Body-Coda or Onset-Rime:
The Syllable Internal Structure of Taiwan Southern Min[*]

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In this study, nearly 600 speech error data were examined to explore the syllable internal structure of Taiwan Southern Min (TSM). Results showed that a great majority of speech errors reflect an onset-rime branching structure. As for the other piece of evidence, syllable contraction data, which was used as a supporting argument for the body-coda structure, we provided an alternative analysis without involving the break of the sub-syllabic constituents in phonological joints. Thus we argue on the basis of speech error data that the syllable structure of TSM is onset-rime, consistent with the traditional concept.

Keywords: syllable internal structure, body-coda, onset-rime, Taiwan Southern Min, speech errors

1. Introduction

Two kinds of data are included in this study to explore the syllable internal structure of Taiwan Southern Min, a dialect of Min spoken in Taiwan. One is spontaneous speech-error data, which is the main focus of this study. Since the 1970s, speech error data have been used as evidence to investigate the components of a syllable as well as syllable internal structure (Fromkin 1971, Fudge 1987, Shen 1993, Wan 1999, Yip 2002). The basic assumption for arguing the reality of a constituent is that if a string *xyz* could be moved as a unit to substitute or be substituted for by another unit, then the string *xyz* forms a constituent. Different kinds of speech errors were analyzed to see how they shed light on the syllable internal structure of Taiwan Southern Min. In addition, we also take a look at data of syllable contractions, in which two successive syllables are contracted into one syllable in oral speech, to see if they reveal consistent results.

2. Syllable structure of Taiwan Southern Min

In Taiwan Southern Min (hereafter TSM), a syllable may be composed of an initial consonant (C_i), a prenuclear glide (G_m), a vowel (V), a postnuclear glide (G_f) or a coda consonant (C_f), and a tone (T). The postnuclear glides and coda consonants are mutually exclusive. The syllable structure can be formulated as (1). Except for the nuclear vowel and the tone, all the other components are optional. The vowel can

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combine with prenuclear glides and postnuclear glides to form a diphthong or triphthong. Hence, a syllable may contain from one to four segments. All possible syllable structures as well as examples are listed in (2).

(1) Syllable structure of Taiwanese
$(C_i)(G_m)V(G_f/C_f)$ T

(2) Various syllable structures and examples in Taiwan Min

Syllable structure	Example	Gloss
V	ã33	'stuffing'
C_iV	ka33	'bite'
VC_f	am21	'dark'
VG_f	aj21	'love'
G_mV	ja33	'night'
C_iVC_f	tam13	'wet'
C_iG_mV	kwa21	'lid'
C_iVG_f	laj13	'come'
G_mVG_f	jaw55	'hungry'
G_mVC_f	jam13	'salt'
$C_iG_mVG_f$	kjaw55	'proud'
$C_iG_mVC_f$	kjam21	'sword'

3. Data collection

In this study, speech errors refer to 'slips of the tongue'. They are defined as one-time errors occurring in speech production, and are involuntary deviations in performance from the speaker's intention in regards to phonological, lexical, or grammatical aspects (Sturtevant 1947, Boomer and Laver 1973, Jaeger 2005). An intended utterance, which is usually a word but can also be a phrase or even a proposition, is mispronounced because something goes wrong in the production planning process. Hence, errors such as repetition, hesitation, repairment due to change of the topic or infelicities of expression were excluded. The speakers were aware of the errors they made and in most cases would immediately correct the errors. Evidence of the occurrence of speech errors includes pauses, gestures, laughs, interjections or comments of the speakers themselves or questions or corrections from listeners (Shattuck-Hufnagel 1986, Jiang 2004).

The data source was an on-going TSM corpus[1] containing recordings of spontaneous speech collected from several radio programs. Most of the programs were conducted by a host and a hostess, and some were by one or two hostesses. Errors were recorded with a complete utterance including relevant context information, pauses, and self-corrections. Phonetic transcription was used when necessary. There are nearly 2000 speech errors collected in this corpus. Data used in this study include four kinds of errors: (1) syntagmatic phonological substitution errors involving single segments, (2) phonological substitution and exchange errors involving larger units,[2] (3) phonological telescoping errors, and (4) lexical blends.[3] Approximately 600 speech errors were adopted for analysis in this study. As for data of syllable contractions, they were adopted from examples listed in the appendix of Liu (2005), which is a paper concerning tone contractions.

4. Analysis of speech error data

In this section, we made analysis of the four kinds of speech errors, i.e. syntagmatic single-segment errors, syntagmatic larger-unit errors, phonological telescoping errors, and lexical blends in sequence to see if speech errors obey syllable structures and what unit acts as the target unit or error unit most often.

4.1 Syntagmatic single-segment errors

There are 338 substitution errors involving single segments which were included in the analysis. These substitution errors are either with only one potential source word or with two potential source words and both potential source segments are in the same syllable position. It is found that in phonological errors with a potential intrusion in the utterance, the error source is within a limited distance from the target word, usually within 7 syllables (Cohen 1973, Nooteboom 1973, Wan 2007). We investigate the relationship of the target and the source segments on the basis of syllable position. If the target and the source segments are both onset consonants, then the interaction relationship of this speech error is a C_i-C_i error. If the target and the source segments are both prenuclear glides, then the error is a G_m-G_m error, the same analogy to the other error types. Examples in (3) and (4) are cases of C_i-C_i error and V-V error, respectively. In the following examples, the first line indicates the intended utterance, beginning with the marker "I:". The second line represents the erroneous utterance,

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[1] Taiwan Southern Min spoken corpus is constructed and maintained by the Institute of Linguistics at National Chung Cheng University.
[2] A larger-unit means a unit which is larger than a segment but smaller than a syllable.
[3] Bilingual errors due to dialectal influence, mainly Mandarin, were excluded from this study.

beginning with the marker 'E:'. The third line represents a word-by-word gloss. The fourth line is an English translation of the intended utterance. The notation of the tone value is adopted from Cheng and Cheng's (1977) system. Regarding the transcription of the utterance, an utterance related to the error unit is phonetically transcribed; others are phonemically transcribed. The target unit is boldfaced, the source unit is underlined, and the erroneous unit is boldfaced and underlined.

