

Compositional Structure of /iu/ and /ui/ in Taiwanese Southern Min Revisited*

Hui-chuan Hsu

National Chiao Tung University

This paper re-examines the rimal structure of /iu/ and /ui/ in Taiwanese Southern Min. Departing from previous studies, this paper argues that /iu/ is a falling diphthong [i̠u̠] and /ui/ is a rising diphthong [ui̠], based on rhyming patterns, syllable contraction, and acoustic measurement of energy amplitude.

Key words: rhyming patterns, syllable contraction, energy amplitude

1. Introduction

Opinions about the compositional structure of /iu/ and /ui/ in Taiwanese Southern Min are divided in the literature. Li (1986:454) implies that they are both rising diphthongs. By contrast, Chung (1996:60) clearly contended that they are both falling in nature. This paper resolves the dilemma, arguing that /iu/ is a falling diphthong, while /ui/ is a rising diphthong, as evidenced by phonological processes and phonetic measurement.

This paper will be organized as follows. Section 2 gives a literature review. Section 3 re-examines the diphthongs in question by means of rhyming patterns and disyllabic contraction. Section 4 shows how energy amplitude measurement helps to identify the diphthongs under investigation. Section 5 gives the conclusion and theoretical implications.

2. Literature review

Li (1986:454) claims that in Taiwanese Southern Min “the medials¹ are more of-

* The phonetic study in this paper benefited from the help of Ho-hsien Pan. Valuable comments and suggestions from two anonymous reviewers are also gratefully acknowledged. Of course I am responsible for errors of fact and interpretation that still remain.

¹ The medial can vary in Chinese dialects phonetically. A comparison between Taiwan Mandarin and Beijing Mandarin (Tseng 2001) reveals significant difference in duration and intensity. It is concluded that the medial in Beijing Mandarin is more consonantal than syllabic, whereas that in Taiwan Mandarin exhibits the opposite picture. How the medial in Taiwan Mandarin be-

ten considered in rhyming, especially when the main vowel is a high vowel such as /i/ or /u/.” Like many Chinese dialects, Taiwanese Southern Min allows two medials, namely /i/ and /u/. Analogically, Li treats /iu/ and /ui/ both as rising diphthongs, and yet no evidence is presented to argue for the position. Probably it is taken for granted from the perspective of historical origin. According to the *Qieyun*, /iu/-rimes derive from Open-mouth Division III rimes, while /ui/-rimes develop from Closed-mouth Divisions I, III, or IV rimes. It is generally held by Chinese historical phonologists that Division III rimes and most Division IV rimes show the prevocalic /i/, and Closed-mouth rimes represent the prevocalic /u/. /iu/ and /ui/ are thus classified as rising diphthongs.² The problem is that when the *Qieyun* was being written, Southern Min had not even been included in the dialects to be discussed. Hence, the conclusion based on the *Qieyun* that /iu/ and /ui/ in Southern Min are both rising in nature is questionable.

If literary and colloquial strata are viewed as different dialects, the variations in (1) below behave just like /nju/ and /nu/ for *new* in different American English dialects. The rationale behind the comparison is: while the glide (phonologically speaking) may delete, the nucleus vowel remains. An inference from this line of reasoning is that /iu/ and /ui/ are both rising diphthongs as Li implies. The thing is the literary/colloquial variations are not consistent on the right column of data in (1). Two readings, /u/ and /iu/, co-occur in the either literary or colloquial layer, which might arouse suspicion about the above conclusion.³ Strictly speaking, no solid evidence proves that /iu/ and /ui/ are both rising in nature.

(1) Literary/Colloquial Distinction

bi/bui	微	tsu/tsiu	珠
k ^h i/k ^h ui	氣	su/ts ^h iu	樹
ki/kui	幾	k ^h u/k ^h iu	丘
i/ui	衣	kiu/ku	久
i/ui	遺	giu/gu	牛
		iu/u	有

hasves may be related to language interference. From my own phonetic study, a diphthong in Taiwanese Southern Min mostly exhibits a VV sequence. This paper uses “medial” and “medial glide” interchangeably, simply because in a syllable the nucleus vowel is projected as the head in contrast with its adjacent vowel/glide in terms of prominence relation. Specific phonetic substance of the medial is not highlighted here.

² For instance, the Middle Chinese forms for the two rimes are reconstructed as *ju* and *juei* by Tung (1985).

³ Sincere thanks go to Hsiao-feng Cheng for bringing this issue to my attention.

