POST-FOCUS COMPRESSION IN ENGLISH-CANTONESE BILINGUAL SPEAKERS

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ABSTRACT

Post-focus compression (PFC), the lowering of fundamental frequency and intensity after focus, is previously found in English but not in Cantonese. This study examines the possible transfer of PFC between these two languages through bilingualism. It is found that out of ten bilingual English-Cantonese speakers, eight have PFC in their English, but none has PFC in their Cantonese. This finding suggests that PFC is hard to transmit across languages through contact.

Keywords: Cantonese, English, focus, post-focus compression, bilingual

1. INTRODUCTION

F_0 variations are a major acoustic correlate of prosodic focus in non-tone languages [2, 8]. Besides on-focus expansion in F_0 and intensity, post-focus compression (PFC), which is a decrease in fundamental frequency and intensity in the part of the sentence after the item in focus, is evident in many languages, including English [12], German [4], Japanese [5] and Korean [6]. For tone languages, although F_0 variations are used for lexical distinction, it has been demonstrated that such F_0 variations are an important means in the realization of focus in Beijing Mandarin [3, 7, 10]. In Beijing Mandarin, both on-focus increase and PFC are found in F_0 and intensity. However, PFC is not observed in Taiwan Mandarin [3], a derivative of Beijing Mandarin. Such finding reveals that even closely related tonal languages can have different realizations of focus. Since Taiwan Mandarin is found to be similar to Taiwanese in having no PFC [3], and Cantonese also does not exhibit PFC [9], it seems that Beijing Mandarin stands out among the Chinese dialects. Consequently, some questions arise as to how Beijing Mandarin acquired PFC: Was it acquired from a proto-language that had PFC? Or was PFC developed spontaneously in Beijing Mandarin? Or was PFC in Beijing Mandarin a result of language contact? In addition to the investigation of the origin of PFC in Beijing Mandarin, experimental investigations have to be done on other Chinese languages in order to provide a better portrayal of how they differ in the realization of prosodic focus, and research of this sort has bearing on the typological classification of Chinese languages. Concerning the possibility of PFC resulting from language contact, since PFC is present in English but absent in Cantonese, whether PFC is present in bilingual speakers of these two languages can provide a hint of the transferability of PFC. This paper presents data of a production experiment involving ten native bilingual speakers of English and Cantonese as an investigation into whether PFC can be transferred between languages.

2. METHOD

2.1. Stimuli

2.1.1. English sentences

For English, four declarative target sentences were used (Table 1). Three different focus conditions (neutral, initial/medial, final) for each target sentence were elicited by precursor questions.

Table 1: English target sentences.

	Test sentences
1	She saw Mona in the morning. medial focus: *Mona*; final focus: *morning*
2	I'll play Naomi in a minute. medial focus: *Naomi*; final focus: *minute*
3	Nina lost the money. initial focus: *Nina*; final focus: *money*
4	Emma comes from Mali. initial focus: *Emma*; final focus: *Mali*

2.1.2. Cantonese sentences

Hong Kong Cantonese contains six contrastive lexical tones [13], labelled Tones 1 to 6. Using a 5-point scale to represent the tone contours, where 1 represents the lowest relative pitch level and 5 the highest, the six Hong Kong Cantonese lexical tones can be transcribed as 55, 25, 33, 23, 21 and 22. Six declarative sentences, one for each lexical tone, were used, with each consisting of three bi-syllabic

words composed of syllables having the same lexical tones (Table 2).

Table 2: Cantonese target sentences.

Tones	Test sentences
1 (high level)	[tsɪŋ˥ tsɪŋ˥ faŋ˥ faŋ˥ tʊŋ˥ kɪŋ˥] Jing-jing has returned to Tokyo.
2 (high rising)	[siu˧ tsɛ˧ hou˧ tsou˧ tsɐu˧ tsɔ˧] The young lady has left very early.
3 (mid level)	[a˧ tʰai˧ tsɔi˧ tsʰi˧ him˧ tsai˧] Tai is in debt again.
4 (low falling)	[jɐn˩ kʷʰɐn˩ wɔ˩ pʰɪŋ˩ jɐu˩ hɐŋ˩] The crowd marched peacefully.
5 (low rising)	[lou˨ lei˨ man˨ man˨ mai˨ hai˨] Mr. Li buys crabs every night.
6 (low-mid level)	[hɔk˨ hau˨ tsʊŋ˨ si˨ wɐn˨ tʊŋ˨] The school values sports.