(3) Example of C_i-C_i error

    I: pin33het3   **l**u55   **g**jam33tjɔŋ33.

    E: …   **l**jam33tjɔŋ33.

      anemia   more   serious

    'The anemia is getting worse.'

(4) Example of V-V error

    I: ma21 b**e**21 ts**ə**21siŋ33 lan55 kʰwan33kiŋ53 **e**33 u33ljam53.

    E: …   ts**e**21siŋ33

      also   not   cause   we   environment   of   pollution

    '(It) won't pollute the environment.'

Frequency based on the syllable position of the target and the source segments is listed in the table in (5). Since the structural representation of the diphthongs [iu] and [ui] is still under debate (Li 1986, Tung et al. 1967, Tung 1988, Chung 1995, Hsu 2004), we conservatively categorize errors involving these two diphthongs separately. The bracket with [u] or [i] indicates the segment involved in the error.

(5) Frequency of interaction types between the target and the source segments

Interaction types	Tokens
C_i-C_i	235
G_m-G_m	3
V-V	62
C_f-C_f	14
G_f-G_f	6
Sum	320 (94.7%)
C_i-C_f	5
G_f-C_f	2
i[u]/u[i]-V	2
i[u]/u[i]-C_f	9
Sum	18 (5.3%)
Grand Total	338 (100%)

In this table, there are 235 errors involving interaction between two onset consonants (C_i-C_i), 3 errors involving interaction between two prenuclear glides (G_m-G_m), 62 errors involving interaction between two vowels (V-V), 14 errors involving interaction between two coda consonants (C_f-C_f), and 6 errors involving interaction between two postnuclear glides (G_f-G_f). These errors indicate that more than 94% (N=320) of the speech errors obey the syllable structure in that segments interact with segments in the same syllable positions. This finding corresponds to the unit similarity found in previous studies (MacKay 1973, Boomer and Laver 1973, Fromkin 1971, Nooteboom 1973, Wan 1999), which showed that onsets interact with onsets, vowels with vowels, codas with codas, and rimes with rimes most of the time, suggesting the existence of syllable structures in the processing of speech production.

Regarding the 18 tokens reflecting asymmetrical mapping relationships between the target and the source segments, the interaction between G_f and C_f is not surprising since it is categorized under the same node 'Ending' in traditional Chinese linguistics. Errors involving 'iu' or 'ui' can be analyzed from two aspects. If the segments in the bracket in 'i[u]' and 'u[i]' are offglides, then their interaction with the vowels and the coda consonants are also explainable. On the one hand, offglides are actually vowels not in the syllabic positions, and hence it is natural for them to interact with nucleus vowels. On the other hand, as mentioned previously, they belong to the same category 'Ending' with coda consonants, which accounts for their interaction in substitution. However, if the segment in the bracket in 'i[u]' and 'u[i]' are vowels, then the 9 tokens reflecting the interaction between i[u]/u[i] and C_f obviously violate the syllable structure and the basic distinction between vowels and consonants. Since, the

representation of the two diphthongs [iu] and [ui] is still uncertain, we tentatively put these data aside without analyzing them.

Excluding the above suspected tokens, the tokens that obviously violate syllable structure are the 5 errors involving the interaction between C_i and C_f. Nonetheless, detailed examination showed that among the 5 errors, there is only 1 actually violating the syllable structure while the other 4 have an alternative analysis. Three of the 4 errors are shown in (6). The common characteristic of the 3 errors is that the target and the source segments are located right next to each other sequentially. Therefore, they can also be analyzed as feature assimilation, i.e. nasal assimilation in (6a-b) and place assimilation in (6c), or phonetic assimilation due to co-articulation at the phonetic level.

(6) a. I: i55 se53kaj53 sjɔŋ33 e33 tʰɔ**ŋ**55k̲e21
     E: …   tʰɔ**k̲**5ke21
         base world up of statistics
         'According to the global statistics, …'

   b. I: li55 i̲ŋ53**k**aj33 laj33 ka33 tsʰi53 tsit0e0a0 kʰw̃ã53mãj̃33
      E: … iŋ53**n̲**aj33
          you should come with try once look
          'You should try once.'

   c. I: in33ui21 tsi̲t̲1 **k**iŋ33 jə21paŋ13 pə33 kui55 tsɔ55
      E: …   **t̲**iŋ33
          because one CLASS pharmacy not several set
          'Because there aren't many sets (of free gifts) in each pharmacy.'

Another error, as shown in (7), is an error in which both the target and the source segments are within the same syllable. Hence, it might be also due to effect of co-articulation at the phonetic level. The only one error that obviously violates the syllable structure without proper alternative explanation is shown in (8).

(7) I: sin33**t**i̲k̲3   [m xy35 tʰaj53tʰaj53].[4]
     E: sin33**k**ik3
         Hsin-chu   Hsu Mrs.
     'Mrs. Hsu from Hsinchu'

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[4] The utterance within the marker "[m]" is an utterance of Mandarin.

(8) I: a21si21kɔŋ55 tə33 bə33 hwat5hen21 tsit5 e33   **mɔ̃33pẽ33**

 E:…   **ŋɔ̃33pẽ33**

 　or　　　　　so　　not　discover　　this CLASS problem

 'Or we did not discover this problem before.'

