SUB-SYLLABIC PROCESSES AND THE SOUTHERN MIN SYLLABLE

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The syllable in Southern Min has been studied extensively from various theoretical perspectives. In this paper, I examine a few phonological processes, especially those which target sub-syllabic segments or strings of segments, and show that the syllable in Southern Min has the structure displayed in (1).¹

(1)

\[ \sigma \]

\[ O \quad R \]

\[ C_r \quad G_m \quad V \quad G_n \quad C_f \]

¹ The abbreviations are: \( C_r \) initial consonant; \( G_m \) medial glide; \( V \) nuclear vowel; \( G_n \) post-nuclear off-glide; \( C_f \) final consonant. Of course, not all elements occur in the same syllable. The maximum size of the Southern Min syllable is four segments, cf. Chaozhou 'huap' method. The co-occurrence of \( G_n \) and \( C_f \) is restricted in some dialects, but allowed in others. In Chaoyang, for example, open syllables—syllables ending in vowels or the glottal stop—may contain an off-glide, but not closed syllables (Zhang 1981; Yip, this volume). In Chaozhou, both open and closed syllables contain \( G_n \); 'pai' rose; 'pau' bag; 'poik' eight; and 'gauk' happy' (cf. Li 1989, Zhan 1959).

This structure is consistent with the traditional analysis of the syllable into the initial \( (C_r) \) and the final \( (R) \); see such standard works as Wang (1956), Luo and Wang (1957), and Yuan et al. (1960). In generative studies on Chinese phonology, this structure is also consistent with the proposals made in Lin (1989), Bao (1990), Chiang (1992), and Chung (1997), among many others.

To support the structure in (1), I consider the data from Southern Min and synthesize the analyses of such data that have been proposed in the literature. In so doing, I will make two assumptions. The first assumption is methodological. I assume that if a phonological process targets a string \( xyz \), then \( xyz \) is a constituent. This working hypothesis allows us to derive unambiguously the structure of the syllable in the Southern Min family of dialects. Second, I assume that Southern Min dialects exhibit similar properties in their syllables. This assumption will be borne out in the data we will discuss shortly.

My argument takes the following form. First, I show that \( G_n \) is not secondary articulation on the initial consonant \( C_r \). Data for this come from assimilation, which affects \( C_r \) without affecting \( G_n \) at the same time. Second, I analyze the partial reduplication data from Southern Min, and show that \( G_m \), \( V \), and \( G_n \) form a constituent, which we will call, following conventional practice, the nucleus (N). Finally, I will show that the nucleus forms a constituent with the final consonant. Taken together, these arguments establish the syllable structure in (1).

1. Assimilation in Taiwanese

Place assimilation is typical of Southern Min dialects (as well as Northern Min; see Chan 1985). I will use data from Taiwanese, a Southern Min dialect extensively studied by Zhang (1983). In this dialect, the maximal syllable is \( C_rG_mVG_nC_f \), \( G_n \) may be \( i, u \), and \( C_f \) may be any of the following segments \( m, n, p, p, t, k \).³ These two, however, do not co-occur. The coda segments assimilate

² In this paper we will not be concerned with tone, which forms the third part of the traditional tripartite division of the syllable into initial, final and tone.

³ In this paper I assume without argument that the glottal stop is a full segment occupying the coda position. Some scholars, among them Li (1989) and Yip (1994, this volume), argue that the glottal stop is a floating glottal feature over the entire syllable, very much
in place of articulation to the following segment, as the data in (2) show (Zhang 1983, tones omitted).

(2) a. sin pu > sin pu  ‘new bride’
    b. sin bun > sim bun  ‘news’
    c. lam t'an > lan t'an  ‘Southern Play’
    d. sat bu > sap bu  ‘gnat’
    e. pak (a) > pat (to)  ‘belly’

Within the theory of feature geometry (cf. Sagey 1986), we can analyze place assimilation in terms of Place Spread, given in (3).

(3) Place Spread
    Root
    
    Place

    Root
    
    Place

The rule creates a homorganic cluster, leaving nasality and voicing on the target unaffected (2a,b).

Now consider the cases in (4).