On the other hand, Chung (1996) claims /iu/ and /ui/ to be falling diphthongs on the ground of co-occurrence restrictions and rhyming patterns. According to Chung (1996:122), underlyingly every syllable in Taiwanese has an XXX template, with the nucleus in the middle. The ability to precede a consonant distinguishes a rising diphthong from a falling diphthong. On the premise that the former occupies one skeletal slot, while the latter occupies two, no extra X slot is available to accommodate any consonant after a falling diphthong. Consider the following patterns.

- | | |
|-----------------------------------|--------------------|
| (2) rising diphthongs | falling diphthongs |
| ia — iam, ian, iaŋ, iap, iat, iak | ai — *aiC |
| ua — uan, uat | au — *auC |
| io — ioŋ, iok | |
| (3) iu — *iuC ui — *uiC | |

In fact, this phonotactic constraint may not constitute reliable evidence for the compositional structure of /iu/ and /ui/. The presence of a following consonant is an indicator of a rising diphthong, but the absence of a following consonant does not necessarily identify a falling diphthong. In Taiwanese Southern Min, that /ue/ is not followed by a consonant does not undermine its nature as a rising diphthong. Note that *pue?* ‘eight’ is but an apparent exception. According to Li (1989) and Chung (1996), the glottal stop is not a true consonant but an entering tone feature, as evidenced by tone sandhi, rhyming patterns, and co-occurrence restrictions. Just like /ie/ in Sixian Hakka (Hsu 2004), /ue/ in Taiwanese Southern Min does not happen to precede any consonant. We cannot exclude the possibility that /iu/ and /ui/ behave the same, and hence the co-occurrence restriction is not indicative of their rimal structure.

Also based on Li’s (1986) independent study of folk song rhyming in Taiwanese Southern Min, Chung (1996) advocates that /iu/ and /ui/ are treated as falling diphthongs since they only rhyme with themselves with rare exceptions. Closer inspection of the rhyming practice in Taiwanese Southern Min suggests a reinterpretation. According to Li (1986:460), “syllables with medials /i/ and /u/ seldom rhyme with syllables without these medials, nor do they rhyme with syllables with different medials, and this practice is rather different from the Chinese tradition of poetics.” To better understand what Li means, let us digress to present the Chinese tradition of poetics.

Generally speaking, the only necessary and sufficient condition for two syllables to pair off as rhyming partners is the identity of the nucleus plus the coda. The presence or absence of the medial glide is irrelevant; so is its different realization, as exemplified by the following stanza of a Mandarin popular song named 中華民國頌 ‘Ode to the Republic of China.’

- (4) 青海的草原，一眼看不完；
 üan uan
 喜馬拉雅山，峰峰相連到天邊。
 san pian
 ‘Qinghai Prairie, the bounds of which are hard to see;
 The Himalayas, peaks of which stretch to the sky.’

If rhyming is unanimously defined over the rime in Chinese dialects, whether the medial glide affects rhyming or not is attributed to the difference in syllable structure (Bao 1996). Specifically, the medial glide in Mandarin is not part of the rime, and hence is tangential with rhyming at all. In Taiwanese Southern Min, the medial glide is part of the rime by being part of the nucleus; therefore syllables containing distinct medial glides do not rhyme.

Now resume our discussion of Taiwanese Southern Min. Two possibilities point to the same result that /iu/ and /ui/ rhyme with themselves. First, that syllables with medials seldom rhyme with syllables without and that syllables with different medials do not pair off is not a tailor-made principle for specific diphthongs. It instead applies to all rising diphthongs. For instance, /ia/, /io/, /ua/, and /ue/ all prefer to rhyme with themselves, to put their nasalized counterparts aside. If /iu/ and /ui/ present rising diphthongs, we expect that they behave the same. Second, given the rhyming requirement of the identity of the nucleus plus the coda, falling diphthongs do not form rhyming partners with others (for exceptions see Cheung 1996 and Hsu 2004). In view of the opposing poles, that /iu/ and /ui/ usually rhyme with themselves suggests four different structural combinations below, which prove untenable Chung’s conclusion that they are both falling diphthongs.

- (5) /iu/ /ui/
 rising rising
 rising falling
 falling rising
 falling falling

3. Phonological evidence

This section presents two phonological arguments, namely rhyming patterns and disyllabic contraction, to argue that in Taiwanese Southern Min /iu/ is a falling diphthong and /ui/ a rising diphthong.