To sum up, analysis of single-segment errors clearly indicates that speech errors respect syllable structure. Therefore, we can investigate the syllable internal structure based on the interaction of phonological elements in errors. Nevertheless, except for this, the results do not reveal much regarding how these segments are organized within a syllable. Hence, we further explore this issue by investigating the interaction of segments involving units larger than single segments.

4.2 Syntagmatic larger-unit errors

There are 103 syntagmatic errors involving larger units, a unit larger than a segment but smaller than a syllable. Errors like the examples in (9) are irrelevant to the breakup of the syllable internal structure since the error unit only includes substitution of the onset consonant and the tone due to the interference of the following syllable [liu33]. Hence they are counted as 'Others' and screened out from analysis. There are 93 errors included for detailed analysis.

(9)　I: tsja21　lan55　e33　　**h**we**53**kŋ53　l̲iu3̲3nŋ53　e0

 　　　　eat　　we　　of　　blood-vessels soft　　　PART

 E: …   **l**we**33**

 　'This medicine will reduce hardening of the arteries.'

Among the 93 errors, 66 tokens are clear cases, like the example in (10). For the remaining 27 errors, it was difficult to decide the error unit due to the overlapping segments between the target and the source words, like the example in (11).

(10) I: i33　ka33ti33　ma21　u21　kʰ**ui**33 pʰe̲33hu33kʰə55 tsin55sɔ53.

 　　he　self　　also　have open dermatology　clinic

 E:…　　　　　　　　　　　kʰe̲33

 　'He himself also has a dermatology clinic.'

(11) I: lan55 kjã33 s**jɔŋ**33 jɘ̰33tsi53.[5]

        we   afraid   hurt   kidney

   E: …   s**jɘ̰**3

   'We are afraid of causing damage to the kidneys.'

In (10), the target unit [ui] is replaced by the vowel [e] due to the interference of the following syllable [pʰe33]. Therefore, it is a substitution between rime and rime. In (11), both the target and the source words contain a prenuclear glide [j], resulting in ambiguity in deciding the error unit. It is hard to decide whether the substitution unit `is the G_mVC_f [jɔŋ] or only the VC_f [ɔŋ]. In the following analyses, clear errors and errors with unit ambiguity will be analyzed separately.

4.2.1 Analysis of clear cases

First, the data without overlapping segments is examined. All 66 errors reflect the internal structure as onset-rime (hereafter O-R) branching. Moreover, a phenomenon worth some discussion concerns the grouping of the prenuclear glides. The structural status of the prenuclear glides seems to be related with the existence of the initial consonants. There are 30 errors in which the target or source syllables or both contain prenuclear glides. Among the 27 errors in which the target or the source words contain initial consonants, all but 2 syllables separate the prenuclear glides from the initial consonants and group the prenuclear glides with the rime, as the example shown in (12).

(12) I: i33siŋ55 tɘ33 sjɔŋ21 k**jã̰**33 tsit5 kʰ<u>wan</u>55 laŋ13

   E: …   k**wan**33

     doctor   then   most   fear   this   kind   person

   'Doctors are most afraid of this kind of person.'

The two exceptions are given in (13). In (13a), the target unit [aj] in the syllable [kwaj53] is replaced by the vowel [e] due to the interference of the following syllable [e33]. On the contrary, in (13b), the target unit [e] in the syllable [le33] is replaced by the unit [aj] in the syllable [hwaj33]. In both errors, the prenuclear glide [w], one in the target syllable in (13a) and the other in the source syllable in (13b), does not move

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[5] Although there is a dialectal variation between [ɘ] and [o], in this error, the speaker noticed the error at once when mis-articulating this intended syllable [sjɔŋ33] as [sjɘ3] and made a correction without finishing the whole syllable. The clue of self-repair implies that the speaker made a distinction between the vowel [ɘ] and [o]. Hence, this error is treated as a larger-unit error involving the substitution either between [jɔŋ] and [jɘ] or between [ɔŋ] and [ɘ].

along with the vowel and the postnuclear glide. Nevertheless, it does not mean that the prenuclear glides do not form a sub-syllabic constituent with the rime but form a constituent with the initial consonants. It could be possible that the prenuclear glides form a larger constituent with the vowels and the postnuclear glides.

(13) a. I: bɔk1kw**aj**53   i33   e̲33   laŋ13   kʰwa21tjə21   kɔŋ55

      E: bɔk1kw**e̲**53

       no wonder   he   of   person   see   say

       'No wonder when people see him, they would say …'

   b. I: tsit5 **l**e33   tsit5zim33   lin55   lɔŋ55   ben55   hw**a̲**j33gi13

      E: …   **l**a̲**j**33

       this   CLASS   responsibility   you   all   without   doubt

       'All of you needn't doubt the responsibility (that I will take on).'

As for the other 3 onsetless syllables, the prenuclear glides display different patterns from those occurring in the syllables with initial consonants. The prenuclear glides consistently do not group with the rime as a substitution unit, as the example shown in (14). The glides seem to be raised to the structural position of initial consonants and act similarly to the initial consonants.

(14) I: he55   tan33a33   **tẽ55**   ki13   j**ɔ̲ŋ**33   nĩã13

   E: …   t**ɔŋ**33

    that   only   short   term   use   so

   'That is only of short-term use.'