In the experiment, all these three-word sentences were assigned with four different focus locations: neutral, initial, medial, and final, which were elicited by precursor questions each asking for a specific piece of information related to the target sentence.

2.2. Speakers

Ten bilingual speakers of Southern British English and Hong Kong Cantonese, five males and five females aged 20 to 35, participated in the experiment. All of them were born and brought up in the UK.

2.3. Recording procedure and data extraction

The recording was done in a sound-proof room at University College London, UK. The test sentences and their precursor questions, generated from a randomized list, were presented one pair at a time on a computer screen. Each speaker read aloud both the precursor and test sentences five times in separate randomized blocks. The speech was captured using a head-worn microphone (Countryman Isomax hypercardiod) and recorded directly onto a computer hard disk with a sampling rate of 44.1 kHz.

Data extraction was performed using Praat [1] and a general-purpose script [11], which enabled manual rectification of the automatic vocal pulse marking generated by Praat. For each target sentence, the script generated a minimally smoothed F_0 contour and computed the mean F_0, max F_0, mean intensity and duration for the voiced part of each syllable.

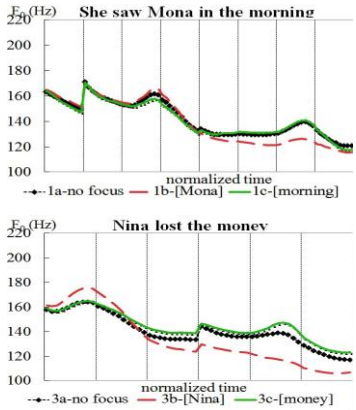
2.4. Results and analyses

2.4.1. English sentences

At first, time-normalized mean F_0 contours for all the four English sentences were plotted. On inspection, the mean F_0 tracings of the two longer sentences (sentences 1 and 2) are similar, and so were the two shorter sentences (sentences 3 and 4). Two of such plots are presented here as representatives in Figure 1.

For the sentence "She saw Mona in the morning" (Figure 1 upper panel), we see that the average F_0 of the on-focus word is not much different from that of the neutral focus word when "Mona" is in focus, and this is also the case when "morning" is in focus. In contrast, when "Mona" is in focus, the post-focus F_0 is clearly lower than its neutral counterpart. For the sentence "Nina lost the money" (Figure 1 lower panel), the change in mean F_0 in both initial and final focus conditions is more pronounced; PFC is also observed in this sentence. The other two sentences (sentences 2 and 4) show the same pattern of focus realization: the longer sentence does not show much F_0 change for the on-focus words, but PFC is observable; the shorter sentence shows F_0 increase when the initial and final words are on-focus, and PFC is again observable.

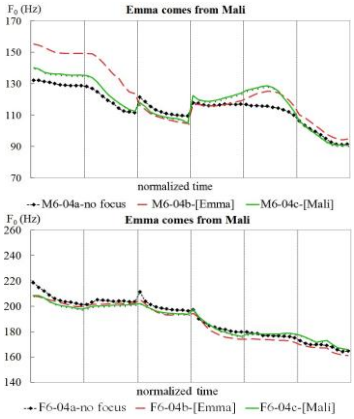
Figure 1: Time-normalized mean F_0 contours of two of the English sentences, each curve representing an average of 50 repetitions by 10 subjects. The vertical lines show syllable boundaries.



