Proceedings of the
WESTERN CONFERENCE
ON LINGUISTICS

Volume Two
1989

WECOL

Edited by
Frederick H. Brengelman
Vida Samiiian
Wendy Wilkins

Department of Linguistics
California State University, Fresno
Fresno, California 93740-0092
The Distribution of Tone in Taiwanese

Jane S. Lee
University of Arizona

1. Introduction

The main claim of moraic theory (Hayes 1989, Hyman 1985, McCarthy & Prince 1986, 1988) is that the only prosodic units within a syllable are moras. In this paper, I show that this claim holds for Taiwanese. In addition to moras, we also need the concept of minimal word (McCarthy and Prince 1988) and the melodic tier to account for prosodic phenomena like tone patterns and compensatory lengthening in Taiwanese. I will show that there is a constraint on the assignment of tone from the melodic tier (i.e., moras alone are not enough to account for the distribution of tone) and that the distribution of tone and the mora structure of the syllable together provide evidence that the minimal word of Taiwanese is a bisyllabic syllable.

Taiwanese, a Chinese dialect belonging to the Southern Min family, has two kinds of syllables. One ends in a sonorant segment (including vowels and sonorant consonants); the other ends in a non-sonorant segment. The former is called a "free syllable" and the latter a "checked syllable" in the traditional terminology. There are seven surface tones in Taiwanese which can be divided into two types. One type I call "long tone" and the other "short tone" since the former is phonetically four times longer than the latter according to spectrographic analysis done by myself.

Interestingly, the free syllables always have long tone, and the checked syllables the short tone. By using moraic theory, we can account for this fact.

This paper is organized as follows. In Section 2, the tone pattern in Taiwanese is introduced. In Section 3, the syllable types are presented. In Section 4, the correlation between syllable structure and tone is demonstrated. Then, the evidence from compensatory lengthening is given in Section 5. Finally, in Section 6, the seven surface tones are reduced to five underlying tones.

2. The pattern of tones in Taiwanese

Taiwanese, like other Chinese dialects, is a monosyllabic tone language, that is, each word is one syllable and every word has a tone. The data cited in this paper are from my own dialect.

Taiwanese has seven tones: high level, rising, falling, high short, low short, and high short. Following Chao (1930), I use digits to denote the Taiwanese tones: "1" denotes the highest pitch, "2" the lowest. For example, "55" is a high-level tone, "52" is a high-falling tone (a contour tone). Only one digit is used for short tones. For example, "2" is a low short tone.

The seven tones are given in (1), together with examples:

(1) 1. 55 (high-level) 2. 52 (high-falling) 3. 53 (mid-level) 4. 21 (low-short) 5. 24 (rising) 6. 22 (falling) 7. 24 (sounding)

Note that the short tones appear only with words that end with a voiceless stop, and the other tones appear with any words except those ending with a voiceless stop. We will come back to this point later.

3. The structure of Taiwanese syllables

3.1. Some generalisations

The lexical number of segments per syllable is four, with at most two prevoical segments and one postvoical segment. There is only one vowel per syllable. This vowel is the only segment that is obligatory within a syllable, e.g. /k/ 24 'she'. All consonants except /l/ can appear in onset position, but only nasals and some voiceless stops (i.e. /p, t, k/) can appear in coda position. Glides can either precede or follow the vowel, and are always adjacent to the vowel. The structure of Taiwanese syllables is summarized in (2).

(2) (C) (G) V (G) (C) (/m, n, ng, p, t, k, l/ only)

3.2. Syllable types in Taiwanese

The examples given in (3) exhaust all possible syllable types in Taiwanese. Syllables are classified into two major types, free and checked, according to the monoply of the last segment in the syllable. Free syllables are sonorant-final, including three subtypes: vowel-final (28), glide-final (3b), and nasal-final (3c). Checked
syllables are stop-final, i.e. nonsonorant-final (3d).