4.2.2 Analysis of ambiguous cases

Next, consider the 27 errors involving overlapping segments. Speech error studies show that the target and the intrusion are often located in the position beside a same segment, so-called repetition effect or phoneme similarity (Wickelgren 1969, MacKay 1973). On the basis of this finding, a principle of minimal movement has been adopted in judging the error unit in speech errors (Laubstein 1987, Wan 1999, Jaeger 2005). Under this principle, the repetition unit is counted as part of the target word rather than the source word and hence it is not part of the target unit under substitution. The same principle is also adopted in our analysis. Accordingly, the example in (11), repeated in (15), is counted as substitution between the VC$_f$ [ɔŋ] and V [ə].

(15) I: lan55 kȷ̃ã33 sjɔŋ33   jə̱33tsi53
     E: …   sjə̱33
         we   afraid hurt   kidney
     'We are afraid of causing damage to the kidneys.'

Based on the minimal movement principle, all of the errors reflect an O-R structure. Though the principle of minimal movement is based on the results of previous studies, on the safe side and for comparison, these ambiguous errors are also analyzed with the maximal movement principle alternatively. Under this principle, the overlapping segment is counted as part of the target unit under substitution. There are 14 errors counted as "Others" since they turn out to be substitution of whole syllables and do not reveal anything about the breaking point inside a syllable, as in the example shown in (16). As for the remaining 13 errors, 3 errors reflect a body-coda (hereafter B-C) structure, as the example shown in (17), and all the others reflect an O-R internal structure.

(16) I: **gɔ21**gwe21hun33 sjɔŋ21 tjɔŋ21jaw21   e0
      E: **gwe21**gwe21
          May   most   important   PART
      '(It's) the most important (event) in May.'

(17) I: **tjɔ**ŋ33kɔk5 taj21ljɔk
      E: **k**ɔŋ33
          China   Mainland
      'Mainland China'

4.2.3 Summary

To summarize, the syllable internal structure reflected on the larger-unit errors and the type tokens are listed in the table in (18).

(18) Frequency of structure type revealed in larger-unit errors

Structure types	Clear cases	Ambiguous cases	
		min. pri.	max. pri.
B-C	0	0	3
O-R	66	27	10
Others	10	0	14
Total	76	27	
Grand Total	103		

Note: "min. pri." refers to "minimal principle" and "max. pri." refers to "maximal principle".

Among the 103 errors involving larger units, there are no errors or at most 3 errors, depending on different analyses, reflecting the syllable internal structure as a B-C branching structure. The overwhelming majority of all the errors reflect the syllable internal structure as an O-R branching structure. As a result, the results of larger-unit errors reveal an O-R branching structure.

4.3 Phonological telescoping errors

There are 24 telescoping errors in our corpus. Nevertheless, most of the cases do not reveal a clear internal structure in terms of the sub-syllabic constituent, as the examples in (19). In (19a), the two syllables [ka33 ki53] are contracted into one syllable [kja53]. It could be analyzed as an insertion of the vowel [i] into the syllable [ka]. In (19b), the two syllables [tsu55i53] are contracted into one syllable [tsu53] by combining the segments of the first syllable and the tone of the second one.[6] Both examples do not reveal the breaking points of the syllable internal structure. Hence, they are counted as 'Others'. There are 18 such errors.

(19) a. I: li55 lɔŋ55 **ka33 ki53**   ti21 he55 thaw33khak3 laj21te53
       E: …   **kja53**
           you all   with   remember at   that   brain   inside
       'You remember all of them.'

   b. I: li55 it5tiŋ21 aj53   **tsu55i53** li55 e33   kin33kut3.
       E: …   **tsu53**   li55 e33
           you must   have   note   you   of   bone
       'You must pay attention to your bones.'

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[6] This error is treated as a telescoping error rather than a tone error due to the appearance of the following utterance [li55 e33] 'your'. If it were a contextual tone error, then the speakers usually would notice it immediately when articulating the error [tsu53] and make a correction at once.

Among the remaining 6 telescoping errors, only 2 errors show a breaking point between the vowel and the coda consonant, as shown in (20) and (21).

(20) I: **tsim55ma53** e33 sjaw53len33a53 lɔŋ55 si21 an55ne55
      E: <u>**tsja53**</u>
          now   of   youth   all BE this
      'The youth nowadays are all like this.'

(21) I: lan55 tsə53 **tsit1 le33**a55 sin33tʰe53 kjam55tsa55
      E: …   <u>**zje13**</u>
          we   do   some   body   examination
      'We should go for a check-up.'

In (20), the two syllables [tsim55ma53] are contracted into one syllable [tsja53]. It is a combination of the body [tsi] of the first syllable and the vowel [a] of the second syllable, which reveals the body [tsi] as an error unit. In the example (21), the two syllables [tsit1le33] are contracted into one syllable [zje13]. Actually these two syllables are fused together rather than a simple contraction of segments. The initial syllable [z] in the contracted syllable inherits the value of the feature [friction] from the initial consonant [ts] in the first syllable and the value of the feature [voicing] from the initial consonant [l] of the second syllable. The two tones are also merged together, resulting in a rising phonetic pitch. There is a breaking point at the boundary between the CV string [tsi] and the coda consonant [t] in the first syllable, thereby displaying a B-C structure.

The other 4 errors display a breaking point at the boundary between the initial consonant and the rime, as the example shown in (22). The contracted syllable [bun21] adopts the initial consonant of the first syllable [bə] and the rime [un] of the second syllable [lun33], showing that the second syllable breaks up at the boundary between the initial consonant [t] and the rime [un].

(22) I: **bə33lun21** zin21hə13 tsit1 haŋ21 mĩ21kjã33
      E: <u>**bun21**</u>
          no matter whatever one kind thing
      'No matter any one thing …'

In a word, the results of the telescoping errors show that there are slightly more errors displaying an O-R internal structure than a B-C structure.

