Concentric: Studies in Linguistics
37.2 (July 2011):123-154

Phonetic Evidence for the Contact-Induced Prosody in Budai Rukai*

Chun-Mei Chen
National Chung Hsing University

This paper investigates the contact-induced prosody in Budai Rukai, an Austronesian language spoken in Taiwan. By providing phonetic representations of word stress shift in Budai Rukai, the contact-induced prosody has been further verified. The contrastive stress in the Budai dialect is in the process of developing predictable penultimate stress resulting in innovations in new settlements. Budai Rukai speakers who have frequent contact with Paiwan speakers tend to produce the Paiwan stress patterns. The prosodic change has applied an optional rule of extrametricality, and echo vowels have been treated as proper vowels in the varieties. Antepenultimate stress becomes penultimate stress in trisyllabic or longer prosodic words, with a release from extrametricality. Results also suggest that speaker variability affected the stress shift in Budai Rukai.

Keywords: phonetic evidence, contact-induced prosody, Budai Rukai, stress

1. Introduction

This paper investigates word-level phonetic features of the varieties of Budai Rukai, and I propose that the prosodic varieties of Budai Rukai have undergone a change due to language contact. Stress in Budai Rukai has been a controversial issue (Li 1977, Ross 1992, Blust 1997). Previous studies address the stress issue mainly within the work of historical reconstruction. None of the existing studies have made a careful examination on the prosodic phonology of stress in Budai Rukai, let alone empirical evidence for the innovation of the prosodic patterns. The controversy of the Rukai stress lies in the inconsistency with the penultimate prominence or "paroxytones", following the practice of Zorc (1983), and the phonological environments in which predictable stress patterns are attested. Phonemic inventory of Budai Rukai has been constructed (Li 1995, Zeitoun 2000), and Li (1995) describes the stress patterns in Rukai as "it falls mostly on the penultimate syllable, but less frequently on the final or antepenult." On the other hand, by examining the five pages of data in Li (1977), Blust (1997) sees no support for the claim that Rukai dialects exhibit a tendency to fixed paroxytone accent. Blust (1997) further points out that the great majority of forms in Rukai are oxytone (final stress patterns), when the echo vowels are discounted. Yet, whether Budai dialects exhibit fixed oxytone remains

* Parts of this study were presented at UCLA–UC Berkeley Joint Conference on Southeast Asian Studies in Los Angeles, USA, January 30-February 1, 2009. I would like to thank Bruce Hayes, Kie Zuraw, and the audience there for their insightful comments. Many thanks go to the two anonymous reviewers for their generous and detailed comments and suggestions. Special thanks go to native speakers of Budai Rukai during the field trips, whose hospitality made the survey possible. Field trips to Sandimen Township and Majia Township, Pingtung County, were partially supported by the National Science Council (NSC 97-2410-H-005-036).

uncertain, based on the calculation of Blust (1997).

Before detailing the prosodic issues in Budai Rukai, I briefly review the background and the classification of the Rukai language. Rukai is an Austronesian language spoken in Taiwan, and it includes six dialects: Tanan, Budai, Labuan, Maga, Tona, and Mantauran. The geographical distribution of the Rukai language includes three different areas in three counties, with a total population of 10,000 for all groups: eastern Tanan dialect in Taitung County, southern Budai dialect in Pingtung County, and the northern Lower Three Villages in Kaohsiung County. The three subgroups of Rukai differ not only geographically but also culturally and linguistically. Budai is referred as Rukai proper (Li 1995), including the villages of Vədai (Budai), Kutsapuŋan (Haocha), Adiri (Ali), Karaməmədəsan (Chiamu) and the other new settlements in Pingtung County. Geographical names are given inside the parentheses for reference. The Budai dialect is geographically close to the Paiwan dialect, and some of the new settlements are located within the Paiwan villages, such as the Sanhe village in Majia[1] Township. Budai is treated as the most representative Rukai dialect in Li's (1995) wordlist. According to Li (1995), Budai is the most conservative in terms of phonological change. In the present paper, I propose that, in what is a historically conservative dialect, innovative prosodic patterns have developed as a reflex of language contact in the sub-dialects of Budai Rukai spoken within the Paiwan villages.

Classification of the Rukai language has been proposed by Li (1973:6-7). Following Li (1973:6), Tanan and Budai dialects of Rukai are close to each other, whereas the dialects of the Lower Three Villages are more distantly related to the other two groups of Rukai. Within the language classification, Tanan, Budai, and Labuan have been designated as the "Eastern Rukai Group" as opposed to the "Lower Village Group" (also referred to as the "Western Rukai Group"). Tona and Maga are closer to each other, and Mantauran is not closely related to these two dialects (cf. Li 1977, Zeitoun 2000, 2007). Other studies on the classification of Rukai (Li 1977, Ho 1983) focus on either historical reconstruction or the internal relationships of Rukai. Much more attention has been drawn on whether Rukai is closer to the Tsouic or the Paiwanic branch. Shelley (1978) deals with some sociolinguistic aspects of the Budai dialect of Rukai, with an analysis of the genetic relationship with the other Rukai dialects and Formosan languages. As a result, the prosodic patterns of the Budai dialect have not been well studied yet.

Li (1973) depicts the structure of Tanan Rukai, and Hsin (2000) describes some aspects of Maga Rukai phonology. The two studies on different dialects of Rukai have

[1] In this paper Hanyu Pinyin was used when the geographical names were given by the Chinese people, such as Majia and Haocha. When the village names were given by the Budai people or associated with the Budai origin, IPA transcription was presented, such as Vədai, Kutsapuŋan, and Karaməmədəsan.

shown distinct phonological representations of Rukai. For instance, Tanan Rukai does not have onset clusters, while onset clusters are important features in Maga Rukai. This indicates distinctive features attested in one dialect could be absent in another dialect of Rukai. Being capable of speaking one dialect of Rukai does not guarantee the intelligibility of the other dialects of Rukai. The description of individual dialect of the Rukai language has become essential for both diachronic reconstruction and synchronic phonological typology. Paralinguistic factors such as age and generation have been attested to affect the linguistic forms in Rukai villages. Li (1973:7-10) has found a couple of features among the younger speakers of Tanan Rukai, such as different vowels from older ones, metathesis of diphthongs, and the variants of interdental fricatives.

Furthermore, mutual language contact and frequent intermarriage have been attested in new settlements of the Eastern and Western Rukai groups, such as the aboriginal villages in Sandimen Township and Majia Township, within the residency of the North Paiwan indigenous people. Due to the geographical areas of new settlements, Budai Rukai indigenous people have had close relations with their adjacent Paiwan indigenous people long before the Chinese people's arrival. The two ethnic groups, Paiwan and Rukai, have mutually influenced each other for a long time. Even though the Budai Rukai people in the villages of Vədai (Budai) and Kutsapuŋan (Haocha) nowadays still preserve much of their traditional culture, do they still preserve the ancestral accent of Budai? The present study aims to answer the question.

The prosodic issues in Budai Rukai have arisen over the past decades. Li (1973, 1977) has done a comprehensive study on Tanan Rukai and a reconstruction study on Proto-Rukai. Later studies (Ross 1992, Blust 1997) on Budai Rukai stress are based on Li's fieldwork data. Li (1977) points out that when the historically secondary vowels (echo vowels) were taken into account, stress is seen to fall mainly on the final syllable in Tanan, but on the penult in the other dialects. Blust (1997) points out that although Li (1977) reconstructs Proto-Rukai forms for all cognate sets presented, Li does not include all the stress contrasts in his data. Based on Li's (1977) data, Ross (1992) proposes four stress patterns in Budai and argues that the oxytones (final stress patterns) of Budai are apparently the last remnants of Proto-Austronesian (PAn) contrastive stress. According to Ross (1992), stress is predictable in some phonological environments in Budai, but not in others. Ross (1992) proposes the following patterns in Budai Rukai: (1)Trisyllables: second syllable accented; (2) Quadrisyllables: second syllable accented; (3) CVCV: penult accented; (4) CVCVC: accent unpredictable. However, the proposal of Ross (1992) is rejected by Blust (1997), as the theory "yields a correct prediction in about 57% (20/35) of the cases, and an incorrect prediction in about 43%. It thus does not offer a serious alternative to

independent development as an explanation for the agreements noted between Budai Rukai and Proto-Philippine" (Blust 1997:402). In fact, Ross (1992) mistakes the glide ([-consonantal]) coda in Li's (1977) data as a consonantal segment in /…C/, and no solid predictable patterns were attested in his reconstruction. But his conclusion is inspiring, by assigning the unpredictable stress patterns in Budai Rukai a prototype status.