(3) **Free syllables** -- (son)-final syllables
   a. Vowel-final syllables and syllabic nasals
      e 24  'shoe'
t 22  'take'
yu 55  'worry'
s 33  'no'
d. Glide-final syllable
   t 24  'love'
   Caw 24  'head'
c. Nasal-final
   lie 11  'shade'
   sven 55  'sneak'

**Checked syllables** -- (son)-final syllables
d. Stop-final syllable
   yap 1  'hide'
sap 2  'push'
kyox 4  'situation'
qay 4  'moon'
sit 4  'real'

So far, we have seen the tone pattern and the syllable structure of Taiwanese. We will see the correlation of tone and syllable structure next.

4. The correlation of tone and syllable structure

4.1. Tones in complementary distribution

As mentioned above, the short tones only appear with checked syllables. On the other hand, free syllables never have short tones. This is shown in (4).

<table>
<thead>
<tr>
<th>Tone</th>
<th>Free syllables Long Tone</th>
<th>Checked syll Short Tone</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>e  e  e  ke  e  e  e</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>e  e  e  ke  e  e  e</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>e  e  e  ke  e  e  e</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>e  e  e  ke  e  e  e</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>e  e  e  ke  e  e  e</td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>e  e  e  ke  e  e  e</td>
<td></td>
</tr>
<tr>
<td>VII</td>
<td>e  e  e  ke  e  e  e</td>
<td></td>
</tr>
</tbody>
</table>

**In summary,** the correlation between tone and syllable structure is three-fold as shown in (5).

(5) "Free syllable" vs. "Checked syllable"
    "Long tone" vs. "Short tone"

4.2. Two hypotheses

In the surface representation, there are two types of tones, long and short. Likewise, there are two types of syllables; free syllables and with a (son) segment while checked syllables end with a (son) segment. There are two hypotheses about this phenomenon.

4.2.1. Hypothesis I -- there are two moras in free syllables and one mora in checked syllables.

Since the checked syllables always have short tone, we may suppose that it is a light syllable which has only one mora. In other words, a nonsonorant stop in coda position is not moraic. The free syllables, then, are heavy and have two moras. This can be seen in (6) and (7).

(6) Free syllables (two moras - heavy)
    (T = tone, M = mora, S = syllable)
    a. (3a)  e 24  'shoe'
    b. (3b)  kway 53  'cheat'
    c. (3c)  im 11  'shade'

(7) Checked syllables (one mora - light)
    (son)  qay 4  'moon'

4.2.2. Hypothesis II -- all syllables have two moras. Suppose that all syllables have two moras, that is, that the minimal word in Taiwanese is a bisyllabic [5] mora.

(8) Minimal word in Taiwanese
    [5 mora] wd
In other words, all consonants in code position are moraic. Now we need to explain why checked syllables get only short tones and why free syllables never get short tones. The explanation can be obtained if we assume that morsa linked up with a [-son] segment in the melodic tier cannot be linked to a tone. In other words, the checked syllables, which end with a [-son] segment, have only one mora that is linked up with the tone.

These two hypotheses give us the same results with respect to tone linking. Since in both hypotheses free syllables have two morsas and the two morsas are linked up with the tone, there is no distinction between them.

For checked syllables, the difference that the two hypotheses make is that there is only one mora in a checked syllable according to Hypothesis I, while there are two morsas in a checked syllable according to Hypothesis II. But if we make the reasonable assumption that morsa linked to a [-son] segment cannot link to a tone, the result in both hypotheses is the same: there is only one mora linked up with the tone in checked syllables. (8) (cf. (7))

(9) Checked syllables (two morsas -- but only one is linked up with the tone)

(=301) ge? 4 'noon'

Since both hypotheses work equally well, now do we choose between them? Fortunately, there is an additional free phenomenon that can help us make the decision, namely, compensatory lengthening.

5. Compensatory lengthening

5.1. Tone Sandhi

Before discussing compensatory lengthening, we should look at the tone sandhi which accompanies it.