3.1 Rhyming patterns⁴

The rhyming practice changes through time. Inspection of Taiwanese Southern Min popular songs after 1980 by the present author reveals that the presence or absence of the medial glide makes no difference.⁵ Still, through rhyming patterns we can take a closer look at the compositional structure of /iu/ and /ui/. In my corpus, 129 out of 193 songs which present the rhyming category /i/ have /ui/ as partners.⁶ Due to the paucity of /ui/-rimed syllables, only one case is found to rhyme with itself throughout. By contrast, not a single song in my corpus presents the rhyming category /u/, and none of the 14 songs which employ the rhyming category /iu/ is found to pair off with /u/. Bear in mind that rhyming requires the identity of the nucleus plus the coda. Only when /iu/ and /ui/ are actually [iu] and [ui], will the asymmetry of ui/i rhyming, but never iu/u rhyming,⁷ be explained. If /ui/ is a falling diphthong as Chung claims, that /ui/ rhymes with /i/ obviously violates the condition of rhyming in that /i/ occurs as the vocalic coda in the former, but the nucleus vowel in the latter.

Popular songs in (6) and (7) below are used to elucidate the *ui/i* rhyming. Each row lists all the line-final syllables in a stanza and the lyricists are indicated in parentheses. Note that the oral/nasal distinction in nucleus is immaterial in rhyming. The popular song in (8) employs two rhyming categories *a*⁸ and *iu*. As clearly displayed, *iu* rhymes with itself or its nasal counterpart alone. This is true of example (9).

⁴ One of the reviewers holds that rhyming in poetry (and song) can be weak evidence for syllable structure. Our reply is that the diverse rhyming patterns he/she provides need further inspection. The crux of the matter lies in which level between the underlying and the surface rhyming is considered. For instance, in modern Mandarin, *an*, *ian* [jɛn], *uan*, and *üan* [ɥɛn] constitute a rhyming set from the consideration of the phonemic representation. As for the rhyme group *ən*, *in*, *uən*, and *ün* in modern Mandarin, the harmonious beauty is again achieved at the phonemic level (Chen 1984). The time dimension presents another way of looking into the issue. Dialect comparison clearly shows that they were respectively *ən*, *iən*, *uən*, and *ün* in an earlier stage (Hsu 2003a). It is very much likely that the rhyme group is adopted even after the widespread nucleus deletion affects *iən* and *ün*.

⁵ Syllables with different medial glides, for instance /ia/ and /ua/, also rhyme a lot, which suggests that the rhyming scheme employed in Taiwanese Southern Min after 1980 is due to contact with Mandarin.

⁶ Li (1986) notices that the oral/nasal and the free/checked (-ʔ specifically) distinctions are ignored in the rhyming scheme exploited in oral traditions in Taiwanese Southern Min. The text does not specify the properties for the sake of presentational simplicity.

⁷ As a matter of fact, the data Li (1986) adopts also reveal such an asymmetry.

⁸ As seen, *a*, *ua*, and *aʔ* constitute a rhyming set.

- (6) 胭脂 ‘Lipstick’
 脂 嘴 你 去
 tsi ts^hui ni k^hi
 子 味 意 勢
 tsi bi i si (許常德)
- (7) 斷腸詩 ‘A Poem on Heartbreak’
 時 天 水 嬰
 si tī tsui ĭ
 墘 晴 市 兒
 kī ts^hī ts^hi li
 機 時 虛 去
 ki si hi k^hi
 悲 味 蕊 時 微 詩
 pi bi lui si bi si (伍佰)
- (8) 歹朋友 ‘Shit’s What Friends Are For’
 我 肉 珠(眼) 我 想 漢 樣 友 友 珠(眼)
 gua baʔ tsiu gua sīū han ĭū iu iu tsiu
 仔 佑 珠(眼) 歹 癢 壽 救 友 友
 a iu tsiu p^hai tsīū siu kiu iu iu (武雄)
- (9) 若是我回頭牽你的手 ‘If I Return to Hold Your Hand’
 手 收 由 手 友
 ts^hiu siu iu ts^hiu iu
 手 柔 愁 酒 珠(眼) 想 甜
 ts^hiu liu ts^hiu tsiu tsiu sīū ĭ (許常德)

3.2 Disyllabic contraction

Disyllabic contraction lends further support to our position that /iu/ is a falling diphthong, and /ui/ is a rising diphthong. Hsu (2003b) proposes a sonority model, the gist of which is stated in (10) below, to account for syllable contraction in Taiwanese Southern Min.

