The Effect of Language Attrition on Low Level Tone in Hakka

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Abstract

This study examines the sound change of low level tone in Hakka, and compares the change with similar tonal mergers in Cantonese and Taiwanese. The Hakka low level tone largely merges into low-falling tone, and the effect of language attrition is hypothesized as the main factor. Three perception tasks and one production task were conducted on three groups of Hakka speakers: young attriters, young speakers, and older speakers. The results show that the low level tone was the least accurate category in all tasks, and there is a significant difference between fluent speakers and attriters. In addition, young speakers confuse low level tone with low-falling tone only in the production task, but not in the perception ones. The perception-production asymmetry, however, is not found in older speakers. The findings suggest that the effect of language attrition is responsible for the tonal change, and that the phonetic and lexical factors should also be considered to account for the asymmetry.

Index Terms: first language attrition, low level tone, sound change, perception-production asymmetry, Hai-lu Hakka

1. Introduction

Hakka languages, including several dialects, undergo dramatic change in the recent decades, and the sound change of low level tone is one of the most palpable cases in the Hai-lu variety. The change coincides with the decline of use frequency in the Hakka community, as Tsao [1] finds that in the late 1990s Hakka speakers no longer use their mother tongue at home where used to be a shelter from Mandarin-speaking hegemony in Taiwan. The decrease of speaking population makes only 11.6% of Hakka children below 13 years old speak fluent Hakka. He believes that the rural areas are the last haven for Hakka at that time. However, ten years later, Hsiao [2] finds that the younger generation does not speak Hakka at home even in the rural areas. These studies [1,2] show that language attrition has become a serious issue of the Hakka community, while the others show that the decrease of use frequency also leads to individual attrition symptoms, such as nonnative accents and difficulties of lexical retrieval. As Yeh [3] indicates, more and more young speakers tend to pronounce low level tone as low-falling tone. Such a tonal accent is largely found in non-daily Hakka users, especially monthly users, so Yeh [3] argues that the effect of language attrition is responsible for the tonal accent and a series of the change.

The similar tonal accent and change is also found in Cantonese by Mok and Wong [4] and in Taiwanese by Yeh and Tu [5]. In Cantonese, low level tone gradually merges into low-falling tone, but Mok and Wong [4] find that the tonal merger occurs only in the production data (not in the perception results). In Taiwanese, mid level tone merges into low-falling tone, and the merger is also found only in the production data. Both the Cantonese and Taiwanese cases are observed in the younger generation, non-daily users, so the change is suggested to be under the influence of language attrition. However, the terms, sound change and tonal merger, should be considered with caution, because the change is still in progress and may involve some unforeseeable transitions. It is not the change itself but the strong tendency that motivates this study to make the cross-linguistic comparison. The common occurrence of non-high level tone change also brings up a further question if the tendency, change from non-high level to low-falling contour, is determined by some universal principles, such as phonetic naturalness.

2. Research Questions

The three research questions: the effect of language attrition, perception-production asymmetry, and phonetic similarity are investigated. First, Yeh [3] argues that the effect of language attrition (rather than language contact) results in the sound change of Hakka low level tone. The attrition variable was previously defined by three kinds of use frequency: monthly, weekly, and daily, but the contact variable was not attended. Hence, the argument should be reexamined by defining the contact variable in the same manner.

Second, the non-high level tone is confused with low-falling tone mostly in production data, but not in perception ones. The perception-production asymmetry is found in both Cantonese and Taiwanese, and then is also predicted in Hakka.

The last research question addresses whether the low level tone is more susceptible to change and whether the low-falling tone is the best substitute for the low level tone. As Yeh [3] suggest, phonetic similarity is the key. As shown in Table 1, the low level tone (T5) is similar to low-falling tone (T3) and rising tone (T2) in pitch height, and similar to high level tone (T1) in pitch contour, which makes it the least perceptually distinctive category. The perceptual indistinctiveness makes it difficult to keep the tonal contrast between low level tone and the others, based on the Dispersion Theory suggested by Flemming [6]. In addition, with respect to the production, low tones usually take more efforts to be produced than their high counterparts in terms of the sternohyoid activity [7] and the jaw and tongue retraction [8]. As Hu [9] indicates, the falling contour may help save the additional efforts of producing low tones, comparing to the rising and checked contour. Hence, the ease of articulation may explain the sound change from low level tone to low-falling tone. To sum up, both the perception and production approaches predict the tonal merger.