In Taiwanese, a base tone changes into a sandhi tone when it is not the last member within a tone group. (See Chen 1987 for detailed discussion.) The Tone Sandhi Rule is given in (10).

(10) Tone Sandhi Rule (Chen 1987)

T -- T' / _ T (within a tone group)

Sanda tone is from my own dialect are given in (11).

There are alternate sandhi tones for short tones (Tone VI and Tone VII). Note that the sandhi tones of Tone IV and Tone V have the same tone values as one of the two alternate sandhi tones, i.e., 51 and 11. We will come to this later.

For checked syllables not ending with a glottal stop /\, the sandhi tones are (4) for Tone VI and (2) for Tone VII. (See (12)). (Sandhi tones are put in curly brackets to distinguish them from base tones.)

(12) a. kut 4 + t\: 53 ----> kut (2) t\: 53 'slip-fall' 'slip-fall'
b. k\x2022 2 + ka: 55 ----> k\x2022 (4) ka: 55 'country' 'home' 'country'

For checked syllables ending with /\, the sandhi tones are (51) for Tone VI and (11) for Tone VII together with glottal stop deletion. (We will talk about the glottal stop deletion in next section.) That is, the sandhi tone shows up long instead of short as we would expect. Examples are given in (13).

(13) a. pe? 4 + ts\k\: 53 ----> pe (11) ts\k\: 53 'white' 'paper' 'white paper'
b. pe? 4 + sa: 55 ----> pe (11) sa: 55 'white' 'clothe' 'white clothe'
c. pe? 2 + tu- 55 ----> pe (11) tu- 55 'eight' 'piece' 'eight pieces of paper'
d. pe? 2 + ni- 24 ----> pe (11) ni- 24 'year' 'eight years'

5.2. Compensatory lengthening

A syllable-final glottal stop is dropped when followed by another syllable, as shown in (14).

(14) ge? 4 + niu- 24 ----> ge (11) niu- 24 '很多玩家' 'many people'

The Glottal Stop Deletion Rule is given in (15).

(15) Glottal Stop Deletion Rule

T -- T' / _ T (within a tone group)
If nothing follows, then the final glottal stop is not dropped and the tone remains the same, as shown in (16).

(16) a. swan 1) - pe? 4 --> swan (53) pe? 4
garlic' 'white'

b. ^ 55 + pe? 4 --> 2 (33) pe? 4
'black and

'Thei 2 + pe? 2 --> thei (11) pe? 2
'number eight, eighth'

The change of a short sandhi tone to long sandhi tone in (13) can be understood as a case of compensatory lengthening (CL) if we assume that a tone linked up with two sors is long. The process is as follows: when the final glottal stop drops, it leaves a sora. The preceding vowel then spreads to that sora and gets lengthened. Since the second sora is not linked to a [+son] segment anymore, the tone can link to both soras and surfaces long. The derivation is given in (17).

(17) pe? 4 ————> pe (11) 'white'

T (Sndhri) T T T T

CL (Sndhri) CL

The difference between IV and VI is neither a difference in underlying tone (they are both L), nor a difference in the moraic structure of the syllables (all syllables are bisyllabic, as we have argued), but rather it is a result of the Tone Linking Constraint given in (19) above. In other words, it's due to the different values of some segments) feature in the melodic tier, the feature (son). This is supported by the fact that after the /l/ is dropped, Tone VI gets the same sandhi tone as Tone IV. In (22), it is shown that Tone IV and Tone VI have the same underlying tone L, and that the Tone Linking Constraint applies to Tone VI, not Tone IV. Thus they surface as short tone and long tone respectively.

(22) a. Tone IV (non-sndhri) b. Tone VI (non-sndhri)

Thus we conclude that Hypothesis II is more desirable than Hypothesis I. By adopting Hypothesis II, we claim that there is a constraint on tone linking, as given in (19): a tone cannot link to a sora that designates a [+son] segment.