Issues in Budai prosody can be detected from the proposal of Ross (1992). First, syllable structure and syllable number may affect the assignment of stress accent. Second, final stress or oxytone may be attested in CVCVC words. Third, echo vowels at the end of Budai words never bear stress. In fact, some affixes do not bear stress. Do long vowels or phonetically geminate vowels (cf. Li 1995) trigger or affect word-level prosody of Budai Rukai? If Budai stress could reflect the accent contrast in PAN, the phonetic vowel length and phonological syllable weight would become crucial for the stress assignment in Budai Rukai.

This paper deals with prosodic features of Budai Rukai stress and the prosodic innovations of Budai Rukai within a Paiwan village by providing phonetic representations of the prosodic prominence. The working hypothesis was that some of the varieties of Budai Rukai have developed specifications for predictable stress patterns in some words and morphemes. The predictable patterns obey the parameters of Sandimen Paiwan stress. In the present study I will refer to the innovations as contact-induced prosody. Aside from the stress patterns of Budai Rukai and the contact-induced prosody, another purpose of this paper is to investigate the phonetic properties of the stress accent in Budai Rukai. Do the Budai Rukai speakers in different villages still preserve the ancestral accent of Budai? What are the phonetic correlates of stress in Budai Rukai? In the following sections, I present a survey on Budai Rukai stress in different villages, a phonetic study on the correlates of stress accent, and a phonological account for the contact-induced prosody.

2. A survey on Budai Rukai stress

Field trips were made in 2005, 2006, and 2009, before the large-scale landslide caused by Typhoon Morakot. Two Budai villages, Budai and Kutsapuŋan (Haocha) and one Paiwan village, ļiutsilaulauðaŋ (Sanhe), were included in the investigation. Vədai (Budai) and Kutsapuŋan (Haocha) are located in Wutai Township, and the entrance to the villages is rather restricted. The Sanhe village is located in Majia Township, where the Paiwan indigenous people are the majority in the villages. Most of the Budai speakers who live in the Sanhe village are bilinguals of Budai Rukai and Sandimen Paiwan, and their ancestors are mainly from Vədai (Budai). The

Rukai language spoken in these villages belongs to the Budai dialect. The villages investigated in the present study were illustrated in Figure 1.

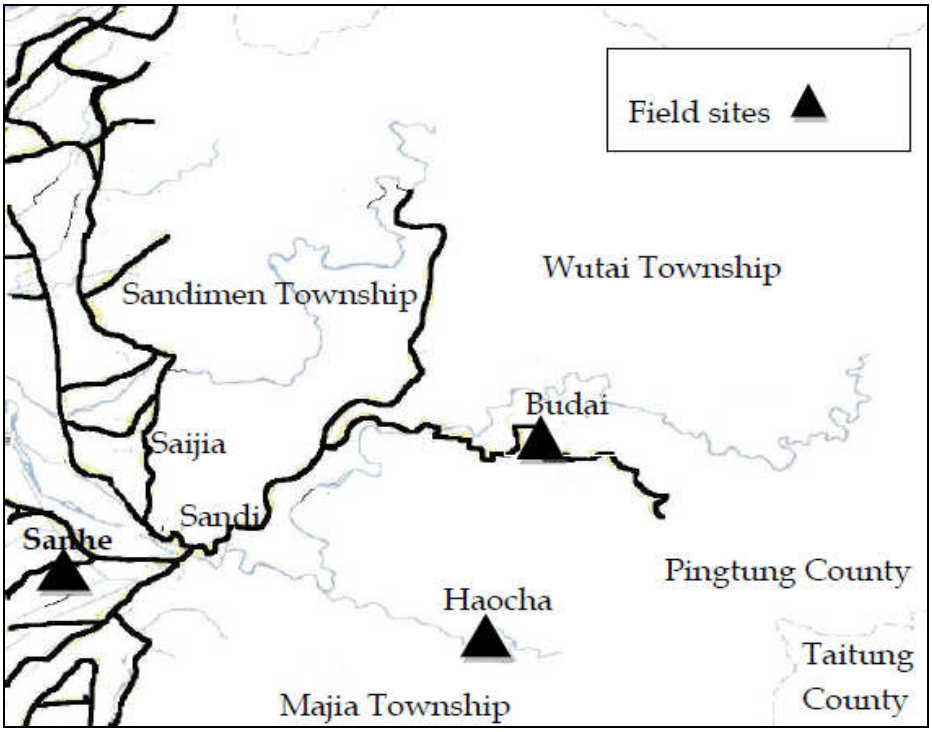

Figure 1. Field sites in the present study

Sanhe village is unique in its migration history and the ethnic population. Chen and Su (2004) describe the Sanhe village as a "new aboriginal spatial mosaic" and "enclave." The village is located in the northeastern Pingtung County, as a new settlement under a national policy of aboriginal modernization. The authorities later transferred the governance to the local offices of Sandimen Township, Majia Township, and Wutai Township. The village was established in 1953 and under the governance of the Majia Township since 1967. The spatial structure and landscape of the new settlement, according to Chen and Su's (2004) investigation, differ significantly from the surrounding areas. The village is not adjacent to any other aboriginal villages in Majia Township.

Sanhe village is geographically divided into three sub-villages, the Northern, the Central, and the Southern. The proportion of the ethnic population among the sub-villages, based on the official data and Chen and Su's (2004) estimates, is listed as follows: 87.5% of the households are Paiwan indigenous people and no Rukai indigenous people in the Northern sub-village; 86.02% of the households are Paiwan indigenous people and 1.08% of the households are Rukai indigenous people in the Central sub-village; 7.14% of the households are Paiwan indigenous people and

73.81% of the households are Rukai indigenous people in the Southern sub-village. There are 156 households of Paiwan indigenous people and 63 households of Rukai indigenous people in Sanhe. Rukai language has been a minor language in the Sanhe village, Majia Township. The proportion of the ethnic population in Sanhe is illustrated in Table 1.

Table 1.[2] The proportion of the ethnic population in Sanhe

Sub-village / Originally from	Northern		Central		Southern	
	Household	Proportion (%)	Household	Proportion (%)	Household	Proportion (%)
Sandimen (Paiwan)	50	62.5%	28	30.11%	5	5.95%
Majia (Paiwan)	20	25%	52	55.91%	1	1.19%
Wutai (Rukai)	0	0%	1	1.08%	62	73.81%
Others	10	12.5%	12	12.90%	16	19.05%
Total	80	100%	93	100%	84	100%

The informants were four male and four female speakers of Budai Rukai, aged 52-71 at the time of recordings. Elicitation words were confirmed by one female speaker at the age of 54 in Budai. All of them spoke the Budai Rukai language fluently. The informants in the two Budai villages were recommended by the village heads and considered representative in the Budai villages. The Budai speakers in the Paiwan village were relatives of the informants in the Budai villages. Seven informants were bilinguals of Budai Rukai and Sandimen Paiwan, and one informant was monolingual of Budai Rukai. All informants were second language speakers of Mandarin and reported no history of hearing impairments or speech disorders at the time of recordings. The language background of the informants is illustrated in Table 2. The name of the village listed in Table 2 indicates the major residency of the informants and the location for the recordings. The Paiwan village in the present study is the Sanhe village, whereas Budai villages include Budai and Haocha. Informant M1 used to work in Paiwan villages, though his major residency was reported as Budai. Informant F3 lived in Vədai (Budai) before the age of 30, and she moved to the Paiwan village after marrying a Sandimen Paiwan speaker. A larger scale of

[2] The table is modified from Chen and Su (2004) and checked by the author during the field trips.

investigation was not available due to the limited number of proficient speakers of the Budai Rukai language.

