

Tone Change in Taiwanese: Age and Geographic Factors*

Wi-vun Taiffalo Chiung

1 Introduction

There are currently seven tonal categories in the Taiwanese language. They are traditional called tones 1, 2, 3, 4, 5, 7, and 8. It has been observed that tone 6 had merged with tone 2 or tone 7 (Ang 1985:2-3), therefore, there are today only seven tones left, as listed in table 1.

Samples	君 [kun ¹] gentle	滾 [kun ¹] boil	棍 [kun ¹] stick	骨 [kut ¹] bone	裙 [kun ¹] skirt	-	近 [kun ¹] near	滑 [kut ¹] glide
Traditional Tone Category	陰平	陰上	陰去	陰入	陽平	陽上	陽去	陽入
Traditional Tone Number	1	2	3	4	5	6	7	8
Tonal Value of Five Scales	44	53	21	3	12		22	5
Graphical Five Scales	┐	┑	┓	┑	┓		┑	┐

Table 1. Tonal categories in Taiwanese (Cheng 1997).

Tone 5 is traditionally described as a low rising tone (12); tone 4 and tone 8 are abrupt tones with low and high contrasts, respectively (Cheng 1977, 1997; Hung 1985; Weingartner 1970). However, Ong (1993) has shown that tone 5 is a low falling and then rising tone based on acoustic measurement in 1945 of his own pronunciation. Tseng (1995: 32) points out that the tone shape of tone 5 can be a rising contour (/) if the starting point is low; or a dipping contour (\) if the starting point is slightly higher. Both contours share the low-rising pattern. As for tone 4 and tone 8, it is said that distinctions between

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tone 4 and tone 8 are not apparent in some areas such as in Tai-tiong city of central Taiwan (Cheng 1977:97; Khou 1990:89).

Although many Taiwanese linguists have shown interest in the study of Taiwanese tones, little research has been conducted to investigate whether or not the different descriptions in tone 5, 4, and 8 have resulted from synchronic and diachronic changes or simply because they have used auditory impressions as the basis of their analysis. Thus, the purpose of this study is to provide a systematic account with regard to the change in Taiwanese tone 5, tone 4, and tone 8, based on computer-assisted acoustic measurements of tone values. The specific questions in this study are: 1) Is tone 5 a low rising tone or not? If not, what trajectory is it? And what factors are contributing to this change. 2) Is tone 8 distinguished from tone 4 by all Taiwanese speakers? If not, who are more likely to have merged tone 4 and tone 8?

2 Sociolinguistic Background in Taiwan

Taiwan is a multi-lingual and multi-ethnic society. Chronologically, the first group is made up of Taiwanese aborigines with 1.7% of Taiwan's population. Secondly, the Holo people with 73.3%, and then Hakka people with 12%, and finally Mainlanders (recent settlers, came to Taiwan around the 1940s) with 13% (Huang 1993:13). The mother tongue of the Holo people is usually called Taiwanese, Holoese, or Southern Min. This is the language we focus on in this paper.

The decline of vernacular languages in Taiwan has been more and more pronounced since the Japanese (1895-1945) and Chinese KMT occupations (1945-2000), which respectively imported and adopted Japanese and Mandarin Chinese as the only official languages in Taiwan. Taiwanese was not only forbidden in school, but also in public places. Moreover, the Taiwanese languages were limited on mass media. Consequently, research has revealed that the use of aboriginal languages, Holo, and Hakka is diminishing, while the use of Mandarin is increasing (Huang 1988; Young 1989). Chan's (1994:iii) research revealed that "proficiency in *Guoyu* [Mandarin] by the Taiwanese is increasing, while that in *Minnanyu* [Taiwanese] is decreasing." In addition, Young (1989:55) pointed out that "there is increased use of Mandarin with each succeeding generation. About half (50.9%) of the Hakka and 41.3% of the Southern Min used Mandarin frequently or most of the time with family members of the younger generation." Moreover, Huang (1993: 160) pointed out that the aboriginal languages in Taiwan are all endangered.