- (10) The Sonority Model
- a. Syllable Template
 Every syllable has an XXX skeleton tier, with the nucleus in the middle.
 - b. Syllable Contraction
 Two syllables merge into one in fast speech.
 - c. Edge Association

The association of segments and the skeleton tier begins with both edges, affecting the onset and the consonantal ending alone.

d. Vocoid Syllabification

The realization of the nucleus abides by the order of syllabification, that is, N-placement precedes rising diphthong formation, which in turn is followed by falling diphthong formation.

e. Vocoid Association

Among the vocoids, the priority of association with the nucleus position is determined by the sonority hierarchy of $a > \text{ɔ} > e > o > i > u$. If there is a tie, association proceeds from left to right. V-neutralization (Chung 1996:154) operates when necessary.

f. Maximality

On the premise that the No Crossing Line Constraint (Goldsmith 1976), Phonotactic Constraints, the Non-identity Constraint, and the Glide Transfer are met, maximal linking between the melodies and the skeleton tier is guaranteed to construct the largest possible syllable (Prince 1985).

Directly relevant to the current discussion is the principle in (10e) that between the two source syllables, the nucleus of the contracted syllable comes from the more sonorous one according to the sonority scale of $a > \text{ɔ} > e > o > i > u$. From examples (11) to (13), V-neutralization turns a mid vowel, when adjacent to a more sonorous one, into high to construct the largest possible syllable. In addition to failure to meet the sonority hierarchy, **tou* in (14) is rejected for violating the Dissimilatory Constraint which bars $\{[+back] \dots [+back]\}$ in the rime (Chung 1996:54). In (15), the prior association of *n* with the coda position blocks *u* from associating with the nucleus position since **iun* contravenes the co-occurrence restriction that a falling diphthong cannot precede a consonant in Taiwanese Southern Min (Chung 1996:80). Examples (16) and (17) give additional force to the higher sonority of /i/ than /u/. Note that **nũã* in (17) is eliminated by the sonority requirement alone, and the output nasal onset results from nasality spreading of the nasalized rime.

- (11) tsa + bɔ laŋ → tsau laŋ ‘woman’
- (12) he + ɔ → hiɔ ‘interjection for sudden realization’
- (13) bo + e → bue ‘unable’
- (14) to + ui → toi/*tou ‘where’
- (15) tsit + tsun → tsin ‘this moment’
- (16) hit + tsun → hin ‘that moment’
- (17) li + k^hũã → nĩã/*nũã ‘look!’

We acknowledge that without independent evidence, the sonority scale based on disyllabic contraction is not convincing due to argumentation circularity. As will be presented in §4, energy amplitude is used as an acoustic indicator, among others, of sonority, which happens to be a linguistic notion invoking both phonology and phonetics. On the premise that there is only one peak per syllable, the greater sonority of /i/ makes it the nucleus vowel when adjacent to /u/ as a diphthong.

4. Production experiment

4.1 Method

The data set of this experiment is tripartite. One presents ten /iu/-rimed and nine /ui/-rimed syllables in isolation. One includes disyllabic phrases initiated by seven /iu/-rimed and six /ui/-rimed syllables in the first group of data. The other is composed of five /i/-rimed and four /u/-rimed isolated syllables.

Tone was controlled in the first two groups of data in the experiment. All the target syllables carry a high level tone. When occurring in a disyllabic phrase, they are all followed by a syllable with the same pitch and a voiceless onset. As for the data about monophthongs, tone was not controlled, and nothing but the nucleus occurred in the target syllable.

Nine native Taiwanese speakers, all male, served as subjects. One came from Yilan, one from Jiayi, three from Tainan, and the other four from Gaoxiong. They all had Taiwanese-speaking parents. In addition, all subjects spoke Mandarin. None of them had speech or hearing problems by self-report.