Table 2. List of Budai Rukai informants

Informant	M1	M2	M3	M4	F1	F2	F3	F4
Gender	Male	Male	Male	Male	Female	Female	Female	Female
Age	54	68	52	63	71	58	56	53
Language background	Bi-lingual	Bi-lingual	Bi-lingual	Bi-lingual	Mono-lingual	Bi-lingual	Bi-lingual	Bi-lingual
Village	Budai	Budai	Paiwan	Paiwan	Budai	Budai	Paiwan	Paiwan

Vədai (Budai) and Kutsapuŋan (Haocha) villages are traditional Rukai villages in Pingtung County. Nearly 100% of the residents in the communities are Budai Rukai indigenous people. Budai Rukai is the primary language in the villages. The residents in Sanhe, on the other hand, are mainly Sandimen Paiwan and Budai Rukai speakers. The number of Paiwan speakers exceeds that of Budai Rukai speakers. Sandimen Paiwan dialect is the primary language in the village.

Each informant was asked to say 500 basic words in Budai Rukai. Each word was elicited twice. Among the elicitation tokens, 270 basic words with identical segmental representations were selected for comparison. For the presentation of stress patterns, 2160 tokens (270 words × 8 speakers) of Budai Rukai words were compiled. In the case of long vowels or diphthongs, they are counted as one syllable. VV-sequences may be long vowels or diphthongs. Diphthongs such as *au, ai, ia* and *ua* may be phonetically realized as [aw], [aj], [ja] and [wa] at syllable-final or syllable-initial position. Surface syllable structure in Budai Rukai includes the following syllable types: V, GV, VG, VV, CV, CVV, and CVG, where G is a glide. No CC onset cluster was found, and no CC cluster at word-internal or word-final position was found. A sentence final intonation might give some effect on the accent and the vowel length in elicitation. Informants were asked to add the word *muɖaɖəkazanə* ‘Rukai language’ at the end of the elicitation if possible.

All the speakers were recorded in a quiet place using a digital recorder (SONY ICD-UX200) with a microphone (SONY ECM-MS907). After completing the field recordings, stress in Budai words was transcribed and analyzed. The distribution of the syllable number of the basic words (N=270) is summarized in Table 3.

Table 3. Syllable number of the basic words

Syllable number	**σ 1**	**σσ 2**	**σσσ 3**	**σσσσ 4**	**σσσσσ 5**	**σσσσσσ 6**
Word (N=270)	5	74	128	45	14	4
Frequency (%)	1.9%	27.4%	47.4%	16.7%	5.2%	1.5%

As shown in Table 3, disyllabic (σσ) and trisyllabic (σσσ) words compose of about 75% of the 270 basic words in Budai Rukai. If we could yield a correct prediction of the stress assignment in about 75% of the cases, the generalization of the stress patterns here would be more convincing than the earlier theory (cf. Ross 1992).

2.1 Comparison of stress assignment

In this section, I will review some of the controversial issues on Budai stress. The innovative varieties will be further compared and analyzed.

There are some words shared by both Sandimen Paiwan and Budai Rukai, as they have been so close to each other geographically, but the semantic meaning of some words may differ. Examples of words with stress assignment are illustrated in (1). Data collected in Budai villages are the base for the stress prominence presented here.

(1)	Budai Rukai	Sandimen Paiwan[3]	Gloss
a.	ŋisíŋisi	ŋísŋis	‘beard’
b.	bábuj	vávuj	‘boar’
c.	báali	váli	‘board’
d.	tátsu	tátsu	‘body louse’
e.	θúθu	túlu	‘breast’
f.	ábaj	kávaj	‘cake’
g.	lúaŋə	lúaŋ	‘cattle’
h.	púnaj	púnaj	‘dove’
i.	túla	túla	‘eel’
j.	váɭu	áɭu	‘eight’
k.	káka	káka	‘elder sibling’
l.	máatsa	mátsa	‘eye’

[3] Main stress in Paiwan falls on the penultimate or the rightmost syllable of each prosodic word, in which prefixes and infixes are excluded from the domain of a prosodic word. Penultimate schwa nucleus does not affect the stress assignment in Sandimen Paiwan. A full description of word-level stress in Sandimen Paiwan is presented in Chen (2009a).

m.	ɭíma	ɭíma	‘five’
n.	ɭáva	ɭáva	‘flying squirrel’
o.	kúaŋə	kúaŋ	‘gun’
p.	kútsu	kútsu	‘head louse’
q.	válu	álu	‘honey’
r.	pədə	púɖu	‘kidney’
s.	áθaj	ʔátsaj	‘liver’
t.	pájsu	pájsu	‘money’
u.	pəəkə	púdək	‘navel’
v.	paŋúɖalə	paŋúɖal	‘pineapple’
w.	págaj	pádaj	‘rice’
x.	pítu	pítu	‘seven’
y.	ə́nəmə	únəm	‘six’
z.	kúuŋu	kúŋ	‘skirt’
aa.	kídiŋi	kíziŋ	‘spoon’
bb.	bitsúuka	vitsúka	‘stomach’
cc.	atsíilaj ‘water’	ʔatsíɭaj	‘stone’
dd.	ɭəsə	ɭəsəʔ	‘tears’
ee.	púɭuku	púɭuk	‘ten’
ff.	túɭu	təɭu	‘three’
gg.	káatsə	k-əm-áts	‘to bite’
hh.	kánə	k-əm-án	‘to eat’
ii.	báaj	pa-váj	‘to give’
jj.	válisi	ális	‘tooth’
kk.	ɖúsa	ɖúsa	‘two’
ll.	látsəŋə	látsəŋ	‘vegetables’
mm.	úɖasə	ʔúdas	‘white hair’
nn.	báva	váva	‘wine’

As shown in (1), both segments and the stress prominence in the words are very similar to each other, especially in disyllabic words. Stress prominence in Budai Rukai reflects the corresponding vowel slot in the skeleton of noun roots in Sandimen Paiwan, except in the noun *ŋisíŋisi* ‘beard’, in which case the stress prominence falls on the vowel following the first velar nasal *ŋ* in Sandimen Paiwan, as shown in *ŋísŋis*. Because of the words shared with Sandimen Paiwan, and because of being surrounded by the Sandimen Paiwan speakers in the Sanhe village, stress patterns of the Budai dialect spoken in the Sanhe village were inevitably affected by Sandimen Paiwan stress.

Another observation from the words due to inheritance or borrowing is the secondary vowel (echo vowels) added to the end of the Budai words with stress falling to the antepenultimate position in trisyllabic examples, such as (1y), (1aa), (1ee), (1jj),(1ll), and (1mm). It is possible that the stress is retained at its original position in the roots, and the echo vowel is a later development. Echo vowels are treated as epentheses to avoid consonantal coda in Budai Rukai (cf. Li 1977, Li 1995, Chen 2006). The canonical syllable structure in Budai Rukai is (C)V(V), in which consonantal coda is forbidden, and echo vowels must be present to avoid any consonant coda. Echo vowels in Budai Rukai were generally perceived clearly in elicitation, except schwa *ə*. Echo vowels are synchronically presented in Budai Rukai. Li (1973:51) has proposed that many Rukai words end in a released consonant followed by a short vowel similar to the preceding vowel, and the vowel in this position is usually assumed to support a word-final consonant (cf. Tsuchida 1976). Given that the vowel is not only a "supporting vowel" but also identical to the vowel in the preceding syllable, it has been referred as an "echo vowel" by most of the Formosan linguists. As far as Budai Rukai is concerned, echo vowels are present in base forms and other compound words. The distribution of echo vowels in Budai Rukai is listed in (2). Echo vowels are underlined and in bold.

(2) Echo vowel in Budai Rukai

	Vowel	Budai Rukai	Gloss	Budai Rukai	Gloss
a.	i	bitsiŋ**i**	'skin'	ma-palil**i**	'salty'
b.	u	patsul**u**	'knee'	uŋul**u**	'to drink'
c.	ə	ma-rətəs**ə**	'faint'	ɭəpəŋ**ə**	'to finish'
d.	a	ɖamar**ə**	'moon'	ɭidam**ə**	'tongue'

An echo vowel reflects the vowel of its preceding syllable. However, when the vowel of its preceding syllable is *a*, the echo vowel becomes the schwa *ə*. In other words, all the vowels are eligible for echo vowels at word-final position, except the low vowel *a*. The distribution and the quality of echo vowels are predictable. Yet, there is still a distinction between a proper vowel and an echo vowel. A proper vowel is always retained, in stems and affixed forms, whereas an echo vowel is dropped out when followed by a suffix that begins with a vowel in suffixed forms. Some typical examples of echo vowels are illustrated in (3a), whereas the contrastive examples of proper vowels are shown in (3b). Echo vowels are dropped when followed by the imperative vocalic morpheme *-a*, whereas proper vowels are retained in the same phonological environments.