It is overt that the monolingual policy of Mandarin has affected the ecology of languages in Taiwan. Language contacts between Mandarin and

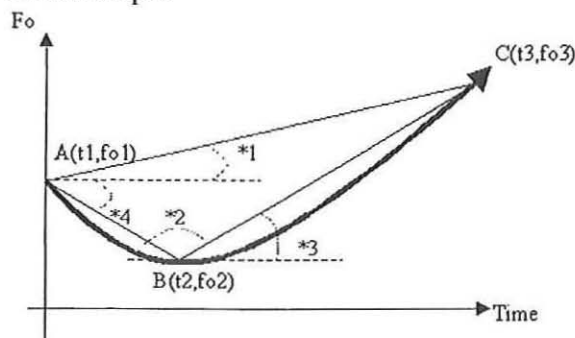
Taiwanese may contribute to the tonal variations in both Mandarin and Taiwanese.

3 Methodology

The Method of Tonal Triangle Analysis (MOTTA) was developed in this research. The strength of MOTTA is that we can have the value of the slope of the pitch trajectory if it is a rising or falling tone; or have the angle value of the curve if it is a rising-falling or falling-rising tone. This strength will allow us to accurately measure and describe tone values occurring in most Asian tone languages, such as Taiwanese and Mandarin. With these values, we can do further statistical analysis and figure out whether or not the tones are changing.

3.1 Method of Tonal Triangle Analysis

The notion behind tonal triangle analysis is that any given monosyllabic tonal contours can be treated as a triangle, and different triangles are acoustically considered different tone shapes. Further, each tonal category should have its own range of tone shapes (i.e., values of the five MOTTA criteria as proposed below). Different tones are perceived by listeners because of their contrasts of the tone shapes.



A: the beginning point of tonal contour

B: the turning point (the lowest point of F_0) of tonal contour

C: the ending point of tonal contour

Figure 1. Method of Tonal Triangle Analysis.

Five criteria are proposed to be measured. They are angle 1 (*1), angle 2 (*2), ROP, BOP, and DOP as described below. If we are able to know the *2,

the lengths of AB and BC, then we are able to determine the triangle shape. In addition, we need to specify the values of point A and *1, in order to fix the triangle in the F_0 -Time dimension. Therefore, there are five criteria to specify the acoustic properties of tones.

- (1) *1: the angle between AC and Time-axis

if *1>0, it means AC is rising

if *1=0, it means AC is level

if *1<0, it means AC is falling

- (2) *2: the angle between AB and BC

When doing data analysis in the paper, the angles measured here were transcribed into another form, for example:

Angle 180=0

Angle 178=2

Angle -177=-3

Thereafter,

if *2>0, it means ABC is a curve, and its mouth face up

if *2=0, it means ABC is a straight line

if *2<0, it means ABC is a curve, and its mouth face down

- (3) ROP (Ratio of Pitch): the length ratio of AB to BC

- (4) BOP (Beginning of Pitch): the starting point of tonal contour in F_0

- (5) DOP (Duration of Pitch): the total period of tonal contour in msec.

3.2 Subjects

Thirty informants were involved in this study. Twenty-two of them are overseas Taiwanese students at the University of Texas at Arlington. The others currently reside in Taiwan. Most of them are bilingual, i.e. Taiwanese and Taiwan Mandarin, except five of the subjects (all of ages over 60) self-reported that their Mandarin speaking abilities were less than 3, based on a 5 degree of scale. Table 2 and table 3 shows the cross tabulation of age, sex and place backgrounds of the subjects. Because of time limitations, the informants were not widely sampled. For example, we may need more informants from elder generations. Since we do not have enough informants involved in this study, we may consider this study a preliminary one.

AGE * PLACE Crosstabulation

Count		PLACE				Total
		North	central	South	other	
AGE	under30	11	4	3	1	19
	30-50	3	2			5
	over50			6		6
Total		14	6	9	1	30

Table 2. Informants' age and resident place.