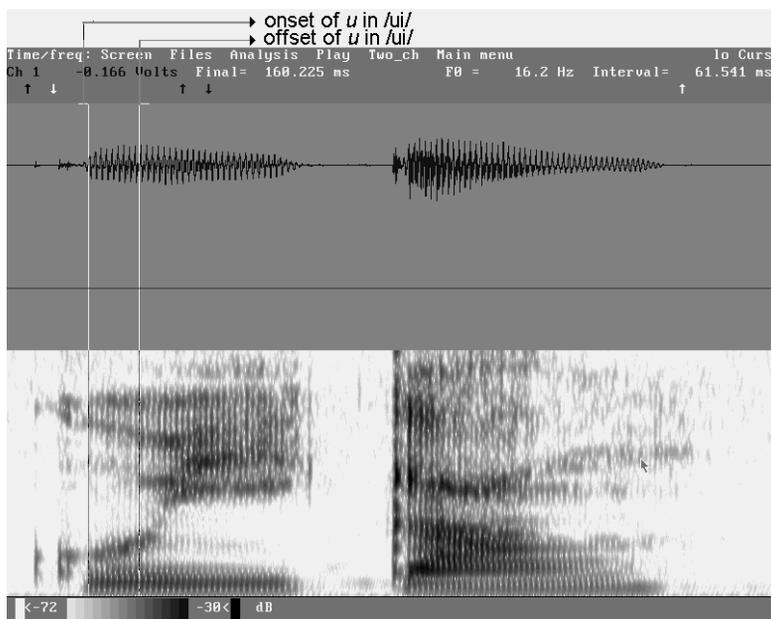
The recordings were made in the sound booth at the Foreign Languages and Literatures Department of the National Chiao Tung University. The twenty-eight isolated syllables and thirteen disyllabic phrases were read three times in random order. The recording is done using a SONY MZS-R4ST MD. The recorded data was saved into computer through Sound Blaster Pentium Live, and then measured and analyzed by Cspeech ver 4.0-Lab Automation.

The recordings were digitized (10 kHz sampling). Energy amplitude of F_2 was measured for the speakers' repetitions of each of the tokens.⁹ Mean energy amplitude of

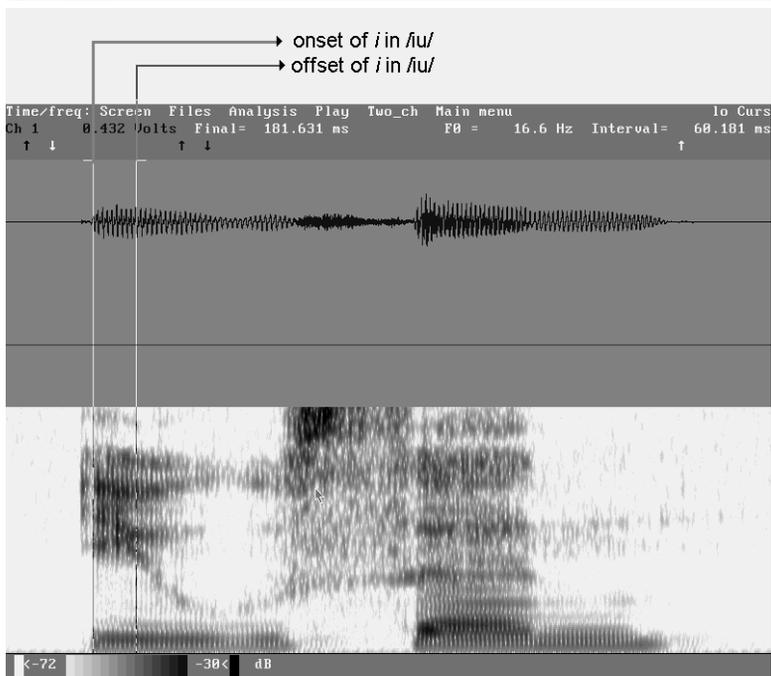
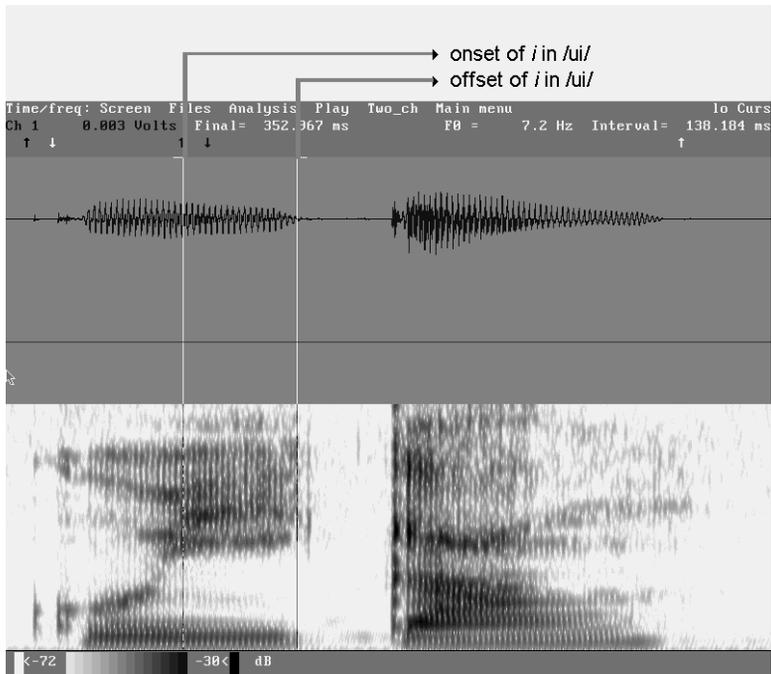
⁹ According to Dr. Jie Zhang (pers. comm.), the result of energy amplitude measurement will reflect the temporal organization of the two diphthongs under investigation. In Zee's (1999) acoustical analysis of the diphthongs in Cantonese, both diphthong formants and duration measurements reach the consensus that /iu/ and /ui/ are phonetically [i:u] and [u:ɥ]. An inference from these arguments is that energy amplitude, formants, and duration will indicate the same thing. This line of reasoning is validated by another experiment of mine on Taiwanese