(3) a. Echo vowels in Budai verbs

Agent Focus	GLOSS	Imperative	GLOSS
wa-uŋulu	‘to drink’	uŋul-a	‘Drink!’
wa-ələbə	‘to close’	ələb-a	‘Close!’
wa-tətərə	‘to kick’	tətər-a	‘Kick!’
wa-səkətə	‘to hide’	səkət-a	‘Hide!’
wa-baɻiθi	‘to exhange’	baɻiθ-a	‘Exchange!’

b. Proper vowels in Budai verbs

Agent Focus	GLOSS	Imperative	GLOSS
wa-kanə	‘to eat’	kanə-a	‘Eat!’
wa-piɻi	‘to choose’	piɻi-a	‘Choose!’
wa-sauɻi	‘to return’	sauɻi-a	‘Return!’
wa-lupu	‘to hunt’	lupu-a	‘Hunt!’
wa-lavalava	‘to try’	lavalava-a	‘Try!’

Li (1973:51) reports in his study that in normal or rapid speech, the echo vowels in Tanan Rukai are much weakened, devoiced, or dropped out. Li (1977) argues that stress would be predictable in the dialect of Tanan Rukai, if the final echo vowel is not represented in the phonemic transcriptions. On the other hand, Li (1973, 1977) also notes that there is little justification for not representing the echo vowels in the other dialects except for Tanan. It would be difficult to account for historical derivations of many forms if the final echo vowels were not treated as phonemic. Li’s (1977) argument to some extent supports the proposal that echo vowels affect the prosodic patterns in the Rukai language.

Echo vowels are not unique in Budai, as they are also attested in the other dialects of Rukai (cf. Li 1977, Hsin 2000, Zeitoun 2007) and Tsou (cf. Tsuchida 1976). Among the Formosan linguists who have ever studied the representations of echo vowels, Li (1973, 1975, 1977, 1995) presents the most insightful discussions on the issue. Based on his investigation on five dialects of Rukai, Li (1977) argues that echo vowels must be given in the Lower Three Villages of Rukai but may be optional in Tanan dialect. If the echo vowels in Budai Rukai could be dropped or devoiced, would the stress patterns in Budai Rukai be consistent with those in Sandimen Paiwan, at least in the words of inheritance? The data listed in (1) seem to support a positive answer.

2.2 Stress patterns in Budai villages

In this section, I will lay out the word-level stress in Budai Rukai, on the basis of the data collected in the Budai villages. Li (1973:21) notices that the monosyllabic articles [ka], [sa], [ku] and [ki] do not bear stress in Tanan Rukai. The articles mentioned in Li's study are treated as prefixes here. As for the stress in Budai Rukai, Li (1995) describes in his wordlist as falling on the penultimate syllable, but less frequently on the final or antepenult. In Zeitoun's (2000) reference grammar, similarly, stress patterns in Budai are on the penultimate syllable of a word, with a few words on the antepenultimate syllable.

Many disyllabic words have penultimate stress in the base form. This pattern is illustrated in (4a), with the corresponding forms with prefixes in (4b). Prefixes do not bear stress in general.

(4)	a. pátsaj	'to die'	b. pa-pátsaj	'to kill'
	kánə	'to eat'	pa-kánə	'to feed'
	láŋaj	'to buy'	pa-láŋaj	'could have bought'
	lájlaj	'to run'	paŋu-lájlaj	'by running'
	túbi	'to cry'	wa-túbi	'cry, crying'
	íipi	'to blow'	wa-íipi	'blow, blowing'

Trisyllabic base forms of words generally have penultimate or antepenultimate stress, which is shown in (5).

(5)	a. tsúŋulu	'to join'	b. wa-tsúŋulu	'join, joining'
	tsíŋasə	'to catch'	mu-a-tsíŋasə	'get caught'
	əlábə	'to close'	wa-əlábə	'close, closing'
	uŋúlu	'to drink'	ļi-uŋúlu	'will drink'
	tinúnu	'to weave'	wa-tinúnu	'weave, weaving'

Syllable weight does not seem to affect the assignment of stress, as the penultimate stress is retained in the word *pátsaj* 'to die' and *láŋaj* 'to buy'. In Li's (1977) data, long vowels (phonetic geminates) were attested at the position of penult in about 63% (24/38) of the cases. Chen (2006) also notices that vowel length contrast is generally expressed in penultimate position, though sporadic long vowels are also attested in antepenultimate position and the nucleus of monosyllabic roots. Are long vowels a phonetic realization of stress or the phonological prominence to trigger stress? The present study treats long vowels at penult or antepenult as a realization of

the prosodic patterns in the language. Prosodic patterns such as stress or phrase-final accent could affect the durations of vowels. That is, long vowels in Budai Rukai in general are not phonemic. Long vowels presented in the present study signify acoustical salience of longer durations compared with the other vowel(s) in the same prosodic word. For instance, the averaged durations of the long vowels in *pəəkə* 'navel' and *bəəkə* 'domesticated pig' are 1.8 times and 2.0 times respectively longer than those of the short vowels in the prosodic words.

In other words, stress is not always predictable from syllable weight or in trisyllabic prosodic words. Stress assignment is not totally random, as in monosyllabic or disyllabic roots it is predictable. Stress in trisyllabic words falls on the penult or the antepenult. Unpredictable stress of Budai Rukai in trisyllabic words was also attested in Li's (1977) and Zeitoun's (2000) studies.

Stress is on the penultimate or the antepenultimate, as shown in (6).

(6)	a. tsúmaj	'bear'	b. síma	'fat'
	ŋúduj	'mouth'	máɖaw	'big'
	pə́əkə	'navel'	bə́ləŋə	'up'
	bətsə́ŋə	'millet'	uɖípi	'alive'
	událə	'rain'	báavanə	'new'
	aɭíma	'hand'	əɖə́kanə	'short'
	kisísi	'goat'	makaə́la	'different'
	ɖumánə	'other'	masámaɖə	'disappointed'
	ɖámarə	'moon'	tikíθanə	'small'
	ŋuŋúanə	'nose'	maararámaw	'same'
	aðáaðamə	'bird'	masúpiɭi	'old'
	ɭəgə́ɭəgə	'mountain'	mamadákitsi	'sticky'

Patterns in Budai villages have shown contrast between roots stressed on the penult and roots stressed on the antepenult. No final stress was attested in trisyllabic roots.

Ross (1992) notes that no Formosan language corresponds in a completely systematic manner with the paroxytone and oxytone contrast of Proto-Philippine (PPh) reconstructed by Zorc (1983). He believes that there are indicators in Formosan languages that such a contrast is fragmentarily reflected in these languages. Stress patterns reported here support the contrast proposal of Ross (1992) that distinctive stress was retained in Budai Rukai, and the oxytones of Budai (when the echo vowels are discounted) are probably the remnants of PAN contrastive stress. Yet, the proposal of Ross (1992) does not apply to words ending with diphthongs such as *tsúmaj* 'bear', *ŋúduj* 'mouth', and *máɖaw* 'big', and he also points out that "only consonant-final

disyllables have lexically determined stress: Budai is in the process of going the way of the other Rukai dialects, that is, towards phonologically predictable stress" (Ross 1992:50). Within the work of historical reconstruction of PAN stress, the theory of Ross (1992) seems to indicate contrastive stress in Budai Rukai is closer to the prototype or the ancestral accent whereas predictable stress is the innovation.

The general distribution of Budai Rukai stress in Budai villages is summarized as follows. Primary stress falls on (i) monosyllabic roots; (ii) the penultimate syllable of disyllabic roots; (iii) the penult or the antepenultimate syllable of trisyllabic or longer roots.

2.3 Stress patterns in Sanhe Village

Although the location of primary stress in disyllabic verbs is also predictable from the number of syllables and the morphological category in the Budai dialect spoken in Sanhe, speaker variability was attested in the village, where the Paiwan language was the primary language for communication. The majority of disyllabic verbs have penultimate stress in the base form. Trisyllabic base forms of verbs generally have penultimate or antepenultimate stress. However, the determination of penultimate or antepenultimate stress in trisyllabic roots varies from one speaker to another. The variability of stress assignment in the base forms of verbs is illustrated in Table 4. Words with stress varieties are highlighted.