(4) a. ba't tsiu > bat tsiu  ‘eyeball’
    b. k'in pian > k'im pian  ‘convenient’
    c. kan pue > kam pue  ‘scallop’

In the data the second syllable contains a medial glide: i in (4a,b) and u in (4c). If, as Chung (1989) and Duannu (1990) argue, the medial glides stand for secondary articulation on the initial segments, tsiu, pian, and pue would have to be transcribed as ts'u, plan, and p'e, with the initials having the structures shown below:

\[
\text{Place Spread applies to the forms in (4), deriving the wrong results: } ^*ba't \text{ ts'u (from (4a), with the structure (5a)), } ^*ki'm \text{ pian (from (4b), with the structure (5b)), and } ^*ka'm \text{ p'e (from (4c), with the structure (5c)). Thus, given the standard representation of complex segments, and the standard treatment of place assimilation as involving the place node, the secondary articulation analysis of } G_m \text{ (i.e. } C_G^{(m)}) \text{ fails to derive the basic place assimilation facts in Taiwanese.}^4 \text{ We therefore conclude that in Taiwanese, and Southern Min in general, the medial glide is not a secondary articulation on the initial segment.}

\]

\[^4\text{Alternative analyses of the Taiwanese data are possible. We can say that Place Spread involves only the primary articulator, not the Place node itself; or we can stipulate a constraint that would rule out codas with secondary articulation. These analyses shed no light on the position of } G_m. \text{ We adopt the place-spreading analysis because it is formally simple and it complements the conclusions of the arguments presented in sections 2 and 3.}
\]

\[^1\text{I thank the anonymous reviewers for making this point clear.}\]
2. Partial Reduplication in Chaoyang

Partial reduplication in Chaoyang comes in two types. The first type involves regular vocabulary items, such as the verb sau 31 'to sweep'. The base may be copied once, to produce a string of two copies; or three times, to produce a string of four copies. Other than the difference in copying, they have the same phonological properties. For this reason I will only cite disyllabic, partially reduplicated words. The second type involves monosyllabic, onomatopoetic words, such as siak, which mimics scratching noise. The two types have complementary properties, as we shall see shortly.

Consider now the data in (6) (Zhang 1979a, Zhu 1982; tones are omitted).5

(6) a. gąg tiaw > gąg nag tiaw 'to dig out'
   b. tā ts'eg-ts'o > tā nā ts'en-ts'o 'to explain clearly'
   c. sau ts'eg-k'i > sau lau ts'eg-k'i 'to sweep clean'
   d. tso lou > tso lo lou 'to continue sitting'
   e. p'ah e > p'ah lai e 'to hit once'
   f. so e-kiā > so lo e kiā 'to massage a little'

Only the first syllable in each of the words in (6) undergoes partial reduplication. For detailed discussion of the sound system of Chaoyang, see Zhang (1979a,b, 1981, 1982); for Southern Min in general, see Yuan et al. (1960, 1989), Lin (1989), and Chiang (1992), which are among the recent works on the dialect family.

As the data show, the initial segment of the second copy is l if the vowel is oral, n if nasal (the vowel in gąg in (6a) is nasalized, although it is not notated as such in the source). To derive the facts, we may formulate a rule, Replace(3), as follows:

(7) Replace(3): Replace the initial segment with l in the second copy

It is worth noting that Replace(3) targets the entire syllable-initial segment, not just a sub-structure of the segment. The derivation of so lo (6f) follows.

(8) Base: so
    Copy: so
    Replace(3): so lo

Now consider the data in (9), which contain the medial glides (Zhang 1979a).

(9) a. kua? tŋ > kua? lua? tŋ 'to break'
    b. zue e > zue lu e 'to wipe (with fingers)'
    c. kiā lai > kiā niā lāi 'to be coming'
    d. ts'iau lou > ts'iau liau lou 'to mix'

We observe that the medial glides are retained in both syllables; so is nasality (9c). Replace(3) only affects Ce but not Gm. In other words, Gm is not a secondary articulation on Ce. The data support the structure in (1).