When the F_0 tracings of each individual subject were analysed, two subjects did not show PFC. Their time-normalized mean F_0 plots are shown in Figure 2. For the male speaker (Figure 2 upper panel), in the target sentence with initial focus, the on-focus word has increased F_0, but the final word is not de-accented and the F_0 of the phrase after the focused word does not go below that of the same phrase in neutral focus. This speaker did this

consistently for the other three target sentences with both initial and medial focus. The female speaker (Figure 2 lower panel) does not show changes in F_0 in the on-focus words and the post-focus words. Similar to the male speaker, the female speaker also exhibited this pattern of focus realization for the other three sets of target sentences.

Figure 2: Time-normalized mean F_0 contours of one of the English test sentences; the curves in each panel were produced by one speaker, the upper panel from a male speaker and the lower panel from a female speaker.



To verify the presence of PFC, we performed one-way repeated measures ANOVA, with focus condition as the independent variable comparing the max F_0/mean intensity of all on-focus/post-focus words and those of the equivalent words in the neutral focus condition. The ANOVA results are presented in Table 3.

Table 3: Repeated measures ANOVA results for the English sentences. The degrees of freedom (between and error) are 1 and 9 respectively. Statistically significant results are shown in boldface (abbreviations: N - neutral; F - on-focus; PF - post-focus; ↓ - being lower than neutral focus).

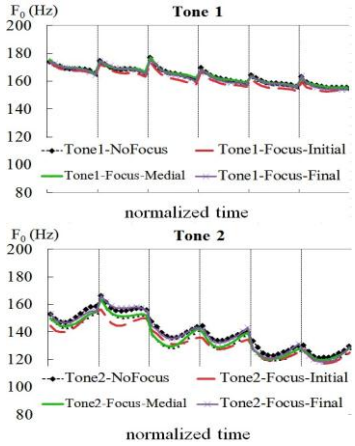
sentence		max F_0		mean intensity	
		F	*p*	F	*p*
1 Mona	F vs. N	0.439	0.524	1.430	0.262
morning	F vs. N	0.286	0.606	0.677	0.432
in the morning	PF vs. N	1.481	0.255	28.315	***0.000*** ↓
2 Naomi	F vs. N	2.455	0.152	0.905	0.366
minute	F vs. N	1.794	0.213	0.083	0.780
in a minute	PF vs. N	2.983	0.118	4.722	0.058
3 Nina	F vs. N	3.419	0.098	0.156	0.703
money	F vs. N	1.978	0.193	4.192	0.071
lost the money	PF vs. N	8.004	***0.020*** ↓	28.111	***0.000*** ↓
4 Emma	F vs. N	1.301	0.283	2.245	0.168
Mali	F vs. N	0.443	0.522	0.001	0.974
comes from Mali	PF vs. N	7.781	***0.021*** ↓	28.846	***0.000*** ↓

The results show that max F_0 of on-focus words is not significantly different from that of the neutral-focus words. The mean intensity of the post-focus words is marginally significantly lower than that in a neutral-focus sentence, and the max F_0 is significantly lower in the two shorter sentences (3 and 4). This confirms the presence of PFC in the English of the bilingual English-Cantonese subjects.

2.4.2. Cantonese sentences

Similar to the English sentences, time-normalized mean F_0 contours for all the six Cantonese sentences were plotted and examined; two of such plots, for Tone 1 and Tone 2 sentences, are shown in Figure 3.

Figure 3: Time-normalized mean F_0 contours of two of the Cantonese target sentences (Tones 1 and 2), each curve representing an average of 50 repetitions by 10 subjects. The vertical lines show syllable boundaries.



In the Tone 1 sentences, we observe that those with initial focus have slightly lower F_0 for all words as compared with the neutral sentence, but there seem to be no F_0 variations in the sentences with medial or final focus. In the Tone 2 sentences, the mean F_0 of the whole sentence is lower than that of the neutral sentence when either the initial or medial word is in focus, but is comparable when the final word is in focus. In the remaining four sentence sets (Tones 3 to 6; not shown), the pitch variations are similar to those of the Tone 1 sentence.

To support the graphical analysis, we performed repeated measures ANOVAs comparing mean F_0, mean intensity and mean duration. For each target sentence, we compared the average measurements of the words in focus or post-focus condition with the words in neutral focus. The results are summarized in Table 4.