Table 4. Stress assignment in verbs among the informants of Sanhe

Informant Budai Stress	M3	M4	F3	F4	GLOSS
dukúlu	dukúlu	dukúlu	dukúlu	dukúlu	'to throw'
kauríva	kauríva	kauríva	kauríva	kauríva	'to talk'
uŋúlu	uŋúlu	uŋúlu	uŋúlu	uŋúlu	'to drink'
ápətsə	**apə́tsə**	**apə́tsə**	ápətsə	**apə́tsə**	'to sleep'
báɭakə	**baɭákə**	báɭakə	báɭakə	**baɭákə**	'to swell'
báɭiθi	**baɭíθi**	báɭiθi	báɭiθi	**baɭíθi**	'to exchange'
báratə	báratə	**barátə**	báratə	**barátə**	'to tap'
θíŋalə	θíŋalə	θíŋalə	θíŋalə	**θiŋáalə**	'to know'
tsúŋulu	**tsuŋúlu**	**tsuŋúlu**	tsúŋulu	**tsuŋúlu**	'to join'
səkətə	səkətə	səkətə	səkətə	**səkə́tə**	'to hide'

As shown in Table 4, the variability occurred most frequently in trisyllabic roots with stress falling on the antepenult. When stress falls on the penult of the trisyllabic roots in the Budai dialect spoken in Budai villages, all the informants in the Sanhe

village confirmed the penultimate stress. When stress falls on the antepenult of the trisyllabic roots in the Budai dialect spoken in Budai villages, only informant F3 did not show the variations. The tendency towards penultimate stress varies among the informants. In other words, the contrastive (penultimate and antepenultimate) stress retained in the Budai dialect is in the process of developing predictable penultimate stress in the Sanhe village.

Stress is generally predictable in monosyllabic and disyllable words, but not in trisyllabic words or longer sequences. In monosyllabic roots, stress falls on the nucleus of the syllable; in disyllabic roots, main stress falls on the penult; in trisyllabic or longer roots, stress falls on the penultimate syllable or the antepenult. Again, no final stress was attested in trisyllabic roots. Not all penultimate vowels are lengthened in the variety. Phonetic vowel length contrast is expressed mainly at the penultimate position. The variability of stress assignment in the base forms of nouns is illustrated in Table 5. Words with stress varieties are highlighted.

Table 5. Stress assignment in nouns among the informants of Sanhe

Informant Budai Stress	**M3**	**M4**	**F3**	**F4**	**GLOSS**
ababaj	ababaj	ababaj	ababaj	ababaj	‘woman’
aɭíma	aɭíma	aɭíma	aɭíma	aɭíma	‘hand’
asúɭu	asúɭu	asúɭu	asúɭu	asúɭu	‘pestle’
kisísi	kisísi	kisísi	kisísi	kisísi	‘goat’
událə	událə	událə	událə	událə	‘rain’
əbəɭə	**əbáɭə**	**əbáɭə**	**əbáɭə**	**əbáɭə**	‘smoke’
ɖámarə	**ɖamárə**	ɖámarə	ɖámarə	**ɖamárə**	‘moon’
túburu	**tubúru**	**tubúru**	túburu	**tubúru**	‘bamboo shoot’
válisi	**valísi**	**valísi**	**valísi**	**valísi**	‘tooth’
vágisi	**vagísi**	**vagísi**	vágisi	**vagísi**	‘thigh’

As shown in Table 5, varieties are attested in trisyllabic nouns with antepenultimate stress. There is a tendency that informants living in the Sanhe village produced the penultimate stress in trisyllabic words[4] more than those living in the Budai areas. The tendency to some extent supports the proposal of Ross (1992) that Budai is in the process towards predictable stress. Although Ross (1992) does not specify the causes of the change, prosodic patterns collected in the Sanhe village to

[4] As shown in Table 4 and Table 5, tokens of some informants were affected, whereas those of the others were not affected. Each informant produced various percentages (ranged from 0% to 70% in verbs and ranged from 20% to 50% in nouns) of contact-induced prosody. However, contact-induced prosody was not attested in the Budai dialect spoken in the Budai areas.

some extent support the hypothesis that the predictable stress in progress is due to language contact with the Paiwan language, in which word-level stress is predictable and the penultimate is the optimal position for stress assignment (cf. Chen 2009a).

In sum, stress assignment between the Budai dialect spoken in the Budai areas and the Sanhe village differ in various percentages of penultimate stress. Budai words in the Budai areas retained the antepenultimate stress in trisyllabic words, whereas Budai words in the Sanhe village were more frequently produced with the penultimate stress in trisyllabic words. Stress contrast in Budai Rukai is an interesting point for the reconstruction of PAN stress. The interaction between stress prominence and echo vowels in roots provides evidence for the proposal of contrastive stress in the proto forms or PAN roots. Yet, precise transcription and abundant field data from the other dialects of Rukai are still needed for a further reconstruction of Proto-Rukai stress. Furthermore, we need more empirical evidence to support the predictable stress patterns in progress in Budai Rukai, as proposed by Ross (1992).

3. Phonetic representations of Budai stress

3.1 Methods

Budai Rukai has either penultimate or antepenultimate stress in prosodic words, which carry independent components of meanings. The absence of a comprehensive investigation of vowel duration and other prosodic prominences makes the phonetic representations of Budai stress unclear. Long vowels have been attested in previous documentation (Li 1977, Zeitoun 2000), but whether Budai Rukai has two durational classes on phonetic grounds is unknown. Along with the descriptions of Budai Rukai vowels, I propose that the occurrence of long vowels in Budai Rukai is a phonetic realization of stress or accentuation. Many factors may influence vowel durations, such as vowel quality, postvocalic place of articulation (Peterson and Lehiste 1960), or speaking rate (Crystal and House 1982). The influence of the factors on vowel duration in English has been well documented, but the factors on the phonetic realization of vowels in Budai Rukai have not been studied at all. To this end, disyllabic (σσ) and trisyllabic (σσσ) words were selected for the measurements here. The first two C-positions were taken by either both stops or consonants sharing same phonetic features, and the first two V-positions were taken by the same vowels. Note that the tokens were recorded in isolation, and a phrase-final intonation may apply to the final vowels of the tokens. A designed word list with the optimal conditions of carriers (such as target words in sentence-medial position) for experiments was not practical in the present study, as some informants were not able to elicit or read the

carrier words on the list. As a result, words were selected from isolation only. Words for measurements are listed in Table 6.

Table 6. List of words for measurements

Disyllabic words (σσ)		**Trisyllabic words (σσσ)**	
bəəkə	‘domesticated pig’	bakalə	‘knife’
luuŋu	‘mortar’	bubutu	‘squirrel’
nana	‘pus’	bukulu	‘spine’
pədə	‘kidney’	butulu	‘pork’
pəəkə	‘navel’	ɖapaɭə	‘foot’
puku	‘joint’	kidiŋi	‘spoon’
ruulu	‘urine’	kuɖulu	‘thousand’
taka	‘older sibling (Ref.)’	lalakə	‘child’
tuɖu	‘stem’	luluŋu	‘goiter’
viri	‘left’	pəpəəkə	‘lizard’
θuθu	‘breast’	pupuli	‘white’
		tatama	‘father (Ref.)’
		tsatsasə	‘curcuma’
		təbəθə	‘belt’
		tuburu	‘bamboo’

Following Fry’s production and perception work on English stress (Fry 1955, 1958, 1965), three direct, and one indirect correlate of stress are expected. The direct correlates include an increased duration, increased intensity, and more extreme formant values. The indirect correlate is associated with fundamental frequency pattern. The view proposed by Beckman (1986) for accentual systems should be taken into account for language-specific features. Accent may be realized phonetically as either stress accent or non-stress accent. In Beckman’s view, although stress accent may have F0 as a correlate, it is thought to use acoustic correlates other than F0 more extensively than non-stress accent. The correlate of stress accent can include duration, amplitude, and vowel quality.