We now turn to onomatopoetic reduplication in Chaoyang. Such reduplication can be total or partial. In total reduplication, a monosyllabic, onomatopoetic word is copied once, and the resultant string is followed by kio 31, which does not appear to carry any lexical meaning. For example, the sound of a sheep is mēi; its totally reduplicated equivalent is mēi mēi kio. Similarly, zi zi kio is derived from zi, a sound uttered to attract chickens.

Descriptively, in onomatopoetic partial reduplication, the base may be copied once, to yield a string of two copies; or twice, to yield a string of three copies. The entire string is then followed by kio. The data are shown in (10) (kio is omitted).

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5 The tone patterns of partial reduplication are determined by the construction types of the phrases in question. Zhang (1979a) does not mention this, but from the data given, we can deduce the following: if the phrase is a serial verb construction, the two copies have exactly the same sandhi tone:

(i) tui 53 tik 5 > tui 31 lui 31 tik 5 'to straighten'
   pull straight

The lowering 31 is derived from 53 (Zhang 1979b). In other construction types, the first copy surfaces with the sandhi tone, the second copy with the citation tone:

(ii) tui 53 ts'uk 1 - lai 55 > tui 31 lui 53 ts'uk 1 - lai 11
   pull out

Among the data given in (6), (6a,b,c) are serial-verb constructions, the rest are not.
I will refer to such words as kio-words. Zhu (1982) observes that the middle copy retains all the phonetic material of the base syllable. What is happening here is that the nuclear vowel \( V \) is replaced by \( i \) in the first copy, and the initial in the third copy is replaced by \( l \). The replaced lateral becomes \( n \) when the following vowel is nasal, as is typical of Southern Min (see Yip, this volume). To derive the data, we can use the rule given in (7), and apply it to the third copy; to derive the first copy, we may use Replace\((N)\), given in (11).

(11) Replace\((N)\): Replace the nucleus with \( i \) in the first copy.

The derivation below illustrates:

(12) Base: 
\[ \text{paŋ} \]
Copy: 
\[ \text{paŋ paŋ paŋ} \]
Replace\((C_i)\): 
\[ \text{paŋ paŋ laŋ} \]
Replace\((N)\): 
\[ \text{piŋ paŋ laŋ} \]

Zhang (1982) observes that, in the first copy, the rhyme \( ip \) surfaces as \( i? \)(10d,e), and the rhyme \( ik \) as \( ik \) or \( i? \)(10f). Implicit in Zhang’s observation is that the surface glottal stop is derived from the syllable-final consonant inherited from the source syllable through total copying. The debuccalization we see in the data, however, is optional.

The table below summarizes the relationship between the source syllable and the initial syllable of a kio-word (cited from Zhang 1982).

<table>
<thead>
<tr>
<th>Source Syllable</th>
<th>(Initial Syllable of) kio-Word</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral Vowel</td>
<td>( i )</td>
</tr>
<tr>
<td>Nasal Vowel</td>
<td>( i? )</td>
</tr>
<tr>
<td>Oral Vowel + ?</td>
<td>( ? )</td>
</tr>
</tbody>
</table>

\[ \text{N} \]
\[ G_m \]
\[ V \]
\[ G_o \]

The correlation noted in (13) provides ample evidence that Replace\((N)\) does not affect the final consonant.

Consider now bases that contain the medial glide \( G_m \), the off-glide \( G_o \), and the coda consonant \( C_i \) (Zhang 1979a).

(14) a. \( \text{hiŋ huaŋ nuaŋ?} \) (sound of mice gnawing)
    b. \( \text{tiaŋ nuaŋ} \) (sound of door opening)
    c. \( \text{tsi tiuən lau} \) (sound of a crowd talking)
    d. \( \text{sik siak lau} \) (sound of scratching)

We make the following observations. First, nasality is transferred to all three copies (cf. (14a,b)). Second, in the first copy, which is subject to Replace\((N)\), the medial glide \( G_m \) and the off-glide \( G_o \) disappear. Third, the coda segment \( C_i \) is not affected: the glottal stop in (14a) and the velar stop in (14d) both survive Replace\((N)\). Clearly, Replace\((N)\) targets \( G_m \), \( V \), and \( G_o \), but not \( C_i \), suggesting a ternary branching nucleus shown in (15).