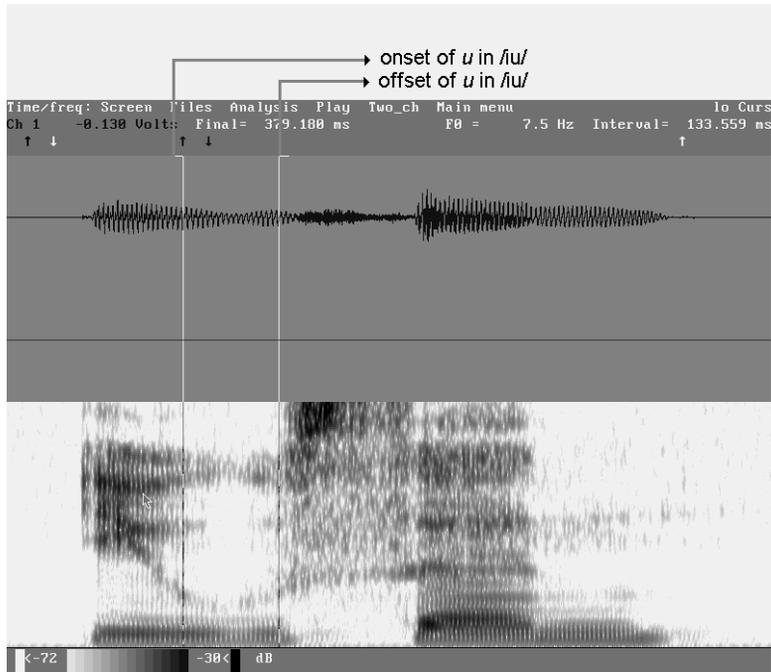
/i/ was calculated for all tokens with the same rime, separating target syllables in isolation and those in the phrasal context. The same analysis was done for /u/. The difference of mean energy amplitude between /i/ and /u/ was examined by paired t-tests in individual diphthong-rimed syllables within the same environment. As for the monophthongs, the difference of mean energy amplitude between /i/ and /u/ in isolation was also inspected by a t-test.

Below are four figures which indicate that formant transition in both /iu/ and /ui/ are ignored in the measurement of F_2 amplitude.



Southern Min, in which the target syllables occur in a frame sentence and formants and duration are measured. Our conclusion that /iu/ is a falling diphthong, and /ui/ a rising diphthong in Taiwanese Southern Min holds true.





4.2 Results

The results of paired t-tests showed that the difference of mean energy amplitude between /i/ and /u/ in individual diphthong-rimed syllables was statistically significant at α level = 0.01. Specifically, /i/ has higher energy amplitude than /u/, both in isolation and in the phrasal position. Consider the following tables.

Table 1: Paired t-test result of /iu/ in isolated syllables

	I	U
Number	297	297
Mean	-33.68	-49.17
Standard Deviation	6.73	13.11

$t = -23.17$ $p = 0.00$ $df = 296$

Table 2: Paired t-test result of /ui/ in isolated syllables

	I	U
Number	243	243
Mean	-32.73	-42.47
Standard Deviation	8.44	9.73

$t = -13.78$ $p = 0.00$ $df = 242$

Table 3: Paired t-test result of /iu/ in the phrasal position

	I	U
Number	189	189
Mean	-38.03	-51.50
Standard Deviation	5.88	10.70

t = -18.07 p = 0.00 df = 188

Table 4: Paired t-test result of /ui/ in the phrasal position

	I	U
Number	162	162
Mean	-35.80	-45.99
Standard Deviation	6.55	8.49

t = -14.47 p = 0.00 df = 161

One wonders if /i/ has higher energy amplitude than /u/ intrinsically. The following table gives a negative answer since the difference of mean energy amplitude between the two monophthongs is not statistically significant at α level = 0.01.