By proposing this constraint, we also claim that the tonal tier is able to look down to the melodic tier.

Returning to tones in complementary distribution

As we recall from (11), we notice that Tone IV and Tone VII are in complementary distribution with Tone VI and Tone VII, respectively.

(20) [ = (11)] Sandhi tones

<table>
<thead>
<tr>
<th>T</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
</tr>
</thead>
<tbody>
<tr>
<td>T (Base tone)</td>
<td>55</td>
<td>24</td>
<td>55</td>
<td>11</td>
<td>33</td>
<td>2</td>
</tr>
<tr>
<td>T (Sndhri tone)</td>
<td>33</td>
<td>33</td>
<td>55</td>
<td>55</td>
<td>11</td>
<td>33</td>
</tr>
</tbody>
</table>

Considering the same sandhi behavior in these two groups, we say that these four tones are underlyingly two tones. We can assign IV/VI as L (low) and V/VI as M (mid), as in (21).

(21) IV VI VII T | 11 (L) | 23 (M) | 2 (L) | 4 (M) |
T | 55 | 11 | 33 | 11 | 7 |

The difference between II and III is a difference in underlying tone (they are both L), and a difference in the moraic structure of the syllables (all syllables are bisyllabic, as we have argued), but rather it is a result of the Tone Linking Constraint given in (19) above. In other words, it's due to the different values of some segments) feature in the melodic tier, the feature (son). This is supported by the fact that after the /l/ is dropped, Tone VI gets the same sandhi tone as Tone IV. In (22), it is shown that Tone IV and Tone VI have the same underlying tone L, and that the Tone Linking Constraint applies to Tone VI, not Tone IV. Thus they surface as short tone and long tone respectively.
(23) a. Sandhi of Tone IV
   S T(L) --> S\n   T
   x y
   /\  (ke: 52) 'separate'
   \ /
   x e (7 >0)
   (as in ke: 53 ts\'wa 33 'marriage') (as in ke: 53 kw\'i 55 'separate-open')

   The case is true for Tone V and Tone VII. We thus reduce 'the seven surface tones to five underlying tones.'

(24) Underlying tone system of Taiwanese

<table>
<thead>
<tr>
<th>Underlying</th>
<th>Tone</th>
</tr>
</thead>
<tbody>
<tr>
<td>H \ U</td>
<td>1</td>
</tr>
<tr>
<td>L R</td>
<td>11</td>
</tr>
<tr>
<td>M</td>
<td>11/2</td>
</tr>
<tr>
<td>L M</td>
<td>11/4</td>
</tr>
<tr>
<td>SNI</td>
<td>11/2</td>
</tr>
</tbody>
</table>

(25) Conclusion
I have argued that the minimal word in Taiwanese is a bisyllabic syllable. This is supported by the phenomenon of compensatory lengthening. I have also shown that the seven surface tones in Taiwanese can be reduced to five underlying tones. This Hayes's model of compensatory lengthening (Hayes 1989) works for Taiwanese, and the concept of minimal word as proposed by McCarthy and Prince (1986, 1988) is necessary in prosodic phonology.

NOTES

(1) I would like to thank Diana Archangeli, David Basilio, Dick Denes, Rosa Garcia, Mike Hammond, Masahide Ishihara, Jorge Lemus, James Myers, Douglas Paynter, Robin Schafer, and Wandy Wiswai for helpful comments on previous versions. Any errors are my responsibility.