Table 1. *Tonal Inventory of Hai-lu Hakka* [10] (H= high, L= low; 5= the highest pitch, 1= the lowest)

Contour	Height	Ex.	Gloss	Abb.
level	H	fu55	lake	T1
	L	fu22	to protect	**T5/3**
falling	H	fu53	skin	T4
	L	fu31	pants	T3
rising	L	fu13	bitter	T2
checked	H	fuk5	luck	T6
	L	fuk2	to obey	T7

3. Methodology

To answer the three research questions, the three factors: use frequency of Hakka and Mandarin, perception and production approaches, and tone types are considered as variables in the experimental setup of participants, task types, and stimuli.

3.1. Participants

32 Hakka participants were recruited from the Hsinchu and Taoyuan areas in Taiwan, and were classified into three groups based on a pre-test survey about participants' language background, including the objective evaluation of Hakka speaking proficiency and use frequency of Hakka and Mandarin. The three groups are young attriters (A), young fluent speakers (Y), and older fluent speakers (O). The young attriters refer to those who used to be Hakka-Mandarin bilinguals but have Hakka exposure once a month or less often in the recent decade. They mostly speak Mandarin at home nowadays, and never speak Hakka at school or at work. As to the young fluent speakers, they speak Hakka almost every day, mostly at home, and usually speak Mandarin at work. The older fluent speakers generally use Hakka all the time, and have very little Mandarin exposure. In other words, the young attriters and the other groups contrast in the degree of language attrition. The older fluent speakers and the other groups differ in the degree of Mandarin contact. Based on the criteria, there are 10 young attriters (4 males, 6 females; mean age: 17.3 years old), 13 young fluent speakers (4 males, 9 females; mean age: 38.9 years old), and 9 older fluent speakers (4 males, 5 females; mean age: 59.1 years old).

3.2. Stimuli

The stimuli include only five Hakka non-checked tones (occurring without unaspirated voiceless stop codas), as abbreviated as T1 to T5 in Table 1, and they consist of two syllables [fu] and [t^ho]. The stimuli were selected from the official publications issued by Council of Hakka Affair in Taiwan [11, 12], and were recorded from two male Hakka speakers by Praat version 5.2.26 [13]. These stimuli are demonstrated in Table 2. Among the [t^ho] syllables, these words, from T1 to T5, mean *peach*, *to beg*, *a set*, *to drag*, and *principle*. Among the [fu] syllables, these words, from T1 to T5, mean *lake*, *government*, *pants*, *skin*, and *to protect*.

Table 2. *Stimuli List in the Experiment*

	T1	T2	T3	T4	T5
[t^ho]	桃	討	套	拖	道
	t^ho55	t^ho13	t^ho31	t^ho53	t^ho22
[fu]	湖	府	褲	虜	護
	fu55	fu13	fu31	fu53	fu22

3.3. Tasks

The experiment includes four tasks total, three perception tasks and one production task. The four tasks are conducted at a random order to avoid potential priming or training effects.

In the AXB discrimination task, participants are provided with three monosyllabic sounds separately in each trial, and they are asked to tell if the second sound is more similar to the first sound or the third. The inter-stimuli interval (ISI) is 300 ms, and the inter-trial interval (ITI) is self-paced. When participants respond to a trial, the next trial will be played in 500 ms. There are 160 (2 voice x 2 syllables x 10 tonal contrasts x 4 orders) trials total.

In the tonal identification task, participants hear only one monosyllabic sound in each trial, and they are asked to categorize the tonal type of the sound, such as T1, T2, etc. Before the identification task, participants are explicitly instructed to categorize five Hakka non-checked tones in terms of the pitch contour and pitch height. The unique T5 is compared with T1 in pitch height and with T3 in pitch contour. The ITI is also self-paced, and the next trial will be played in 500 ms, as the response of the previous one is made. There are 80 (2 voices x 2 syllables x 5 tones x 4 repetitions) trials total.