4.4 Lexical blends

There are 109 lexical blends in the TSM corpus. More than half of the tokens are contracted with a breaking point at the syllable boundaries (MacKay 1982, Kelly 1998), like the one in (23) and some errors only involve features or tone on surface, like the one in (24).

(23) I: **piŋ33sjɔŋ33si13** tə21 u21 te55 tsja53
      E: **piŋ33laj13**
          ordinarily   so   have Progressive eat
      '(I) take (the medicine) ordinarily'
      blended lexical items: piŋ33sjɔŋ33si13 (ordinarily) / pun55laj13 (originally)

(24) I: kin33a55zit3 tsə53 **tset5bɔk5**
      E: …   **ten21lɔk5**
          today   do   program
      '(I) host the radio program today, …'
      blended lexical items: tset5bɔk5 (program) / ten21taj13 (radio station)

In (24), the blend is composed of the first syllable of the component [piŋ33sjɔŋ33si13] 'ordinarily' and the second syllable of the other component [pun55laj13] 'originally'. In (24), the first syllable of the blend is adopted from the first syllable of the component [ten21taj13] 'radio program'. The second syllable of the blend combines the second syllable of the other component [tset5bɔk5] 'program' with the 'place' feature of the second syllable of the component [ten21taj13], forming a hybrid syllable [lɔk5]. Data like these which do not reveal the breaks inside a syllable or do not reveal a clear syllable internal structure are all counted as 'Others'. Moreover, errors in which the two lexical items involved in the blend are composed of simple CV or CGV structures, as the example in (25), are also counted as 'Others' since they do not reveal anything related to the breakup of complex syllables. There are 74 errors counted as 'Others' and 35 blends involving the break within a syllable.

(25) I: a0   li55 hɔ̃0 be55 laj33 **pə53** ten21we33 hɔ̃0
     E: …   **kə53**
         PART you PART want come   report phone   PART
     '(If) you want to report your phone number, …'
     blended lexical items: pə53 ten21we33 (report the phone numbers) / kha53 ten21 we33 (make the phone call)

Among the 35 blends, there are 13 clear cases and 22 cases with unit ambiguity due to the overlapping segments between the two blended components. The high percentage of lexical blends with overlapping segments between the two components indicates that the two components involved in blends usually have phonemic similarity (MacKay 1982, Kelly 1998). Likewise, we separate the clear cases from ambiguous ones.

Regarding the 13 clear cases, all reflect an O-R structure. Of the 22 ambiguous cases with overlapping segments, there are 6 errors displaying a B-C structure and 6 errors displaying an O-R structure. The remaining 10 errors display a B-C structure in one way and an O-R structure in the other way depending on different treatments of the overlapping segments. An example and the possible analyses are given in (26).

(26) I: u21e33　　kə55　e21　　**tsʰwan33**　　kʰi55kə55　　kʰi55bin53.

　　 E: …　　　　　　　　　　**tsʰwan55**

　　　　some　　still　　can　　prepare　　toothpaste　　toothbrush

　　'Some will even prepare toothpaste and a toothbrush.'

　　blended lexical items: tsʰwan33 (prepare) / kʰwan55 (prepare)

Analyses	Origins		Blend	Syllable structure
Analysis 1:	[tsʰ-wan33]/[kʰ-wan55]	→	[tsʰ-wan55]	C_i-G_mVC_f; C_i-G_mVC_f
Analysis 2:	[tsʰw-an33]/[kʰw-an55]	→	[tsʰw-an55]	C_iG_m-VC_f; C_iG_m-VC_f
Analysis 3:	[tsʰwa-n33]/[kʰwa-n55]	→	[tsʰwa-n55]	C_iG_mV-C_f; C_iG_mV-C_f
Analysis 4:	[tsʰwan33]/[kʰwan55]	→	[tsʰwan-55]	Syllable, T

In (26), the two lexical items [tsʰwan33] 'prepare' and [kʰwan55] 'prepare' contain the same segments except the onset consonant. Regarding the error [tsʰwan55], there are four possible analyses which differ according to the treatment of the overlapping segments. In each analysis, the dash within each lexical item and within the syllable structure indicates the boundary of two sub-syllabic constituents. The syllable internal structure revealed in each analysis is given at the end of each analysis. Analysis 1 and 2 display a branching of O-R division while Analysis 3 displays a branching of B-C division. The blend error can also be analyzed as a combination of the segments from the item [tsʰwan33] with the tone from the item [kʰwan55], as Analysis 4. It is impossible to select a certain analysis and discard the others objectively. Therefore, these 10 cases with discrepant internal structures between the B-C or O-R division due to different analyses are also counted as "Others".

The error tokens of each structure type derived from lexical blends are listed in the table in (27). Though there are some tokens reflecting a B-C structure, rimes are still preserved 3 times more often than bodies.

(27) Frequency of structure types revealed in lexical blends

Structure types	Clear cases	Ambiguous cases
B-C	0	6
O-R	13	6
Others	74	10
Total	109	

5. Syllable contraction data

5.1 Analysis based on syllable structure

Syllable contraction is a process occurring in oral speech in which two successive syllables are contracted into one syllable. Examples of syllable contraction like [hɔ21 laŋ33] → [hɔŋ13] 'let them' and [tsit5 tsun33] → [tsin53] 'this moment' are used as evidence to support the B-C branching of the syllable internal structure. In this section, we analyze this kind of data to see if they reveal consistent patterns and can be taken as a supporting argument for a certain syllable internal structure.