AGE * SEX Crosstabulation

Count		SEX		Total
		female	male	
AGE	under30	11	8	19
	30-50		5	5
	over50	3	3	6
Total		14	16	30

Table 3. Informants' age and sex.

3.3 Word List

The data were adopted from part of my previous research on the acoustic properties of Taiwanese and Mandarin tones. The word list was prepared in a set of disyllabic words or short sentences. Only their last syllables were measured for analysis since Taiwanese possesses tone sandhi and only the tone in the last syllable remains unchanged in a sequence of syllables. I did not use monosyllabic words in isolation because in reality speakers rarely speak in this way. If listeners can distinguish the tones in a sequence of utterance, we should not have any problems with regards to the measurement of tone values.¹

T-tone 4, 排骨 [pai ˩ kut ˩]* (spareribs)

T-tone 5, 短裙 [te ˩ kun ˩]* (short skirts)

T-tone 8, 路真滑 [lo ˩ tsin ˩ kut ˩]* (the road is very slippery)

(* Surface tones were presented here)

¹ Generally speaking, the tones in isolated and non-isolated syllables remain relatively the same in the case of Mandarin (Fon and Chiang 1999:24). In my pilot study of a 28 year-old male Taiwanese speaker, Taiwanese tone 5 also shows a falling-rising contour in a isolated monosyllabic word 裙.

3.4 Experimental Procedure

The 30 informants were told to read words on a set of cards with five repetitions, which were prepared according to the word list. The subjects were tape recorded and at a later time, the subject responses were played into a computer digitized by the Computerised Extraction of Components Intonation of Language (CECIL) software/hardware speech analysis package (JAARS, Waxhaw, NC)(Ross et al. 1986, 1992; Chu 1998). Fundamental frequency was extracted per millisecond and represented in semitones.² Once digitized, points A, B, and C of each tone token were determined manually and further calculation and analysis were undertaken using MS-EXCEL and SPSS.

4 Results and Discussion

In this section, the Taiwanese tones were described in terms of the five criteria. In addition, each tone was illustrated by a pitch trajectory graph drawn from informant *ab*, a 26 year old female.

4.1 Tone Five

Traditionally, Taiwanese tone 5 is described as a low rising tone (12). However, my measurements suggest that tone 5 should be a low falling and then rising tone (212), as shown in figure 2. The mean value of angle between falling and rising (i.e. Angle 2) is 1.4932 MOTT with a standard

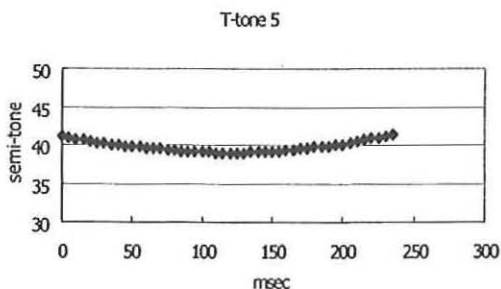


Figure 2. Pitch trajectory of Taiwanese tone 5.

² Because the perception of equal pitch intervals is not represented by a constant span of Hertz with increasing pitch, an interval-preserving metric in semitones is needed (Ross et al. 1986:288-289).

deviation of 1.093 (see table 4). The mean value of ratio of falling to rising (i.e. ROP) is 1.498 MOTTA with a standard deviation of 2.052. Among the 30 subjects, 21 of them show low falling-rising contours, only 5 show low rising shape. The most surprising finding was that 3 of them produced a low falling shape.

T-Tone 5	ROP	*1	*2	BOP	DOP
mean	1.498	-0.332	1.493	36.6	212.4
sd.	2.052	0.733	1.093	4.7	93
highest	9.000	1.175	3.535	44.7	450
lowest	0.000	-2.555	0.000	29.1	35

Table 4. MOTTA values of Taiwanese tone 5.