In the lexical task, participants hear only one monosyllabic sound in each trial, too, and they are asked to recognize the word meaning of the sound. The words, as illustrated in Table 2, are thoroughly reviewed, before the task, to help participants feel familiar with the task. The procedure and the trials are the same as in the identification task.

In the production task, participants are asked to read a word list of 40 (2 syllables x 5 tones x 2 word positions x 2 proficiency levels) Hakka lexical items, mostly disyllabic words, and they are recorded using Praat [13]. The 40 words are selected from the official publications issued by Council of Hakka Affair [11, 12]. The two word positions refer to the word-final and non-final position, and the two proficiency levels refer to the rudimentary and intermediate vocabulary.

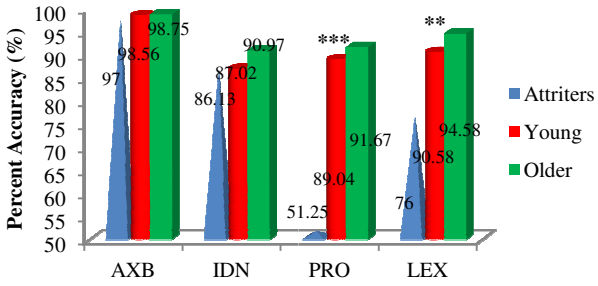
4. Results

To answer the three research questions, three statistics analyses were conducted. First, percent accuracy of all tasks was estimated, and the one-way ANOVA was conducted to evaluate the effect of language attrition and language contact. Second, the low level tone (T5) errors were compared with any other tone, and the two-sample T-test was conducted to examine if the T5 errors are significantly more than the others. At last, the T5 error matrix was analyzed, and the paired T-test was conducted to examine if low-falling tone (T3) is the better substitute for the T5 than any other tone. The T5 errors were also analyzed separately in perception and production results to examine the perception-production asymmetry.

4.1. ANOVA and the Attrition Effect

The tonal errors of all participants in all tasks were calculated, and the accuracy results show that older fluent speakers have the best performance in all tasks, and attriters have the worst performance, as shown in Figure 1.

Figure 1. *Percent Accuracy Results of Four Tasks*



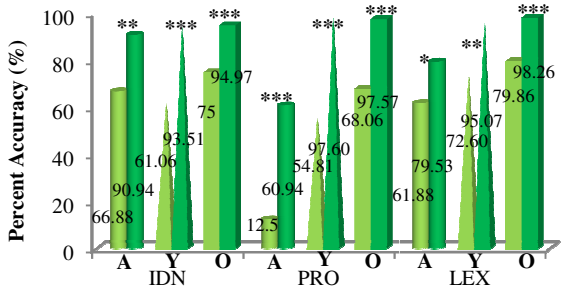
Then the errors of three participant groups were statistically compared, and the one-way ANOVA results show that there is no significant difference across the three groups in the AXB discrimination task (AXB), $F(2,29)=2.0532$, $p>0.05$; there is no significant difference in the identification task (IDN), $F(2,29)=0.6165$, $p>0.05$; there is a significant different in the

production task (PRO), F(2,29)=27.995, p<0.001***; there is a significant difference in the lexical task (LEX), F(2,29)=7.3056, p<0.01**. Then, the post-hoc analysis was conducted on the production and lexical results to further examine the cross-group difference. The results show that the significant difference in both tasks is contributed by the contrast between attriters and non-attriters, and there is no significant difference between young and older fluent speakers.

4.2. Two-sample T-Test and the T5 Errors

The low level tone (T5) errors and the other errors were calculated separately, and the accuracy results show that T5 are the least accurate category to all participants in all tasks, except for the discrimination task, as shown in Figure 2. The AXB discrimination task examines tonal pairs instead of single tones, so the T5 errors alone cannot be compared with any other tone in the discrimination results.