(2) The tone values vary slightly among sub-dialects. (Ting 1970, Weingartner 1970)

(3) Phoneme Inventory of Taiwanese

<table>
<thead>
<tr>
<th>Consonants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labial</td>
</tr>
<tr>
<td>p p*</td>
</tr>
<tr>
<td>Dental</td>
</tr>
<tr>
<td>t t*</td>
</tr>
<tr>
<td>Alveo-palatal</td>
</tr>
<tr>
<td>ts ts*</td>
</tr>
<tr>
<td>Velar</td>
</tr>
<tr>
<td>x x*</td>
</tr>
<tr>
<td>Glottal</td>
</tr>
<tr>
<td>ʔ h</td>
</tr>
</tbody>
</table>

(The alveo-palatalae are palatalized when followed by /i/ or /ɪ/; /s̃/ /s̃'/ /a/ are affricates. /h/ marks the aspiration. /i, ɪ, x, k/ are unrounded word-finally.)

b. Vowels (The vowel in an open syllable is phonetically long. However, there is no phonetic vowel length contrast in this language.)

<table>
<thead>
<tr>
<th>Vowel</th>
</tr>
</thead>
<tbody>
<tr>
<td>e a u o</td>
</tr>
</tbody>
</table>

(4) I thank Robin Schafer for reminding me to look at the tone sandhi date.

(5) A question can be raised about the lack of a corresponding short tone for Tone I, the high tone. This is interesting both diachronically and synchronically. Diachronically speaking, the seven surface tones are the result of the tone split of the four tones in Middle Chinese due to the devoicing of the initial consonants. Thus:

<table>
<thead>
<tr>
<th>Middle Chinese Tone IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
</tr>
<tr>
<td>II</td>
</tr>
<tr>
<td>III</td>
</tr>
<tr>
<td>IV</td>
</tr>
</tbody>
</table>

(M.B. Some Middle Chinese Tone II words changed to Modern Taiwanese Tone V.)

If Middle Chinese Tone III and Tone IV were in complementary distribution, it is not an accident that Modern Taiwane IV/IV and VI/VII are also in complementary distribution. Synchronically speaking, Cantonese does have three short tones, I am not sure at this point if they correspond to three long tones in Cantonese.

REFERENCES

Hayes, Bruce, 1989, 'Compensatory Lengthening in Koinic
Arizona Regional Usage of Lexical Items:

- Roller Shades
- Submarine Sandwich
- Swamp Cooler
- and Arcadia Door

Linda van der Wal
Arizona State University

Following the model of previous submarine sandwich lexical item studies done by Edwin Eades and Howard Bobo in 1947 and William Labov in 1988 in which telephone directory yellow pages were sampled, Phoenix Yellow Page directories were studied to determine usage changes and variations of four lexical items: roller shades, submarine sandwich, swamp cooler, and arcadia door.

My study begins with 1949, the year Hans Kurath first studied "roller shades," and ends with the last available directory for Phoenix, 1989. The sample years correlate as closely as possible with those of previous lexical studies on two of the items. Of the four lexical items and their variants, two of them—"roller shades" and "submarine sandwich"—were chosen on the basis of previous studies of their transregional usage and two of them—"swamp cooler" and "arcadia door"—on the basis of their intraregional usage.

"Roller shades" and its variants have been studied in the Eastern United States by Kurath in 1949, in California by David Reed in 1953, in Colorado by Clyde Hankey in 1960, and in eight Southern states by George Wood in 1970. These studies, based on Kurath's original research, deal with dialect regions that have an influence on Arizona's dialect patterns.

"Submarine sandwich" and its variants such as "hero," "poor boy," and "mopie," have been studied by Eades and Robb in 1967. Their research includes 190 cities in the United States where they study not only lexical variants, but also frequency of use. Their samples come from newspaper articles, questionnaires, direct observations by local informants, and telephone directories. In 1988, Labov also studied distribution of "submarine sandwich" and its variants by direct observation, questionnaires, and Yellow Page listings. Although his research reports on such cities as San Francisco and Los Angeles, he focuses on Northeastern cities, including Philadelphia, Boston, and Pittsburgh.

Following these two models, I have used the Metropolitan Phoenix Yellow Page listings to study not only the local historical development of "roller shades," and "submarine sandwich," but also the two Southwestern items, "swamp cooler" and "arcadia door." I made follow-up telephone calls to businesses in the 1988-89 yellow...