Mandarin by native Beijing speakers, Chinese-heritage and non-Chinese-heritage American learners.

Figure 4 shows that the native BJ Mandarin speakers exhibited a clear pattern of PFC. In contrast, the NCH learners showed no PFC of F0 and no F0 expansion on focused words. The CH American learners presented an intermediate pattern in the production between native BJ Mandarin speakers and NCH learners.

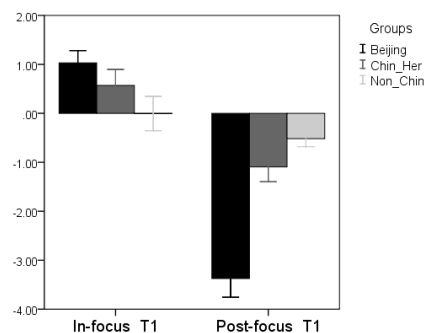


Figure 5: In-focus and post-focus mean F0 change (semitone) in Mandarins by native Beijing speakers, Chinese-heritage and non-Chinese-heritage American learners.

A two-way ANOVA on F0 change values indicated no group effect for in-focus position, but a significant effect of group for post-focus position [ $F(2, 27) = 26.067, p < 0.001$ ]. Figure 5 shows that NCH American learners did not show in-focus change of mean F0 on Tone 1. The difference of post-focus F0 change between native speakers and learners was noticeably larger than that of in-focus F0 change.

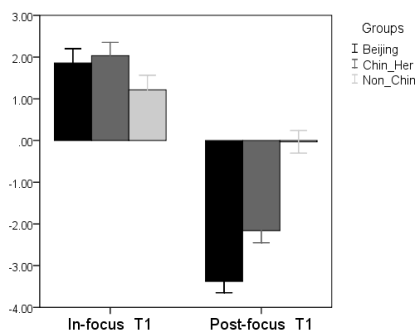


Figure 6: *In-focus and post-focus mean intensity (dB) changes in Mandarin by native Beijing speakers, Chinese-heritage and non-Chinese-heritage American learners.*

A two-way ANOVA on intensity indicated no effect of group on in-focus intensity change, but an effect of group on post-focus intensity change [ $F(2,27) = 37.137, p < 0.001$ ]. These results are presented in Figure 6. The figure shows that all the three groups increased in-focus intensity. NCH American learners showed no PFC of intensity whereas the CH group exhibited some PFC of intensity in their Mandarin production.

#### 4. Discussion

The results of Experiment 1 indicated that all the three groups of QZ SM-Mandarin bilinguals increased F0 and intensity on in-focus constituents to different extents in their L2 Mandarin production. Both younger and mid-age groups produced PFC of F0 and intensity. Instead of compression, the older group increased F0 and intensity on the post-focus constituents. In contrast to Chen et al.'s results [1], focus production in the younger QZ-SM group was more Beijing-like than in the other two groups. The mid-age group exhibited an intermediate pattern of prosodic focus between the younger and older groups. Since speakers in all the three groups were early learners of Mandarin in a societal bilingual situation, the substantial difference in the amount of L2 Mandarin use could be the main factor that impacted the acoustic features of prosodic focus. But the complicated situation of societal bilingualism may mean that other factors also contributed to the effect of age on focus production in Mandarin. For example, compared to the older speakers, younger speakers may have also been exposed to purer Beijing-like Mandarin. Although we did not examine patterns of prosodic focus in QZ Southern Min in this paper, previous reports on Southern Min suggests that this language does not have PFC. Since TW SM speakers did not produce PFC, Quanzhou bilingual speakers may not have PFC in their L1 Southern Min either. If it is in this case, then the absence of PFC in Mandarin produced by older QZ SM speakers may reflect the influence of L1 on L2.

Experiment 2 revealed that the American NCH learners did not have PFC in their L2 Mandarin production in spite of their high Mandarin proficiency. These speakers did not even increase F0 on focused words in Mandarin. In contrast, the CH learners produced more native-like prosodic focus in Mandarin, especially PFC of intensity. It would be interesting to investigate whether this pattern of results would hold when other acoustic features of prosodic focus are examined. Although earlier exposure to Mandarin might explain the difference between NCH and CH learners of Mandarin, it is

also possible that the CH learners had more L2 Mandarin input and use than the NCH learners. All the CH subjects were second or third generation of Chinese immigrants from south China. Some of them were from Cantonese or Taiwanese families; however, they were exposed in BJ Mandarin at school. Since the NCH learners did not produce PFC in L2 Mandarin unlike that in their L1 English [15], the PFC of intensity produced by the CH learners is more likely to be due to the good acquisition of BJ Mandarin than to the influence of L1 English.

#### 5. Conclusions

The results from the two experiments reported here can be taken to confirm that PFC is not easily transferred from language to language, as suggested by Wu and Chung [11]. However, the finding that younger QZ SM-Mandarin bilinguals and American CH learners of Mandarin are able to produce Beijing-like prosodic focus suggests that, under the right conditions (L1/L2 use, age of acquisition), native-like productions of prosodic focus can be obtained.

#### 6. Acknowledgment

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#### 7. References

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