Tokens from eight native speakers of Budai Rukai were recorded and sampled at 22,050Hz to facilitate the FFT spectral analysis performed for the amplitude measures on the PCquirer and Praat programs. A total of 208 (26 tokens × 8 speakers) elicitation tokens were measured. The stimulus was a Mandarin word, and the response was a Rukai word. Words were repeated twice in isolation, with about 3 seconds in between, allowing double measurements of the same word to be made.

Multiple measurements of the same word were averaged. The results were statistically analyzed by one-factor ANOVAs.

The F0 at the temporal midpoint of the vowel in each syllable of the target word was measured, using the auto-correction method. The pitch analysis range was modified to accommodate the pitch range for each speaker. Vowel durations of the target vowels were measured from 300Hz bandwidth spectrograms, including the portion from the burst of the initial consonant to the cessation of high frequency energy. The measures of vowel durations were made using waveform and spectrographic displays in Praat. The duration of the vowel was measured from the onset of the first full glottal pulse to the offset of the last full glottal pulse corresponding with the end of visible energy. Measurements included vowel durations, an estimate of the value of the first formant, the fundamental frequency at the midpoint of each vowel, and the intensity at the midpoint of each vowel.

Vowel length of stressed non-final vowels (i.e., stressed penults or antepenults) and unstressed final vowels were measured to examine the effect of final lengthening or shortening (cf. Turk and Shattuck-Hufnagel 2007, Nakai et al. 2009). Boundary-related lengthening has been reported to affect the phrase-final word in a number of languages such as English (Wightman et al. 1992, Byrd et al. 2006), Dutch (Cambier-Langeveld 1997), German (Kohler 1983), and Hebrew (Berkovits 1994). The presence of utterance-final lengthening in many other languages has supported the widely held view that final lengthening is a universal tendency. Lengthening was strongest in the final syllable. Durations of stressed penults and antepenults were measured to see if the long vowel has its corresponding phonetic representations.

3.2 Stressed vowels

Figure 2 presents the mean F0 at vowel midpoint for male and female speakers in disyllabic words, and Figure 2 presents the mean F0 in trisyllabic words. As the Budai language collected in the Sanhe village exhibited various degree of speaker variability, the tokens were divided into two groups: Budai and Sanhe.

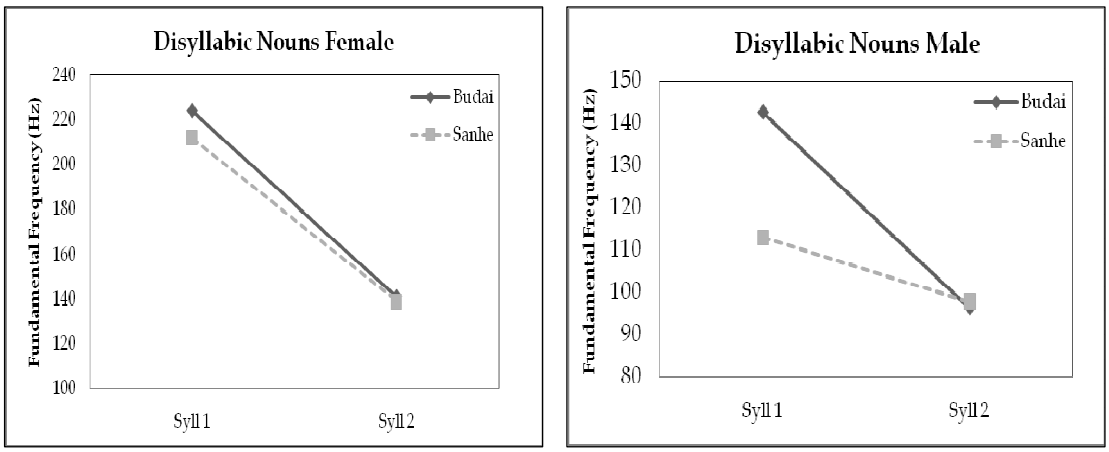

Figure 2. Mean F0 at vowel midpoint for each syllable at target words produced by the native speakers of Budai Rukai in different villages

In Figure 2, the disyllabic target words were produced by two groups of native speakers of Budai Rukai. Tokens in both village groups have shown that penultimate syllables have higher F0 than the final syllables. Tokens of male speakers in Budai Rukai have shown much higher mean F0 value of Syll 1 but slightly lower mean F0 value of Syll 2. Pitch range of the male speakers in Budai villages seems wider.

Stressed vowels average 218Hz pitch high while unstressed vowels average 140Hz at midpoints in the tokens of female speakers. ANOVA analyses of variance have shown that the effect of stress was significant (Female: F [1,86] = 440.84, $p < .0001$; Male: F [1,86] = 74.30, $p < .0001$). In post hoc analyses, pitch values measured at the penultimate syllable (Syll 1) were different from those measured at the final syllable (Syll 2) among the tokens produced by all the speakers at $p < .0001$, and there was a significant pitch difference between the two syllables. The results indicate that stress affects pitch values in Budai Rukai, and the effect is significant. Pitch is a strong correlate of stress in Budai Rukai. There were no significant effects for the village groups in the disyllabic target words for either female or male speakers. In other words, no innovation forms have been attested in disyllabic nouns.

In trisyllabic target words, on the other hand, gender and the village groups do make differences. For the tokens produced by female speakers in all the villages, antepenultimate syllables (Syll 1) have been reported as having the highest pitch values than the penultimate (Syll 2) and final syllables (Syll 3), as shown in Figure 3. Although tokens produced by the male speakers in Budai villages have shown the same patterns, tokens produced by the male speakers in the Sanhe village have shown higher pitch at the penultimate syllables. In trisyllabic nouns, male speakers in the Sanhe village tend to produce penultimate stress, with the highest pitch values falling on the penult, second-high pitch on the antepenult, and the lowest pitch on the final. Yet, ANOVA analyses of variance have shown that the effect of stress was not

significant. The results to some extent support the proposal that the prosodic varieties of Budai Rukai are in the process of going the way from the antepenultimate to the penultimate stress in trisyllabic nouns.

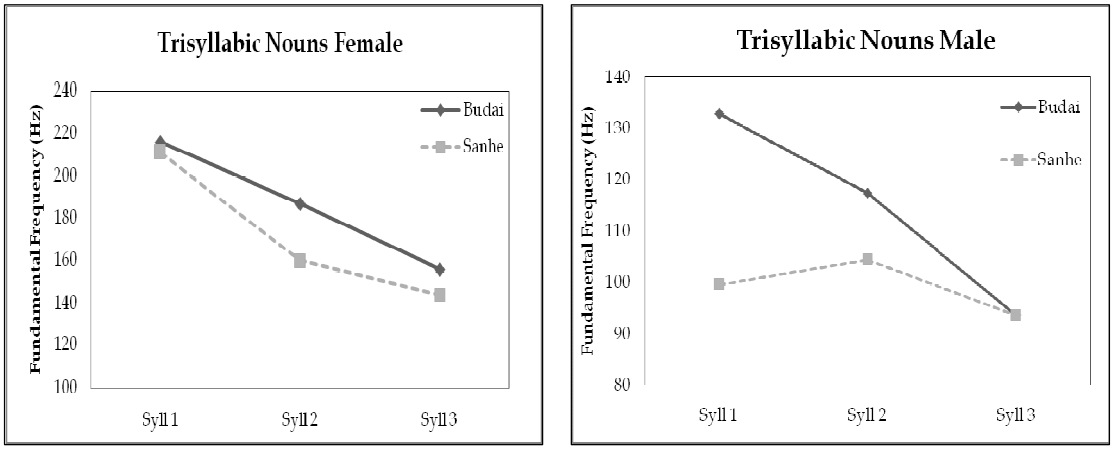

Figure 3. Mean F0 at vowel midpoint for each syllable at target words produced by the native speakers of Budai Rukai in different villages

Measurements of the vowel durations include the length at penultimate and final syllables in disyllabic target words and the length at antepenultimate and penultimate syllables in trisyllabic target words. The duration of the target vowels was measured to determine whether there were systematic differences in duration related to stress accent. Figure 4 presents the results comparing penultimate stressed vowels to unstressed vowels in disyllabic target words, and Figure 5 presents the results of trisyllabic target words.