This falling-rising feature in tone 5 raises interesting questions. Is this a tone change from low-rising to falling-rising or are linguists are not aware of this falling feature? If this falling-rising feature has resulted from tone change, what are the factors?

In order to answer these questions, the data sets for angle 2 of tone 5 were analyzed by using univariate ANOVAs of SPSS. Sex, age, and resident place were first pre-assumed as the significant independent factors. Being monolingual in Taiwanese was not listed as an independent factor because this is already reflected in the age factor. After several trials, univariate ANOVA was re-run with only age (under 50 vs. over 50) and place (north vs. central vs. south) factors.

Considering the statistical results, although age ($p=0.155$) and place ($p=0.147$) factors are not statistically significant at the 5% significance level, it reveals a tendency that age and resident place might be contributing to the change of tone 5. If we can get more subjects from balanced age groups and resident places, we may have better statistical results with regard to this issue. In fact, if we do not consider both age and place factors simultaneously, they do show statistically significant differences, as shown in table 5 and table 6.

Pairwise Comparisons

Dependent Variable: ANGLE2

(I) AGE	(J) AGE	Mean Difference (I-J)	Std. Error	Sig. ^a	95% Confidence Interval for Difference ^a	
					Lower Bound	Upper Bound
under 50	over 50	1.268 ^a	.506	.019	.224	2.312
over 50	under 50	-1.268 ^a	.506	.019	-2.312	.224

Based on estimated marginal means

- *. The mean difference is significant at the .05 level.
- a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).
- b. An estimate of the modified population marginal mean (J).
- c. An estimate of the modified population marginal mean (I).

Table 5. Pairwise comparisons between age categories.

Pairwise Comparisons

Dependent Variable: ANGLE2

(I) PLACE	(J) PLACE	Mean Difference (I-J)	Std. Error	Sig. ^a	95% Confidence Interval for Difference ^a	
					Lower Bound	Upper Bound
North	central	-.977 ^b	.481	.053	-1.970	1.550E-02
	South	.355 ^b	.446	.434	-.565	1.276
central	North	.977 ^b	.481	.053	-1.550E-02	1.970
	South	1.332 ^a	.540	.021	.218	2.446
South	North	-.355 ^b	.446	.434	-1.276	.565
	central	-1.332 ^a	.540	.021	-2.446	-.218

Based on estimated marginal means

- *. The mean difference is significant at the .05 level.
- a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).
- b. An estimate of the modified population marginal mean (I).
- c. An estimate of the modified population marginal mean (J).

Table 6. Pairwise comparisons between place categories.

	Under 30	30-50	Over 50	total
Falling-rising	16	4	1	21
Low rising	3	1	4	8
total	19	5	5	29*

* One was excluded because his data of tone 5 was missing.

Table 7. Observed numbers of each category by age and tone feature.

In order to gain a better idea about the contributions of age and place factors to the change of tone 5, we may examine the original data set. The data (see table 7) reveal that 16 out of the 21 falling-rising featured informants are

aged under 30; or 16 out of the 19 who are aged under 30 are falling-rising featured speakers. In contrast, four out of the eight low-rising featured speakers are over 50 (although one of the other four who are under 50 is 47); only one out of the five speakers over 50 has the falling-rising feature. To better understand the relationship between the contour feature and age factor, it will be useful if we can do chi-square tests with these data in table 7. However, because some data cells contain numbers less than five, we are not able to do chi-square tests. We may do chi-square tests in the future when we add up more subjects. Even without the tests, it seems that young people tend to have falling-rising features, but older generations tend to have low-rising features. In addition, my measurements reveal that younger generations tend to have a larger value of angle 2 ('over 50,' 'between 30-50,' and 'under 30' have mean values of 0.511, 1.667, and 1.927, respectively). Are these phenomena of age-grading or of diachronic change resulting from language contact? Based on the evidence available, it seems more likely that it is a consequence of language contact.