If we assume that the combination of contracted forms in syllable contraction also honors the syllable structure and the breakpoints fall on the boundaries of sub-constituents as speech errors, then based on the examination of the surface structure of the contracted form, we find that the boundary of the first and the second source syllables occurred at various points. Examples in (28), like the one [hɔ21 laŋ33] contracting into [hɔŋ13] in (28a), reveal a breakpoint at the boundary between the nucleus and the coda in both components. On the contrary, examples in (29), like the one [si53 tsap5] contracting into [sjap5] in (29a), reveal a breakpoint at the boundary between the onset consonant [ts] and the rime [ap] in the second component. The former reflects a B-C internal structure while the latter reflects an O-R division.

(28) Contracted examples reflecting a B-C structure
    a. [hɔ21 laŋ33 (ljam33)]   → [hɔŋ13 (ljam33)] 'scolded (by others)'
    b. [se53 han53 (tsik3)]   → [sen53 (tsik3)]   'little (uncle)'

(29) Contracted examples reflecting an O-R structure
    a. [si53 tsap1 (hwe21)]   →   [sjap5 (hwe21)] 'forty (years old)'
    b. [tsit5 e55]   →   [tse55] 'this one'

Examination of the contracted examples listed in Liu (2005) showed that among the 63 examples, there are 38 tokens not revealing a clear internal structure of

complex syllables since the contracted forms either involve the whole syllable or involves syllables merely containing a simple CV structure, as the examples shown in (30).

(30) a. [kwa33a55 hi21] → [kwa35 hi21] 'Chinese opera'
     b. [tsa55 k^{h}i55 (si13)] → [tsaj55 (si13)] 'morning time'

In (30a), the second source syllable contains a simple vowel [a55], which is the same as the nucleus vowel of the first source syllable. Therefore, it is impossible to tell the source of the nucleus vowel of the contracted form. In (30b), the two syllables [tsa55 k^{h}i55] contract into the contracted form [tsaj55]. Since both source syllables are composed of a simple CV structure, the contracted form does not reveal anything related to the constituent of onset consonants with vowels or vowels with coda consonants. Hence, these data do not display the syllable internal structure in terms of a B-C or O-R division.

Among the remaining 25 examples, there are 20 examples reflecting a B-C structure and 5 examples reflecting an O-R structure. Hence, there are more contracted examples reflecting a B-C structure than an O-R structure. As a result, it may be concluded that the syllable internal structure reflected in the speech error data is discrepant from that reflected in the syllable contraction data. The former reflects an O-R division within a syllable while the latter displays a B-C division. However, things may not be so simple. In the following, we would postulate an alternative proposal with a different interpretation to account for the construction process in syllable contractions, which shows that the internal structure of the contracted syllables can be analyzed without involving the breakup of sub-syllabic constituents. In other words, the formation of the contracted syllables is irrelevant to the breakup of the sub-syllabic constituents.

5.2 Alternative analysis

5.2.1 The nature of syllable contraction data

Before analyzing syllable contraction data, some properties related to the nature of syllable contractions should be addressed first. These properties are ignored in the previous studies dealing with syllable contractions. However, they are absolutely important and definitely related to the analysis of syllable contraction data since they provide good motivation to explain the formation of the contracted forms. Syllable contractions, also sometimes called syllable blends, have a common property with

lexical blends in speech errors or lexical blends in English such as *smog*, which comes from *smoke* and *fog*, in that they all involve contraction of two lexical items into one, causing the omission of some segmental components. To distinguish the lexical blends that occur in speech errors and the lexical blends used in English such as *smog*, we call the former "unconscious lexical blends" since they occur erroneously by accident and the latter "conscious lexical blends" since they are not errors and occur under a certain conscious intention of the speaker.

Nonetheless, syllable contractions differ from both kinds of lexical blends in terms of two distinct properties. First, the two source syllables of syllable contractions are never semantically related and do not belong to the same part of speech. On the contrary, the two source components of lexical blends are usually semantically related and belong to the same part of speech. Second, the two source syllables in syllable contractions bear a linear-order relationship, while the two source components of lexical blends have no such liner-order relationship. Therefore, the two source syllables of syllable contractions frequently occur together in oral speech with a linear order the same as the linear order they appear in syllable contractions. The two source components of lexical blends evidently can not occur together sequentially in an utterance due to the first property. In a word, syllable contractions are basically a syntagmatic merger of two contiguous components with a linear-order relationship while lexical blends are a paradigmatic merger of two components with a semantic relationship.

These essential differences between syllable contractions and lexical blends lead to their difference in the contraction process. Unconscious lexical blends in speech errors involve activation and mis-retrieval of two semantically related lexemes at the semantic level. Both the intended and the intruding lexical items are selected in the retrieval of lemmas. The phonological structure of these two lexical items later merges into one syntagmatic slot at the level inserting phonological representation in speech planning, resulting in a phonologically blending error. Therefore, the contraction process occurs at a phonological level. Accordingly, lexical blend errors can reflect the phonological structure of lexical items. Though the combination of these two source components honors syllable internal structure, it seems unlikely to predict the sequential order of the combination. Namely, it is impossible to predict which source component would be selected as the first half of the blend and which one as the latter half. The examples shown in (31) can explicate this characteristic. The two source components of the blend errors in (31a) and (31b) are the same. However, the blend forms are different. Under the assumption that blend errors also honor syllable structure, the blend [ts^{h}wan55] in (31a) may be analyzed as the combination of the onset [ts^h] from the source component [ts^{h}wan33] with the rime

and the tone [wan55] from the other source component [kʰwan55]. The blend in [kʰwan13] (31b), on the contrary, reflects the reverse pattern. It is composed of the onset [kʰ] from the source component [kʰwan53] and the rime as well as the tone from the other source component [tsʰwan13]. Both errors can also be analyzed as a combination of segments from one component with the tone from the other component.