Table 4: Repeated measures ANOVA results for the Cantonese sentences. The degrees of freedom (between and error) are 1 and 9 respectively. Statistically significant results are shown in boldface (abbreviations: N - neutral; F - on-focus; PF - post-focus; ↑ - being higher than neutral focus; ↓ - being lower than neutral focus).

Tone		mean F_0		intensity		duration	
		F	*p*	F	*p*	F	*p*
1	F vs. N	0.63	0.448	1.59	0.240	64.36	***0.000***↑
	PF vs. N	2.50	0.148	11.98	***0.007*** ↓	0.65	0.442
2	F vs. N	15.92	***0.003*** ↓	7.19	***0.025*** ↓	5.48	***0.044***↑
	PF vs. N	17.92	***0.002*** ↓	28.33	***0.000*** ↓	0.73	0.415
3	F vs. N	5.40	***0.045*** ↓	1.61	0.237	3.73	0.086
	PF vs. N	9.60	***0.013*** ↓	24.28	***0.001*** ↓	0.21	0.660
4	F vs. N	3.27	0.104	0.00	0.998	1.06	0.330
	PF vs. N	5.20	***0.049*** ↓	5.18	***0.049*** ↓	0.05	0.833
5	F vs. N	18.98	***0.002*** ↓	7.09	***0.026*** ↓	6.36	***0.033***↑
	PF vs. N	16.72	***0.003*** ↓	24.06	***0.001*** ↓	8.75	***0.016*** ↓
6	F vs. N	14.65	***0.004*** ↓	0.14	0.717	0.13	0.727
	PF vs. N	9.64	***0.013*** ↓	13.63	***0.005*** ↓	1.67	0.233

From Table 4, we see that there is no on-focus increase for mean F_0 and intensity. Rather, for both mean F_0 and intensity, whenever there were statistically significant differences between the neutral focus words and on-focus or post-focus words, the neutral focus words have higher values for these two acoustic features. Therefore, consistent with what we see in the graphical analysis, the Cantonese sentences show an overall downward shift in mean F_0 of the whole sentence when there is focus. Also consistent with the graphic analysis, no lowering of either mean F_0 or intensity is found post-focally in Cantonese. In contrast, in half of the cases, the subjects had increases in duration for the on-focus words.

3. DISCUSSION

In the graphical analysis of the overall English data, we see that the acoustic difference between on-focus and neutral focus words is consistent with previously reported results in that F_0 is increased, and PFC is a clear feature in these subjects. Yet, on inspection of the individual data, some subjects do not have very pronounced increases in F_0 in the on-focus words and do not exhibit PFC. This individual variation in the realization of prosodic focus in English among the bilingual English-Cantonese speakers points to the possibility of influence from Cantonese. On the other hand, the overall Cantonese data show no increase in F_0 or intensity of the on-focus words in all the sentences with six tones. Word duration is significantly increased in three tones, and so the bilingual speakers seemed to be using duration lengthening for focus less consistently as the monolingual Cantonese speakers [9] who show significant increases in both intensity and duration for on-focus words.

Therefore, in prosodic focus realization, the English of the bilingual speakers is comparable to that of monolingual speakers, whereas their Cantonese differs slightly from that of the monolingual counterparts, but a similar pattern of employing word lengthening for focus is seen. Besides, same as the monolingual subjects, the bilinguals' Cantonese does not show PFC. Our data suggest that PFC does not seem to be able to spread from one language to another. Further research can be done to see if this is still the case when bilinguals brought up in an environment where Cantonese is the dominant language. It would also be interesting to see if the current finding is applicable to bilinguals of other languages.

4. CONCLUSION

Our experiment demonstrated that in general the English-Cantonese bilingual speakers have PFC in their English but not in their Cantonese. Two of the ten subjects do not conform to the general pattern and do not show PFC in their English. These findings point to the possibility that PFC is not easily transferred from language to language.

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