\( 6 \) According to Zhang (1982), the rhyme \( ip \) is not attested in onomatopoetic reduplication. However, nasal vowels + \( p \) sequences are attested in Zhang’s data:

\( ? \) ap kio (squeezing sound)
\( niŋ niŋ kio \) (unhappy sound)
\( hiŋ hup nup kio \) (blowing sound)

But see Yip (1994, this volume) for a treatment of Chaoyang which does not allow such rhymes.
The coda consonant $C_r$ does not occupy the same syllabic position as $G_r$. The following derivations illustrate (the colons separate constituents).

(16) a. Base: tsiao
    Copy: tsiao tsiao tsiao
    Replace($C_r$): tsiao tsiao liau
    Replace($N$): tsi tsiau liau

b. Base: siak
    Copy: siak siak siak
    Replace($C_r$): siak siak liak
    Replace($N$): sik siak liak

We have shown that Chaoyang partial reduplication supports a hierarchical analysis of the syllable. The two rules, Replace($C_r$) and Replace($N$), complement each other in that the former rules out the possibility that $C_r$ and $G_r$ form a constituent (either as an onset or as a single segment $C_r^{G_r}$), whereas the latter groups $G_r$, V, and $G_r$ into a constituent. We now have two structures which are compatible with both Replace($C_r$) and Replace($N$).

(17) a. \[ \sigma \]
    | \[ N \]
    | \[ C_r \]
    | \[ G_m \]
    | \[ V \]
    | \[ G_s \]
    | \[ C_t \]

b. \[ \sigma \]
    | \[ R \]
    | \[ N \]
    | \[ C_r \]
    | \[ G_m \]
    | \[ V \]
    | \[ G_s \]
    | \[ C_t \]

The Chaoyang data we have examined up to this point do not differentiate the two structures. We have to look elsewhere for decisive evidence.

There is a class of four-syllable words in Chaoyang which are partially reduplicated, and onomatopoetic in nature. These words support the constituency of $N$ and $C_r$ i.e. the structure in (17b). The data in (18) are taken from Yuan et al. (1960, 270-271).

(18) a. ki li ku lu (sound of speaking)
    b. tsii li tsiao liau (sound of birds chirping)
    c. p'i li p'iau liak (sound of breaking)

This type of onomatopoetic reduplication is widespread across Chinese dialects. Yuan et al. (1960) observe that the first and third, the second and fourth syllables share the same initials, and the first two and the last two syllables share the same rhymes. Take (18a), for example. The first and third syllables share the initial $k$, the second and fourth syllables, the initial $l$, the first two syllables have the same rhyme, $i$, the third and fourth syllables, $u$. These words differ from kio-words in the number of syllables generated and their segmental makeup. Suppose that the third syllable is the base. In the case of (18c), whatever rule that derives the first two syllables must refer to (i)ak as a constituent. We may use Replace($C_r$) to derive the initials of the even-numbered syllables (both are $l$), and Replace($R$), where $R$ includes the nucleus and $C_r$, to derive the first two syllables. The words may be derived in the following steps:

(19) Base: p'iau
    Copy: p'iau p'iau p'iau p'iau p'iau
    Replace($C_r$): p'iau liak p'iau liak
    Replace($R$): p'i li p'iau liak

The analysis, however, does not carry over to bases with a nasal coda. Consider the cases in (20).

(20) a. k'in lin k'g li (sound of moving)
    b. p'in lin p'g li (sound of shooting)

Given Replace($R$), we would expect *k'i li k'g li from $k_g$, rather than the attested (20a). We need additional rules to derive the nasal coda in the first two syllables of the data in (20). It must be acknowledged that such a need weakens
the conclusion that Replace(R) targets N and C, and treats them as a constituent.\(^7\)

Similar data can be found in Taiwanese, as shown in (21) (Zhang 1983, 161-164).\(^8\)

(21) a. i 55 o\(\text{si}\) 53 si 55 so\(\text{si}\) 53 (sound of frogs)
b. ki 55 kiu 53 si 55 siu 53 (sound of toy turtle whistles)
c. ò 55 uài 53 si 55 suài 53 (sound of a loose bed)