Figure 2. *Results of T5 and Any Other Tone* (left- light green: T5 errors, right- green: any other tone errors)



Then the two-sample T-test was conducted to compare the T5 errors and the others, and the results show that the T5 errors are significantly more than any other tone to all participants in the identification task, attriters (A): t(18)= 2.9437, p<0.01**, young fluent speakers (Y): t(24)= 3.8522, p<0.001***, older fluent speakers (O): t(16)= 4.5352, p<0.001***; in the production task, A: t(18)= 4.7008, p<0.001***, Y: t(24)= 5.7276, p<0.001***, O: t(16)= 5.6793, p<0.001***; in the lexical task, A: t(18)= 2.2250, p<0.05*, Y: t(24)= 3.433, p<0.01**, O: t(16)= 7.1792, p<0.001***. In other words, T5 is the most confusing tone to all participants in the three tasks.

4.3. Paired T-test and the T5 Error Matrix

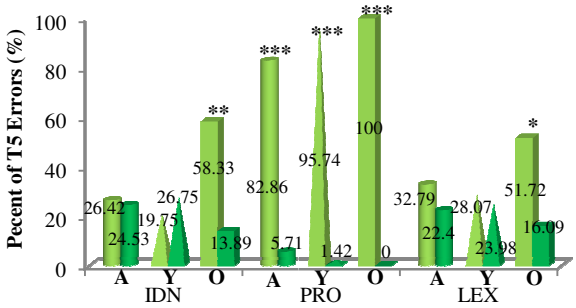
The pattern of low level tone (T5) errors was analyzed, and the results of T5 error matrix, as shown in Table 3, show that high level tone (T1) and low-falling tone (T3) are both potential substitutes for T5, especially in the three perception tasks. In some cases, T5 is also confused with low rising tone (T2). However, in the production task, T5 is largely replaced by low-falling tone (T3) to all participants.

Table 3. *Low Level Tone (T5) Error Matrix*

T5 Errors \ As		T1	T2	T3	T4
Young Attriters	IDN	25	14	14	0
	LEX	22	14	20	5
	PRO	9	0	58	3
Young Fluent Speakers	IDN	54	11	16	0
	LEX	29	12	16	0
	PRO	0	0	45	2
Older Fluent Speakers	IDN	15	0	21	0
	LEX	6	8	15	0
	PRO	0	0	23	0

The low-falling (T3) substitute was compared with any other response (T1, T2, and T4) by the paired T-test to examine if T3 is a better substitute for low level tone (T5), and the results are illustrated in Figure 3.

Figure 3. *Results of T5 Error Patterns* (left- light green: T3 responses, right- green: any other tone responses)



The paired T-test results show that low-falling tone (T3) is the better substitute for low level tone (T5) to all participants in the production task (PRO), attriters (A): t(9)= 5.0493, p<0.001***, young fluent speakers (Y): t(12)= 5.285, p<0.001***, older fluent speakers (O): t(8)= 6.2026, p<0.001***. In the identification task, there is no significant difference in both young groups, (A): t(9)= 0.1817, p>0.05, (Y): t(12)= -1.0247, p>0.05, but there is a significant difference in the older fluent group, (O): t(8)= 3.9715, p<0.01**. Similarly, in the lexical task, there is no significant difference in both young groups, (A): t(9)= 0.7767, p>0.05, (Y): t(12)=0.8371, p>0.05, but there is a significant difference in the older fluent group, (O): t(8)= 2.8886, p<0.05*. Moreover, in the AXB discrimination task, the T3-T5 pair is more confusing than any other pair to all participants. The two-sample test results show that there is no significant difference in the young attriter group, t(18)= 1.3374, p> 0.05, but there is a significant difference in the young fluent group, t(24)= 2.6888, p<0.01**, and in the older fluent group, t(16)= 2.6648, p<0.01**. In other words, low-level tone (T5) is generally more likely to be replaced by low-falling tone (T3) in the production task than in the perception tasks.

5. Discussion

The current results generally support the effect of language attrition and phonetic similarity on the sound change of Hakka low level tone, and the perception-production asymmetry is also observed in the groups of Mandarin-dominant users (young attriters and young fluent speakers). However, the asymmetry is not found in the group of Hakka-dominant users (older fluent speakers).