(31) a. I: u21e33 kə55 e21 **tsʰwan33** kʰi55kə55 kʰi55bin53
       E: …   **tsʰwan55**
          some still can prepare   toothpaste toothbrush
       'Some will even prepare toothpaste and a toothbrush.'
       blended lexical items: tsʰwan33 (prepare) / kʰwan55 (prepare)
   b. I: lɔŋ55 ka33 li55 **tsʰwan13** a0 la0
           all with you prepare ASP PART
       E: …   **kʰwan13**
       '(The medicine) has been prepared for you.'
       blended lexical items: tsʰwan13 (prepare) / kʰwan53 (prepare)

Conscious lexical blends, though also occurring at the semantic level like unconscious lexical blends, are different from unconscious lexical blends in two respects. One is that the former occurs with no time pressure while the latter occurs due to time pressure. The other is that the former occurs with a motivation while the latter occurs merely by mistake. The main motivation of conscious lexical blends is ease of articulation, which is a means to achieve efficient communication. It is shorter and hence more efficient in communication to articulate a lexical blend such as *spork* than to pronounce both source components *spoon and fork* intact. Such contractions are processed with the speaker's awareness. Accordingly, they can even more clearly reflect speakers' internal linguistic knowledge. Since these blends are contracted with the speaker's awareness and occur in the absence of any time pressure, unlike unconscious lexical blends, the sequential order of conscious lexical blends is not combined at random. Instead, the ordering patterns of the combination are actually predictable and governed by some factors. Kelly (1998), by examining English blends, showed that shorter and more frequent words would be selected for the first part of the blends.

Syllable contractions resemble conscious lexical blends in that they occur for the same reason, i.e. to achieve efficient communication via ease of articulation. However, different from lexical blends which are semantically grounded, syllable contractions are basically phonetically based. That is, the contraction mainly involves merger of

segments at a lower phonetic level in speech production (Some might involve a higher phonological level after the contracted forms have been fossilized, which will be discussed later). Oral communication is composed of two parts, i.e. speakers and listeners. Efficient communication does not only take the speaker's production into consideration but also the listener's perception. Accordingly, it is a compromise between production and perception. We argue that the compromise between production and perception is exactly the premise of syllable contractions. In other words, the premise of syllable contractions is to maintain maximal segmental information in the contraction process. On the one hand, it reduces the burden of speakers in production and on the other hand, it still keeps enough information, both semantically and syntactically, for listeners' perception, to reach the goal of efficient communication. In the following, we posit a different proposal under this premise to account for syllable contraction data. It does not involve the breakup of the syllable internal structure.

5.2.2 Our proposal

Based on the premise that syllable contraction should maintain maximal segmental information while reducing the production burden, we argue that syllable contraction is a dynamic process which may occur at two different levels in speech production. One is a lower phonetic level and the other is a higher phonological level. All syllable contractions start at the phonetic level. Most of the syllable contractions still operate at the phonetic level while some have risen to operate at the phonological level. When contraction occurs at the phonetic level, the contracted form would preserve maximal segmental information, including maintaining the phonetic properties of the source segments. Hence, there are variants of syllable contractions due to idiosyncratic pronunciation of the speakers, as the examples shown in (32). All these examples have two or three variants. The contracted forms of the examples in (32c) and (32d) further clearly support our argument that phonotactic constraints are not taken into consideration at the phonetic level since the contracted rimes [ɔaj] and [jaj] are not legitimate rimes in TSM.

(32) a. [kʰa55 e21]   →   [kʰae51]/[kʰaj51]   'how come'
      b. [tsa33 bɔ55 laŋ13] →   [tsaɔ35 laŋ13]/[tsaw35 laŋ13]/   'woman'
                                   [tsɔ35 laŋ13]
      c. [lɔ31 laj21]   →   [lɔaj31]/[lwaj31]   'come down'
      d. [kʰi31 laj21]   →   [kʰjaj31]/[kʰaj31]   'get up'

Then how can we account for the examples in (33a-c) in which the contracted forms are not the first variants preserving most of the phonetic information, marked by a pound sign, but the second ones in which the vowels of the second source syllables are deleted in the contracted forms?

(33) a. [hɔ21 laŋ33]   →   #[hɔaŋ13]/[hɔŋ13]   'let them'
     b. [tsit5 tsun33]   →   #[tsiun53]/[tsin53]   'this moment'
     c. [se53 han53 tsik3] →   #[sean53 tsik3]/[sen53 tsik3] 'the youngest uncle'
     d. [kʰi31 laj21]   →   [kʰjaj31]/[kʰaj31]   'get up'

Based on the essence of our proposal, we propose that in the beginning, the original contracted forms of these examples are the first ones marked with a pound sign, just like the pattern of [khjaj31] from [khi31 laj21] in (33d), in which the contraction is merely co-articulation of vowels of two syllables by deleting intervocalic consonants and a contraction of tones. Then what causes the change from the original variant to the second one used nowadays? The answer lies in the fossilization of the contracted forms. As mentioned previously, the highly frequent usage of the contracted form makes the contracted form become fossilized and once it becomes fossilized, it is on the way to become a lexical item of TSM. Then the operation of this contracted form rises from a mere contraction at the phonetic level to a lexicalization at the phonological level, where phonotactic constraints should be respected. Obviously, the contracted forms [hɔaŋ13], [tsiun33], and [sean53] violate phonotactic constraints of TSM since the rimes are illegitimately formed. Hence speakers readjust the internal structure to respect phonotactic constraints.