From the data, we observe that the odd-numbered syllables and the even-numbered syllables contain the same rhymes, and the first two syllables and the last two syllables contain the same onsets. We don’t know exactly the phonological shape of the syllables from which such reduplicated expressions are derived. This degree of ignorance is tolerable. For the sake of argument, we assume that the last syllable of a kio-word is the original syllable. It is reduplicated to yield a string of four copies. We then replace the onsets of the first two syllables, and the rhyme of the odd-numbered syllables with i. The following derivations illustrate.

\[
\begin{align*}
\text{(22) a. Base:} & \quad\text{siu} \\
\text{Copy:} & \quad\text{siu siu siu siu} \\
\text{Replace(C,:)} & \quad\text{kiu kiu siu} \\
\text{Replace(R,:)} & \quad\text{ki kiu si} \\
\text{b. Base:} & \quad\text{suài} \\
\text{Copy:} & \quad\text{suài suài suài suài} \\
\text{Replace(C,:)} & \quad\text{uài uài suài suài} \\
\text{Replace(R,:)} & \quad\text{ò uài si suài}
\end{align*}
\]

The onset in the first syllable of a kio-word is idiosyncratic, unlike the new rhyme, which is invariably i.

Onomatopoetic reduplication in the two Southern Min dialects (Taiwanese and Chaoyang) supports the constituency of the nucleus and C, i.e. the structure shown in (17b). It also shows the remarkable cohesion in syllable structure within the Southern Min family.

3. La-pi

La-pi, a language game based on Taiwanese, exhibits properties which are similar to Chaoyang partial reduplication in relevant respects. The language game has been the subject of a number of studies (Li 1985, Lin 1989, Bao 1990, Duannu 1990, Chiang 1992, Chung 1997). The analysis of La-pi follows Bao (1990) and the data are taken from the original study of Li (1985).

First, consider cases with simple vowels:

\[
\begin{align*}
\text{(23) a. be} & \quad> \quad\text{le bi} \quad\text{‘buy’} \\
\text{b. kam} & \quad> \quad\text{lam kin} \quad\text{‘sweet’} \\
\text{c. tsin} & \quad> \quad\text{lin tsin} \quad\text{‘very’} \\
\text{d. ng} & \quad> \quad\text{lag in} \quad\text{‘red’} \\
\text{e. tsap} & \quad> \quad\text{lap tsit} \quad\text{‘ten’} \\
\text{f. t’at} & \quad> \quad\text{lat t’it} \quad\text{‘kick’} \\
\text{g. pak} & \quad> \quad\text{lak pit} \quad\text{‘peel’}
\end{align*}
\]

From the data, we make three observations. First, the first C, surfaces as l, and the second V surfaces as i. Second, the rhyme structure of the source syllable remains intact: the coda of the source syllable remains in the derived La-pi word. Third, velar and labial segments become alveolar in the second syllable. To derive these forms, we may formulate two rules, Replace(C,) and Replace(N), as follows:

\[
\begin{align*}
\text{(24) Replace(C,:)} & \quad\text{Replace C, with l in the first syllable.} \\
\text{Replace(N,:)} & \quad\text{Replace N with i in the second syllable.}
\end{align*}
\]

A sample derivation follows, where ‘Alveolarize’ denotes the process whereby a
nonalveolar segment becomes alveolar:

(25) Base: pak
Copy: pak pak
Replace(C): lak pak
Replace(N): lak pik
Alveolarize: lak pit

Note that Replace(C) targets C, and Replace(N) targets V.

Now consider the data below:

(26) a. tsyaw > lyaw tsi 'bird'
b. hwe > iwe hi 'flower'
c. t'aw > law t'i ?

(26c) has no clear lexical meaning. These data show that Replace(C) targets only C, whereas Replace(N) targets G, V, and G, suggesting that the three segments form a constituent, as in (15). The derivation of (26a) is shown below:

(27) Base: tsyaw
Copy: tsyaw tsyaw
Replace(C): lyaw tsyaw
Replace(N): lyaw tsi

Like the partial reduplication data in Chaoyang, the La-pi data allow us to group G, V, and G, into a single constituent, supporting the structure shown in (1).