5.1. About the Three Research Questions

First, the accuracy results show that attriters make more tonal errors than non-attriters, and there is no significant difference between young and older fluent speakers who supposedly have different degrees of language contact with Mandarin. The finding suggests that the effect of language attrition, but not language contact, is more likely to be responsible for the confusion of a less distinctive category, like low level tone in Hakka, and then the confusion may lead to the sound change from the less distinctive category to a more phonetically similar substitute. The effect of phonetic similarity, especially the articulatory account, explains how low level tone is more

susceptible to change and how the low level tone is more likely to be replaced by low-falling tone. The analysis of error matrices shows that low level tone is confused primarily with high level tone and low-falling tone, and sometimes with low rising tone. The high level tone has similar pitch contour to low level tone, and the low-falling tone has similar pitch height, which makes the two categories more phonetically similar to low level tone. However, the two substitutes are not evenly distributed. In the production results, low-falling tone is the better substitute for low level tone, whereas in the perception data, high level tone is the better substitute. The uneven distribution is dubbed as the perception-production asymmetry. Such an asymmetry is also found in Cantonese [4] and in Taiwanese [5]. As Yeh and Tu [5] propose, the sound change of low level tone is very likely to be determined by some post-lexical mechanisms, such as gestural coordination or production grammars. The proposal is supported by the empirical findings of Erickson et al [7] and Erickson et al [8]. These studies [7, 8] show that the supralaryngeal coordination of producing low tones, including tongue and jaw position, and the laryngeal movement, takes fewer articulatory efforts to generate falling pitch contour than level pitch, so the production mechanisms may favor low-falling tones over low level tones, for the sake of 'ease of articulation'.

5.2. Exception to Perception-Production Asymmetry

However, the asymmetry is only found in Mandarin-dominant users, but not in Hakka-dominant speakers. The current results show that these Hakka-dominant bilinguals confuse low level tone with low-falling tone not only in the production task but also in the perception tasks. The strong tendency to misperceive low level tone as low-falling tone occurs only to the Hakka-dominant sperkers. The exception seems related to their intensive Hakka use and exposure, so the older fluent speakers' errors were further examined. The results of additional analyses show that these Hakka-dominant users make significantly more errors on [fu] syllables than on [t^ho] ones in all tasks, which is rarely found in Mandarin-dominant users. In the production task, the error rate is even higher, which shows that eight participants out of nine (88.89%) pronounce *fu22* (low level tone) as *fu31* (low-falling tone) in non-final word position, like ***fu31****-si22* 'nurse' and ***fu31****-san22-k^ho53* 'obstetrics'. The lexical bias seems a confounding variable. According to Liu [14], these [fu] words with low level tone happen to have a heteronymous counterpart with low-falling tone. For example, 婦 *fu22* 'married woman' can be pronounced as *fu31* with the same meaning, and 傅 *fu22* 'master' can be pronounced as *fu31* referring to a surname. The heteronymous [fu] words indeed cause lexical confusion, and then may exacerbate perceptual difficulties which may explain why Hakka-dominant speakers confuse low level tone as low-falling tone not only in the production task, but also in the perception tasks. The lexical factor is proposed to account for the exception to perception-production asymmetry. Moreover, the lexical account can be verified by the bidirectional confusion between low level and low-falling words. According to the error matrix of low-falling tone, low-falling words are mostly confused with low level words to all participants, especially to Hakk-dominant speakers. These further analyses suggest that there should be some lexical confusion between low level and low-falling words in general, so the low level and low-falling words are confused with each other, even to fluent Hakka speakers.

6. Conclusion

The study suggests that the effect of language attrition results in the sound change of Hakka low level tone, and the change is determined by some post-lexical mechanisms, supposedly for the sake of 'ease of articulation'. The phonetic similarity of pitch height (high versus non-high) is the key to the change, which accounts for the common occurrence of non-high level tone change cross the three languages. However, the Hakka data show that the lexical factor of heteronyms and some other factors, such as prosodic position (word-initial or word-final), can also exert an influence on the sound change. To sum up, more Hakka lexical items are needed to examine the lexical account of exception to perception-production asymmetry, and the similar paradigm of experimental setups should be applied to both the Taiwanese and Cantonese cases for a better cross-linguistic comparison.

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