As shown in Figure 4, stressed vowels average 225 milliseconds (ms) while unstressed vowels average 242ms for the tokens recorded in Budai villages. In other words, final unstressed vowels are longer than the penultimate stressed vowels. Vowel durations do not correspond to the stress prominence. The results indicate final lengthening seemed to occur in disyllabic nouns for the tokens recorded in Budai villages. On the other hand, the duration of a stressed vowel is 1.4 times that of an unstressed vowel for the tokens recorded in the Sanhe village. ANOVA analyses of variance have revealed that the effect of stress was significant (F [1,86] = 20.60, $p < .0001$). The results indicate that stress may affect vowel durations in the Budai dialect spoken in the Sanhe village. Duration is a phonetic correlate of the stress in the Budai dialect spoken in Sanhe. The finding also supports the argument that long vowels are a realization of stress in Budai Rukai.

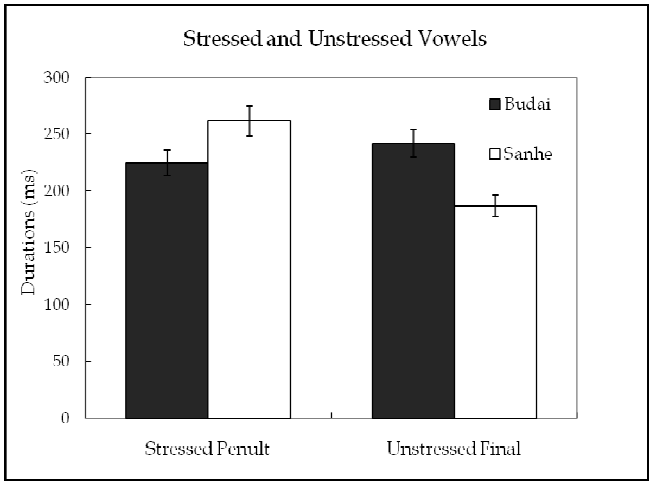

Figure 4. Mean and standard error at vowel midpoint for the measures of vowel duration for vowel stressed on the penultimate syllable and for unstressed final syllable in disyllabic nouns

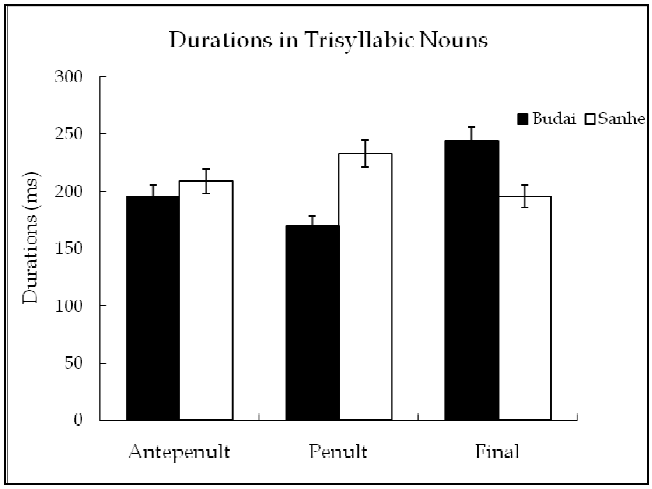

Figure 5. Mean and standard error at vowel midpoint for the measures of vowel duration for vowel on the antepenultimate, penultimate, and final syllable in trisyllabic nouns

Final unstressed long vowels were also attested in Li's (1977) data, as shown in words *ágaa* 'rice (cooked)' and *sápaa* 'mat'. The measures for disyllabic nouns reported here seem to provide accounts for the final long vowels in previous documentation, as final lengthening (as phrase-final accent) may occur in isolated elicitation.

In trisyllabic nouns, final syllables have been reported as the longest for the tokens recorded in Budai villages (duration: final > antepenult > penult), and penultimate syllables as the longest for the tokens recorded in the Sanhe village (duration: penult > antepenult > final). Vowels at penult tended to be longer in the Budai dialect spoken in Sanhe might be subject to stress assignment on the penult. ANOVA analyses of

variance have shown that the effect of syllable position was significant for the tokens recorded in Budai villages (F [2,177] = 41.78, $p < .0001$). Yet, the effect of syllable position was not significant for the tokens recorded in the Sanhe village (F [2,177] = 5.62, $p > .05$). The results indicate that the prosodic patterns in the Sanhe village have different phonetic representations from those in Budai villages.

As far as intensity is concerned, stressed vowels average 93dB while unstressed vowels average 91dB at vowel midpoints in disyllabic nouns. Both groups of tokens have shown the tendency of stressed vowels with more amplitude. ANOVA analyses of variance have shown that the effect of stress was significant (F [1,174] = 34.95, $p < .05$). In trisyllabic nouns, antepenultimate syllables have shown more amplitude than the penultimate syllables, and final syllables have been reported as the weakest. Tokens recorded in all the villages have demonstrated the same tendency. ANOVA analyses of variance have shown the effect of syllable position was significant (F [2,357] = 91.83, $p < .05$).

In sum, the results from the measures of disyllabic and trisyllabic nouns support the claim that pitch and intensity are robust phonetic correlates of stress prominence in Budai Rukai, though the tokens produced by male speakers in Sanhe have shown the high pitch alignment with the penult. The high pitch values attested at the penult also provide evidence for the existence of prosodic varieties in the Sanhe village. Boundary-related lengthening seemed to occur in the Budai dialect spoken in Budai villages. The findings provide accounts for the final unstressed long vowels attested in previous documentation. Phrase-final accent could be imposed on elicitation tokens in isolation. Stress may affect vowel durations in Budai Rukai. Yet, before the factor of syllable structure or phrasal positions of the target words is controlled for the measurements, any account for vowel duration as a phonetic correlate of stress in Budai is in doubt. Duration was at best a weak correlate of stress word or phrase internally. Taken together, long vowels in Budai Rukai may be a phonetic realization of stress, but not all long vowels are stressed. Stressed long vowels are aligned with higher pitch, while vowels with lower pitch could be long word or phrase finally.

3.3 The innovations

Let us consider the cause for the prosodic varieties of Budai Rukai. Why did the Budai speakers in the Sanhe village produce the penultimate stress? What triggers the stress falling on the penult rather than the antepenult? As we have seen from the measures for disyllabic and trisyllabic nouns in Budai, long vowels were not aligned with stress prominence in all cases. Instead, they may be the phonetic realization of phrase-final accent in elicitation. In other words, phonetic representations of long

vowels are not always associated with stress prominence. Long vowels were attested at antepenult, penult, and final positions in Li's (1977) data. Both antepenultimate and penultimate long vowels may be phonetic geminates. In the quadrisyllablic word *aðaaðamə* 'bird', for instance, the long vowels were attested at the antepenult in Li's (1977) transcription, and phonetic representations of high pitch have confirmed the stress prominence at antepenult, based on the tokens produced by the speakers in Budai villages. Figure 6 presents the F0 measured at vowel midpoint for each syllable at the word *aðaaðamə* 'bird' produced by the native speakers of Budai Rukai in different villages.

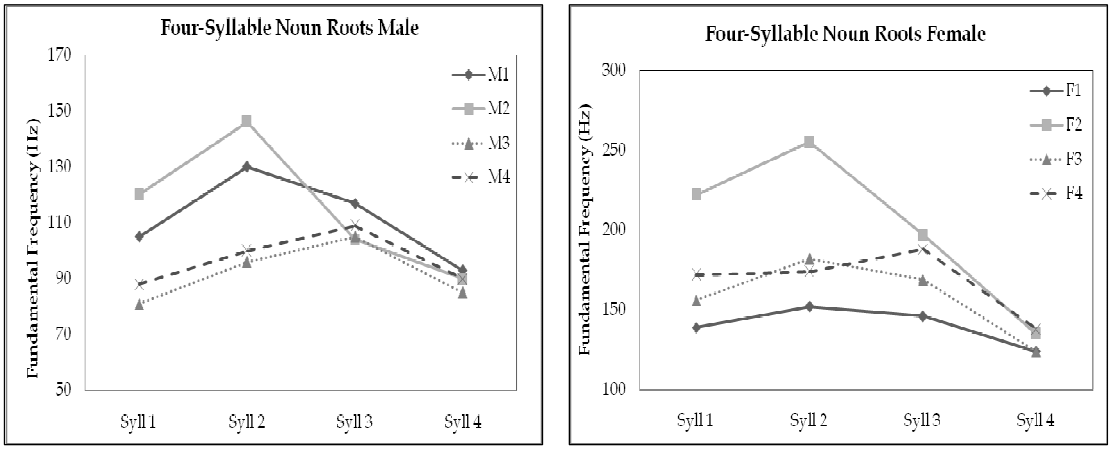

Figure 6. F0 measured at vowel midpoint on the initial, antepenultimate, penultimate, and final syllable in the word *aðaaðamə* 'bird'