Take the readjustment from [hɔaŋ13] to [hɔŋ13] for example. The change from the combination of a back round vowel plus a low unrounded vowel to a back round vowel is a common process shown in vowel change (Roca and Johnson 1999:219). Accordingly, we propose that at the beginning of the lexicalization process, both variants [hɔaŋ13] and [hɔŋ13] exist in oral speech at some period. But later, as the process of lexicalization approaches the end, the variant obeying phonotactic constraints becomes the major one while the variant violating the phonotactic constraints decreases in frequency of occurrence, resulting in only the contracted form [hɔŋ13] nowadays.

5.3 Summary

At first glance, analysis of syllable contraction data based on the surface structure of the contracted syllables shows that more examples reflect a B-C syllable internal

structure as opposed to an O-R structure. However, we posit an alternative analysis to argue that these data can be dealt with consistently without involving the breakup of the sub-syllabic constituent. Analyzing contraction data without involving the breakup of the syllable internal structure is also adopted in Chung's (1995) analysis on syllable contractions. Accordingly, the finding that more examples reflect a B-C structure in syllable contraction data can not be taken as a valid counterexample against the O-R internal structure of TSM syllables.

6. Discussion

The table in (34) lists the token frequency of different syllable internal structures shown in different kinds of speech errors in regards to the syllable internal structure.

(34) Frequency of different syllable internal structures shown in speech errors

Internal structures	Larger-unit errors		Telescopings	Lexical blends		Total
	Clear	Ambiguous cases	Clear	Clear	Ambiguous cases	
B-C	0	0-3	2	0	6	8-11
O-R	66	27-10	4	13	6	116-99
Others	10	0-14	18	74	10	112-126
Total	103		24	109		236

First of all, single-segment errors show that speech errors respect the syllable structure in that most of the errors involve the interaction of segments in the same syllable position. The results of the other kinds of speech errors shown in the table in (34) further reveal two points of significance. Firstly, in larger-unit errors, telescoping errors and lexical blends, there are at least 99 errors reflecting an O-R structure and only 8-11 tokens reflecting a B-C structure. Errors reflecting an O-R division are 10 times more than those reflecting a B-C structure. Accordingly, results of speech-error data clearly reveal an O-R branching structure in the syllable internal structure of TSM.

Secondly, Laubstein (1987) found that in her English phonological error data (N=559), there were few speech errors (N=19, 3%) which seemed to be a rime substitution (N=11, 2%) or a body substitution (N=8, 1%). She provided an alternative analysis to deal with these errors without involving the concept of rime or body. Based on her analysis, these errors could be analyzed with a two-step process, syllable exchange first and an onset or coda omission later. For example, given what appears to be a body error $[C_{i2}V_2]$, the target is the syllable $[C_{i1}V_1C_{f1}]$ and the intrusion is the syllable $[C_{i2}V_2C_{f2}]$. This error can be analyzed as a whole syllable exchange first. So

the target $[C_{i1}V_1C_{f1}]$ turns to be $[C_{i2}V_2C_{f2}]$. Then it follows a coda omission, resulting in the error $[C_{i2}V_2]$. Consequently, Laubstein argued for the flat structure as the internal representation of English syllables and no sub-syllabic constituents of body or rime based on the rarity of such errors and the alternative analysis. This alternative analysis, though reasonable, is too complicated. It might be appropriate to account for errors with rare tokens. However, if there are many errors with an error unit of rime or body and they all need to be analyzed with such double processes, it is quite unlikely that speakers will make such complicated errors so often. Therefore, a premise accompanying this alternative analysis is that there should be few examples of this type of error.

Connect this alternative double-process analysis with our results. This alternative analysis might be possible to account for the few tokens reflecting a B-C structure and denies the reality of the sub-syllabic constituent 'body'. However, the considerable number of errors displaying the rime as a target unit in our data is quite impossible to be analyzed without adopting the constituent 'rime'. These errors are quantitatively sufficient to reveal the psychological reality of the sub-syllabic constituent 'rime' in TSM syllables and to indicate that the internal structure of a TSM syllable is hierarchical, mainly a left-branching of O-R structure.

As for the syllable contraction data, our analysis showed that the process of syllable contraction can be analyzed under the premise of retaining maximal segmental information, which mainly takes the phonetic form into consideration. Using this type of analysis, the combination of syllable contraction data is irrelevant to the breakup of the sub-syllabic constituents. Accordingly, syllable contraction data can not be taken as valid data to examine the syllable internal structure nor can they be taken as counterexamples of the O-R model.

7. Conclusion

In this study, we examined speech error data and syllable contraction data to explore the syllable internal structure. Speech errors involving single segment errors showed that speech errors do respect syllable structure. Results of errors involving larger units, telescoping errors and lexical blends showed an overwhelming preference for the O-R branching structure. Moreover, analysis of the syllable contraction data showed that syllable contraction can be analyzed as a process irrelevant to the breakup of the sub-syllabic constituents. Hence, syllable contraction data can not be taken as valid evidence to explore the syllable internal structure or as counterexamples against the O-R branching structure. In a word, analysis of spontaneous speech errors revealed an onset-rime branching structure of TSM syllables.

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體—尾或是聲—韻：台閩語的音節內部結構

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本研究分析近 600 個口語語誤資料來討論台閩語的內部音節結構。結果顯示絕大部分的語誤資料反映出聲—韻的右分叉結構。對於用來支持體—尾結構的音節合併證據，我們也提出可以不涉及內部音節結構的分析或解釋，因此，這類的證據並不能做爲聲—韻分叉結構的反證。總言之，根據口語語誤的分析，本研究結果和傳統音韻學的分析一致，支持台閩語的內部音節結構爲聲—韻右分叉的結構。

關鍵詞：音節內部結構、體—尾、聲—韻、台閩語、口語語誤

體—尾或是聲—韻：台閩語的音節內部結構