Several recent reports have shown that Mandarin tones in Taiwan have developed slightly differently from the traditional tone descriptions, which are primarily based on Beijing Mandarin (Fon and Chiang 1999; Chu 1998; and Chiung 1999). Generally speaking, Mandarin tone 2 is changing from rising (Beijing 35) to falling-rising (Taiwan 323); Mandarin tone 3 is changing from low falling and then rising (Beijing 214) to low falling (31 or 21) or low falling with slightly rising (312) or low level (22). The distinction between tone 2 and 3 in Taiwan Mandarin is primarily based on the contrast of relatively high and low. The changes of Mandarin tone 2 and tone 3 are very likely to be the consequence of contact with Taiwanese. If the influence of Taiwanese on Mandarin tones exists, it is also possible that Mandarin has influence on Taiwanese tones. Because the contour of falling-rising is apparent in Mandarin, this falling-rising feature may be imposed on the learners of Taiwanese. As time went on, the new generations of Taiwanese speakers gradually adopted the falling-rising feature.

We may conclude that Taiwanese tone 5 is diachronically changing from low-rising to falling-rising feature. Recall that Mandarin was not spoken by the Taiwanese people prior to the 1945. Thereafter, Mandarin was adopted as the official language and exclusively taught in the national education system. Because those aged over 50 are less influenced by Mandarin, they tend to retain the low-rising feature. In contrast, the increasing use of Mandarin by the younger Taiwanese generations has forced the falling-rising feature to be imposed on the Taiwanese language. Because the traditional description of tone 5 was based on the older generations, it did not account for the tone

change among younger generations; thus, tone 5 was described as a low rising tone.

In addition to the age factor, resident place could be a significant factor too. The results of pairwise comparisons in table 6 show that place categories, i.e. north, central, and south, are significantly different from each other at 5% significance level except the pair of north vs. south. Their values of angle 2 are 1.395, 2.372, and 1.040, respectively. Among the place categories, the central area has a prominently higher value of angle 2. In other words, the curvature of falling-rising feature in central Taiwan Taiwanese speakers is substantially bigger than in northern and southern speakers. This finding reveals that Taiwanese tone 5 is synchronically changing in addition to diachronic contributions, and geographical differences contribute to the synchronic change. The reason for the synchronic change remains unclear and further research is needed to answer it.

4.2 Tone Four and Tone Eight

Tone 4 is a short and abrupt falling tone, with BOP value at an average of 39 semitones, and DOP value at an average of 71 msec (see figure 3 and table 8). The BOP was chosen as a criterion to examine whether or not speakers make distinctions between tone 4 and tone 8. The statistical results of t-tests between the data sets of tone 4 and tone 8 reveal that there is no significant difference among the informants. It suggests that the majority of the informants did not distinguish between tones 4 and 8. Only a few cases make distinctions, such as informant ca who produced tone 4 at the BOP value of 38.9 semitones, and tone 8 at the value of 43.4 semitones.

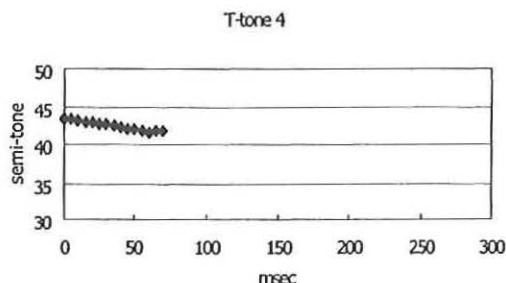


Figure 3. Pitch trajectory of Taiwanese tone 4.

T-Tone 4	ROP	*1	*2	BOP	DOP
mean	0.046	-1.214	-0.216	39	71
sd.	0.122	0.634	0.615	3.6	18
highest	0.444	-0.246	0.000	47.0	95
lowest	0.000	-2.545	-2.578	31.3	25

Table 8. MOTTA values of Taiwanese tone 4.