Table 5: T-test result of /i/ and /u/ in isolated syllables

	I	U
Number	135	108
Mean	-41.03	-41.60
Standard Deviation	5.28	6.30

t = -0.76 p = 0.44 df = 241

An important question concerns whether energy amplitude constitutes reliable evidence for the compositional structure of /iu/ and /ui/. Parker (2002:1-2) clearly states that “sonority is strongly correlated with intensity of the voice (in decibels) in a positive direction... the more sonorous a sound is, the louder it will tend to be.” In addition, our findings from Taiwanese Southern Min are not language-specific. The same outcome is obtained in another study on Sixian Hakka (Hsu 2004). On the premise that energy amplitude is in direct proportion to sonority,¹⁰ a conclusion drawn from our experiment

¹⁰ According to Ladefoged (2001:227), “the sonority of a sound can be estimated from measurements of the acoustic intensity of a group of sounds that have been said on comparable pitches and with comparable degrees of length and stress.” The results of acoustic measurements in Fry (1979) and Levitt (1978) show that the average power for the English phoneme /u/ is 21.5 dB, and that of /i/ is 20.5 dB, as expressed in reference to /θ/ which is the English sound with the lowest intensity and hence a value of “1.0” is arbitrarily assigned to it. That /u/ has more sonority than /i/ in English is further manifested by the fact that /u/ is lower than /i/

is: /i/ has more sonority when co-occurring with /u/ as a diphthong. Given that syllable nuclei be maximally sonorous (HNUC in Prince & Smolensky 1993), /i/ with greater sonority surfaces as the nucleus vowel. Therefore, /iu/ is a falling diphthong, and /ui/ is a rising diphthong.¹¹

5. Conclusion and theoretical implications

In the literature, opinions are divided on the rime structure of /iu/ and /ui/ in Taiwanese Southern Min. Li (1986) regards them as rising diphthongs, while Chung (1996) treats them as falling diphthongs. This paper has argued that /iu/ and /ui/ are /iu/ and /ui/ respectively, employing a range of evidence from rhyming patterns, disyllabic contraction, and energy amplitude measurement.

A theoretical implication concerns syllable theory. Chung (1996:80) rejected the traditional syllable structure for Chinese languages, CGVX, for “in a syllable with two high vowels, [it] makes no predictions as to which segment is the nucleus vowel, which is the medial, and which is the vocalic ending, because either *i* or *u* can be a medial glide, a nucleus vowel, or a vocalic ending”. A question arises as to whether the XXX syllable template Chung proposed is able to predict the nature of the diphthongs under investigation. The answer is negative. Both rising diphthongs and falling diphthongs are projected into the nucleus position. The difference lies in that the former occupies one X slot, while the latter occupies two. Here we propose that X-theory together with a language-specific sonority scale manages to pinpoint the compositional structure of /iu/ and /ui/. In Taiwanese Southern Min, /i/ with more sonority occurs as the nucleus vowel.

Another theoretical implication of this paper has to do with sonority hierarchy. Kiparsky (1979) proposes a sonority scale of $a > e > o > i > u$, which seems to hold true in Taiwanese Southern Min, but not in American English. (See fn.10.) The one claimed by Selkirk (1984), namely $a > e, o > i, u$, points out that vowels with the same tongue height are equally sonorous, as evidenced by the Kobon language of Papua New Guinea (Parker 2002:28). To sum up, empirical data indicate a tripartite division as to the

in vowel height (Ladefoged, 2001:207-208). Our assumption based on the positive correlation between intensity/energy amplitude and sonority will prove valid.

¹¹ Note that the so-called “rising diphthong” and “falling diphthong” are technical terms in phonology. The definition of a diphthong in phonetics is a sequence of two vowels rather than a sequence of a vowel together with a glide. Yet, no matter which form the two rimes in Taiwanese Southern Min under investigation represent, a central idea behind this paper is: there is only one peak per syllable. For a diphthong (VV, VG or GV phonetically), there must exist a strong-weak contrast, which shows in F_2 energy amplitude.

sonority relation between *i* and *u*.

Furthermore, this study helps to clarify the issue of where to put tone marks in the Taiwanese Orthography (Chang 2001:86-88). Pursuant to Campbell (1913), the tone mark for /ia/ is put above /a/, while that for /oa/¹² is above /o/. As for /iu/ and /ui/, the tone mark stands on top of /u/. In fact, we can just demand that the tone be indicated above the nucleus vowel to avoid the inconsistency incurred for the present. Hence, /oa/ has its tone mark above /a/, and /iu/ and /ui/ have their tones both marked above /i/.