4. Labial Co-occurrence Restriction in Taiwanese

Labial co-occurrence restriction in various Chinese dialects has been the subject of numerous studies, among them, Steriade (1982), Yip (1989), Lin (1989), Duanmu (1990), and Bao (1994). Its properties vary across the dialects; and many dialects do not restrict labial co-occurrence within a syllable at all. In dialects which do, the occurrence of labials interacts with syllable structure.

Taiwanese is one such dialect. The hierarchical structure we have established for Taiwanese (and Southern Min) (cf. (1)) has interesting consequences for the analysis of labial co-occurrence in Taiwanese. My account follows Bao (1994), which is based, to a large extent, on Lin (1989).

Taiwanese restricts more than one labial segment from occurring in the same syllable. The forms which do not occur due to this restriction are enumerated in (28) (C', V', and G' represent labialized consonants, vowels, and glides, respectively).

(28) a. V'G': *ou
c. G'V': *uo
d. G'...G': *uau
e. G'...C': *uap, *uam, *aup, *aum
f. C'...C': *pam, *bip *pup, *him

Given the representation within the standard theory of feature geometry (Clements 1985, Sagey 1986), the labials in (28) are adjacent on the Labial tier, although they may not be string-adjacent. We may formulate the labial co-occurrence restriction as in (29).

(29) Labial Co-occurrence Restriction (LCR):
* [...Labial...Labial...]_

LCR is a special case of the OCP operating on the Labial tier, regardless of [round] specification (Mester 1986, Yip 1989). It rules out syllables that contain two labials.

There are two gaps in the data, both of which contain two labials, and are well-formed:

(30) a. C'V': pu, bo
b. C'...G': paa, pua

LCR should therefore be constrained to rule out cases in (28), but allow cases in (30).
Sub-syllabic Processes

There is a curious asymmetry between the onset and coda when the nucleus contains a labial. In such cases the coda can not be labial (31a), but the onset can (31b).

(31) a. *[ ... [ ... Labial ... ]₀ Labial ]₀ *uap (cf. (28b,c))
   b. [ Labial ... Labial ... ]₀ Labial ]₀ pau (30)

Indeed, (31b) is the only configuration which tolerates labial co-occurrence.

From the perspective of linear precedence, the fact that (31a) is ill-formed is surprising, since it is the mirror-image of the well-formed structure in (31b). The onset-coda asymmetry can not be explained by the relatively 'flat' structure of the syllable, shown below:

(32)

\[ \begin{array}{c}
\sigma \\
C \\
G \\
V \\
G \\
C \\
\end{array} \]

However, assuming that the nucleus and coda form the domain of the rhyme (R), as in (1), one may propose that LCR operates within the sub-syllabic domain of the rhyme (R) (cf. Fu (1990)). This will explain the onset-coda asymmetry: the two labials are in the same domain in (31a), but not in (31b). However, such a proposal fails on forms like *pam, which have the following structure:

(33) *{ Labial [ ... ]₀ Labial ]₀ *pam (cf. (28f))

We can not simply restrict LCR to apply to a particular sub-syllabic domain. The mystery remains that an onset labial may not occur with another labial in a nonadjacent coda position (*pam), but occurs with another labial in the string-adjacent nucleus (pam).

Given the hierarchical structure (1), we can interpret the onset-coda asymmetry in hierarchical terms: labial co-occurrence is tolerated just in case one labial is sufficiently embedded. The statement of the condition on labial co-occurrence must therefore mention the syllabic constituent in which it is obeyed, and the level of embedding of the labials within the constituent.

To determine what constitutes sufficient embedding, consider the structures of the ill-formed cases in (28), shown in (34), and contrast them with the structures of the well-formed cases in (30), shown in (35).