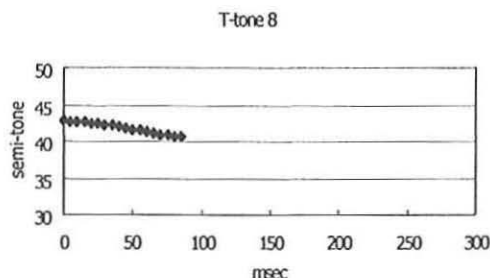


Figure 4. Pitch trajectory of Taiwanese tone 8.

T-Tone 8	ROT	*1	*2	BOT	DOT
mean	0.135	-0.843	-0.091	39.9	77.7
sd.	0.426	1.448	0.762	3.8	37
highest	2.000	4.086	1.337	48.9	210
lowest	0.000	-2.934	-2.864	30.4	20

Table 9. MOTTA values of Taiwanese tone 8.

We may classify the subjects based on their tone feature (i.e., make distinctions or not between tone 4 and tone 8), resident place, and age categories, as shown in table 10 and table 11. Table 10 reveals that speakers in the northern and central Taiwan areas are more likely to have merged tone 4 and tone 8. In contrast, southern Taiwanese speakers are more likely to preserve the distinction between tone 4 and tone 8. As for the age factor, table 11 shows that speakers with age over 50 are more likely to distinguish tone 8 from tone 4; however, speakers with age under 50 are more likely to have the merger of tone 8 and tone 4. The only speaker who distinguishes tone 8 from tone 4 in the age category 'under 30' lives in the Chiong-hua city, where is located in between central and south areas of Taiwan.

Although we need more data and advanced statistical analysis to confirm the results, the preliminary findings are pretty reasonable. First, geographi-

cally, the Taiwanese language has less vitality in northern (where the capital Taipei is located) and central areas than in the southern area after over fifty years' monolingual policy of Mandarin. The decreased use of Taiwanese in the northern and central areas of Taiwan has made the speakers lose the ability to distinguish between tone 4 and tone 8.³ Second, because the younger generations are losing their ability of speaking Taiwanese, they are encountering difficulties in learning tone 4 and tone 8. In many cases, the young speakers are neither able to pronounce tone 4 nor tone 8. Instead, their tone 4 and tone 8 are uttered in the way close to tone 2, tone 3, or tone 7 with relatively shorter duration.

	North	Central	South	<i>total</i>
Distinct	0	1	5	6
Mergence	14	5	4	23
<i>total</i>	14	6	9	29*

* One was excluded because he was from eastern Taiwan.

Table 10. Observed numbers of each category by place and tone feature.

	Under 30	30-50	Over 50	<i>total</i>
Distinct	1	0	5	6
Mergence	18	5	1	24
<i>total</i>	19	5	6	30

Table 11. Observed numbers of each category by age and tone feature.

5 Conclusion

There are several preliminary findings with regard to the change in Taiwanese tone 5, tone 4 and tone 8. For the tone 5, there is a diachronic change from low rising (older generations) to falling-rising (younger generations), as well as synchronic change, in which geographical differences contribute to its change. As for tone 4 and tone 8, age and resident place are contributing factors. Generally speaking, tone 4 and tone 8 are merging together among the younger generations (age under 50). Geographically, the distinction between tone 4 and tone 8 is mainly preserved only in the southern area of Taiwan. These changes in tone 5, tone 4, and tone 8 might be the results of language

³ Taiwanese tone 4 and tone 8 are called *Jip-sia*ⁿ (入聲) or Entering tone, which do not exist in the current Mandarin Chinese. Thus, Taiwanese tone 4 and tone 8 are generally regarded the most difficult part for the Mandarin-speaking learners of Taiwanese.

contacts between Taiwanese and Mandarin Chinese since 1945. Further research with larger database is needed to confirm these preliminary findings.

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Program in Linguistics
University of Texas at Arlington
Arlington, TX 76019-0559
taiffalo@ling.uta.edu