References

- Bao, Zhiming. 1996. The syllable in Chinese. *Journal of Chinese Linguistics* 24.2: 312-354.
- Campbell, William. 1913. *Xiamenyin Xin Zidian [A New Dictionary of Amoy]*. Tainan: Taiwan Kauhue Kong Posia.
- Chang, Yü-hong. 2001. *Principles of POJ or the Taiwanese Orthography: An Introduction to Its Sound-Symbol Correspondences and Related Issues*. Taipei: Crane.
- Chen, Matthew Y. 1984. Unfolding latent principles of literary taste—Poetry as a window onto language. *Tsing Hua Journal of Chinese Studies*, New Series 16.1-2: 203-240.
- Chung, Raung-fu. 1996. *The Segmental Phonology of Southern Min in Taiwan*. Taipei: Crane.
- Fry, Dennis B. 1979. *The Physics of Speech*. Cambridge: Cambridge University Press.
- Goldsmith, John. 1976. *Autosegmental Phonology*. Cambridge: MIT dissertation. (Published by Garland, New York, 1979.)
- Hsu, Hui-chuan. 2003a. A particle analysis of *ü* in Chinese. *Tsing Hua Journal of Chinese Studies*, New Series 33.1:173-197.
- Hsu, Hui-chuan. 2003b. A sonority model of syllable contraction in Taiwanese Southern Min. *Journal of East Asian Linguistics* 12.4:349-377.
- Hsu, Hui-chuan. 2004. On the structure of /iu/ and /ui/ in Sixian Hakka. *Journal of Chinese Linguistics* 32.1:129-156.
- Kiparsky, Paul. 1979. Metrical structure assignment is cyclic. *Linguistic Inquiry* 10.3: 421-441.
- Ladefoged, Peter. 2001. *A Course in Phonetics*. New York: Harcourt College Publishers.
- Levitt, Harry. 1978. The acoustics of speech production. *Auditory Management of*

¹² Some linguists transcribe the sound as /ua/.

- Hearing-Impaired Children*, ed. by Mark Ross and Thomas G. Giolas, 45-115. Baltimore: University Park Press.
- Li, Paul Jen-kuei. 1986. Rhyming and phonemic contrast in Southern Min. *Bulletin of the Institute of History and Philology, Academia Sinica* 57.3:439-463.
- Li, Paul Jen-kuei. 1989. On the nature of syllable final -ʔ in Southern Min dialects. *Bulletin of the Institute of History and Philology, Academia Sinica* 60.3:487-492.
- Parker, Steve. 2002. *Quantifying the Sonority Hierarchy*. Amherst: University of Massachusetts dissertation.
- Prince, Alan. 1985. Improving tree theory. *Proceedings of the Berkeley Linguistic Society* 11:471-490.
- Prince, Alan, and John Smolensky. 1993. *Optimality Theory: Constraint Interaction in Generative Grammar*. Manuscript. Rutgers University, New Brunswick and University of Colorado, Boulder.
- Selkirk, Elizabeth O. 1984. On the major class features and syllable theory. *Language Sound Structure*, ed. by Mark Aronoff and Richard T. Oehrle, 107-136. Cambridge: MIT press.
- Tseng, Chin-Chin. 2001. Liangan jieyin duibi fenxi [A contrastive analysis of the pre-nuclear glide between Beijing Mandarin and Taiwan Mandarin]. Paper presented at the 7th International and 19th National Conferences on Chinese Phonology. Taipei: National Chengchi University.
- Tung, Tung-Ho. 1985. *Hanyu Shengyun Xue* [*Chinese Phonology*]. Taipei: Wenshizhe Publisher.
- Zee, Eric. 1999. An acoustical analysis of the diphthongs in Cantonese. *ICPhs, University of California, Berkeley* 2:1101-1104.

[Received 27 February 2003; revised 15 June 2004; accepted 19 June 2004]

Department of Foreign Languages and Literatures
National Chiao Tung University
1001, Ta-Hsueh Road
Hsinchu 300, Taiwan
hchsu@cc.nctu.edu.tw

台灣閩南語 /iu/ 與 /ui/ 組成結構的再檢討

許慧娟

國立交通大學

本文重新檢討台灣閩南語 /iu/ 與 /ui/ 的韻母結構。在從前的研究基礎之上，本文就押韻模式、音節縮併、以及能量強度的聲學測量等方面的證據，進一步主張 /iu/ 為下降複元音，而 /ui/ 為上升複元音。

關鍵詞：押韻模式，音節縮併，能量強度