(34) a. N
       u o
 b. N
       u a u
 c. R
       N
   t u p
 d. R
   N
   u a p
 c. σ
   N
   p a m

(35) a. σ
   R
   N
   p u
 b. σ
   R
   N
   p a u
 c. R
   N
   Lab
   Lab
   N
   Lab

There are two structural configurations in which labial co-occurrence is not tolerated: either the offending labials are immediately dominated by a common node, namely, N (34a,b), or they are dominated by a common node, and one labial is immediately dominated by one and only one node which does not dominate the other labial (N in (34c,d) and R in (34e)). The expression 'one and only one' is crucial. The configurations which tolerate labial co-occurrence all involve two nodes (R and N in (35)) which dominate one labial but not the other. The formal configurations are summarized as follows.
We restate the generalization on Taiwanese labial co-occurrence in (37).

(37) Labial Co-occurrence Restriction (LCR):
\[ *[\ldots \text{Labial}_1, \ldots \text{Labial}_2, \ldots]_o \]
except when Labial\(_1\) is the onset, and Labial\(_2\) is the nucleus.

The generalization in (37) provides strong evidence in favor of the hierarchical representation of the syllable, as many authors have argued, among them, Hockett (1955), Selkirk (1982), Harris (1982), Steriade (1982), Levin (1985), and Fudge (1987). It is not expressible if the syllable structure is ‘flat’ (Clements and Keyser 1983) or moraic (Hyman 1985, McCarthy and Prince 1986, Hayes 1989). Though richer in structure than the flat representation, the moraic representation is not rich enough to express the generalization. In Hayes’s version of the moraic theory, for example, the syllables *pam and pau would be assigned the structures in (38).

(38) a. \[ \sigma \]
    \[ \mu \]
    \[ p \]
    \[ a \]
    \[ u \]

b. \[ \sigma \]
    \[ \mu \]
    \[ p \]
    \[ a \]
    \[ m \]

There is no way to differentiate the two in terms of syllabic or moraic structure. The generalization concerning labial co-occurrence in Taiwanese is missed.

We have seen that hierarchical syllable structure regulates the occurrence of more than one labial within a syllable in Taiwanese. How are we to explain the generalization in (37)? The intuitive idea towards an explanation lies in the interaction between the OCP and syllable structure. In McCarthy’s (1986) study of
gemination, the OCP as a blocker of gemination is sensitive to prosodic environment, particularly to boundaries created through morpheme concatenation prior to tier conflation. Adjacency of identical nodes is by itself not a sufficient condition to trigger the OCP. Taiwanese labial co-occurrence supports this conclusion in an interesting way. The data demonstrate that the OCP is sensitive to the intrasyllabic configurations in which the labials occur; and its effect is suspended when the labials, though adjacent and identical on the Labial tier, are sufficiently embedded in the hierarchical structure of the syllable.

5. Conclusion

The preceding analysis of assimilation, partial reduplication, a language game, and labial co-occurrence restrictions in Southern Min establishes the syllable structure in this dialect group. It is shown in (1), repeated in (39) below:

(39) \[ \sigma \]
    \[ O \]
    \[ R \]
    \[ N \]
    \[ C_i \]
    \[ G_m \]
    \[ V \]
    \[ G_o \]
    \[ C_t \]

Within Southern Min, the sub-dialects show a great deal of variation in the phonetic details of the segmental and tonal inventories, and in phonotactics such as labial co-occurrence. Chaoyang, for example, does not restrict labial co-occurrence in the same way that Taiwanese does. For example, lou (in ts‘iau lou ‘to mix’) is a legitimate syllable in Chaoyang, but not in Taiwanese. With respect to syllable structure, however, we see a remarkable degree of cohesion: the analysis of partial reduplication in Chaoyang and Taiwanese, and the Taiwanese-based language game La-pi, leads to the same structure of the nucleus.

It is quite remarkable that sub-syllabic processes, whether segmental alternation or partial reduplication, motivate essentially the same syllable structure in Southern Min. In other dialects, especially of the Mandarin family, I have shown elsewhere that sub-syllabic processes fail to resolve the exact position of the
medial glide (Bao 1995a,b). Indeed, in some Shanxi dialects, the medial glides are asymmetrical in their syllabic affiliation (Bao 1997). Certainly, sub-syllabic processes allow us some insight into the internal organization of the syllable, as is demonstrated by our analysis of the Southern Min data. They may not be able to provide the same degree of insight in all languages.

REFERENCES