In fact, the factor of speaker variability must at least in part account for the stress shift, as three speakers (M3, M4, and F4) preferred the penultimate stress and five speakers (M1, M2, F1, F2, F3) preferred the antepenultimate stress. I propose that the stress shift reported here is not free variation. Instead, antepenultimate stress reflects the prosodic slot for prominence in roots with the adding of historically secondary vowels (echo vowels). Paralinguistic factors such as language contact trigger the stress falling on the penult rather than the antepenult. We have noted that most informants in the present study were bilinguals of Budai Rukai and Sandimen Paiwan. Continuous and intensive contact with the Paiwan speakers in the Paiwan dominant speech community results in the process of going the way from the antepenultimate to the penultimate stress. Ancestral accent such as unpredictable stress (on the penult without echo vowels and on the antepenult with echo vowels) is more possibly retained in the speech produced by the speakers in Budai villages. In other words, the prosodic patterns in Budai villages are more conservative, whereas those in the Sanhe village are the innovations.

Languages may differ in the realization of prosodic prominences. Remijsen (2002)

described Ma'ya, an Austronesian language, as having contrastive stress accent, as well as an independent three-way tonal contrast on final syllables. Stressed vowels were found to have longer duration, and the tonal contrasts were primarily correlated with F0 differences. Remijsen and van Heuven (2005) described Curaçao Papiamentu, a Caribbean Creole, as having contrastive stress that is independent of the tonal specification found on the penultimate syllable in some words. In their study, manipulation of prosodic condition revealed an F0 specification for tone, regardless of discourse context. However, F0 was not correlated with stress in Curaçao Papiamentu, in which case stressed syllables were primarily correlated with greater duration, as well as greater intensity. Hyman (2006) has proposed an approach to word-level prosodic typology. In his proposal, stress accent is the only accentual type admitted and it is defined by features of metrical prominence. It may be too early to claim that the prosodic varieties attested in the Sanhe village are of hybrid tone and stress accent system. What we know for sure is that the contact-induced prosody is in progress in the Paiwan dominant speech community. Only when the antepenultimate stress is not available anymore in the Sanhe village can we claim a loss of ancestral accent in the new settlements.

4. Contact-induced prosody

Accent and vowel length in Budai Rukai may differ depending on different authors (cf. Li 1977, Zeitoun 2000), such as *báva* 'wine' and *bubútu* 'squirrel' in Li's (1977) data and *baava* 'wine' and *bubuutu* 'squirrel' in Zeitoun's (2000) data. Tokens with unpredictable stress are also attested in the present study. The proposal of contact-induced prosody here is to offer a metrical account for the stress shift attested in the Sanhe village, not a claim for the phonemic accentuation in Budai Rukai. It is also true that predictable stress is not always available in other Budai villages. Stress in Budai Rukai is not phonemic, and stress patterns are sometimes not consistent among the speakers in the same village.

In this section, I will present a phonological account for the contact-induced prosody within the work of metrical prominence. The metrical algorithm (cf. Hayes 1995) set up for penultimate stress in Sandimen Paiwan (cf. Chen 2009b) is presented in (7); it applies to every possible prosodic word in Sandimen Paiwan. The symbol "#" represents the beginning or end of a word. Degenerate feet refer to single syllables in the quantity-insensitive systems.

(7) Penultimate stress in Paiwan words

a. Foot Construction: i. Form a syllabic trochee, going from right to left.
ii. Degenerate feet are allowed.

b. Word Layer Construction: End Rule Right

(x)		(x)	
(x .)		(x .)	
… σ ́σ	σ #	and	# ́σ σ #

For words without echo vowels (i.e., final vowels are the proper vowels) in Budai Rukai, metrical parameters listed in (7) apply to disyllabic prosodic word as well. However, when echo vowels were added to the prosodic words, such as the trisyllabic words listed in (1), an additional metrical rule must be proposed the so-called "extrametricality" (cf. Liberman and Prince 1977, Hayes 1981, 1995). Following Hayes (1995), extrametricality is a notion of metrical theory that designates a particular prosodic constituent as invisible for purposes of rule application. Thus in Budai Rukai, the final echo vowels are extramentrical, as illustrated in (8), and the stress falls on the antepenultimate syllable in trisyllabic prosodic words.

(8) Antepenultimate stress in Budai prosodic words with echo vowels

a. Syllable Extrametricality: σ → <σ> / ___]$_{word}$

b. Foot Construction: i. Form syllabic trochees from right to left.
ii. Degenerate feet are allowed.

c. Word Layer Construction: End Rule Right

(x)
(x .)
… ́σ σ <σ>

Note that the vowel in a monosyllabic root of Budai Rukai is a proper vowel, not an echo vowel.

The contact-induced prosody attested in the Sanhe village, on the other hand, has applied the optional extrametricality rule, and echo vowels were treated as proper vowels in the varieties. Antepenultimate stress becomes penultimate stress in trisyllabic or longer prosodic words, with a release from extrametricality, as shown in (9). As a result, words with innovative penultimate stress were attested, as illustrated in (10).

(9) Release from Extrametricality:

(x)		(x)
(x .)	→	(x .)
… ǵ σ <σ>		…σ ǵ σ

(10)

Budai (Conservative)	Sanhe (Innovative)	Gloss
válisi	valísi	‘tooth’
ə́bəl̪ə	əbə́l̪ə	‘smoke’
túburu	tubúru	‘bamboo shoot’
vágisi	vagísi	‘thigh’
ɖərə́ɖərə	ɖərəɖə́rə	‘thunder’

Kang (2010) studies prosodic adaptation in loanwords in diverse languages and proposes that stress languages have stricter restrictions on the location of prominence. It is often not possible to faithfully preserve the input language prominence in the original position. A group of languages employ the stress shift option. The pattern of contact-induced prosody reported in the present study also confirms her proposal. She further points out that “any hypothesis that makes a strict prediction based on the structural characteristics of the native language phonology is too rigid, given the intra-language variation in adaptation both synchronic and diachronic.” On the other hand, Broselow (2009) proposes that stress adaptation takes place during perception. Broselow argues that in Fijian, what is perceived from the input is not the position of stress per se, but rather vowel length on a stressed syllable, which in turn attracts stress in the production grammar. In cases of Budai words produced in the Sanhe village, speakers of Budai Rukai adopted the predictable stress patterns of Sandimen Paiwan to Budai Rukai. Consequently, prosodic varieties were attested, and Budai stress has been reported as being in the process of going the way from the antepenultimate to the penultimate stress.

In sum, we have to take language contact into consideration with regard to the prosodic varieties reported here. Ansaldo (2004) points out that in multilingual societies we would have a significant degree of linguistic variation, a clear sign of a heterogeneous speech community. Sanhe village in Majia Township is a heterogeneous speech community of the new settlements of Sandimen Paiwan, Budai Rukai, and the Chinese people. In such a community it is impossible to postulate that a single set of linguistic features could be passed on without interferences from other languages. It is expected that the bilingual or multilingual linguistic communities are heterogeneous pools of utterances. The Budai dialect spoken in the Budai villages, on the other hand, more likely preserve the ancestral accent of the Budai Rukai language.

5. Conclusion

This paper investigates the contact-induced stress patterns in Budai Rukai. By providing word-level phonetic representations of the varieties of Budai Rukai, the proposal of the contact-induced prosody has to some extent been supported. The speech communities of Budai Rukai have long been geographically close to those of Paiwan, and the new settlement of the Sanhe village is located within the Paiwan communities. The contrastive stress retained in the Budai dialect is in the process of developing predictable penultimate stress in the Sanhe village. Because of the words shared with Paiwan, and because of being surrounded by the Paiwan speakers in the Sanhe village, stress patterns of the Budai dialect spoken in the Sanhe village were inevitably affected by Paiwan stress.

Words in Budai Rukai generally end with a vowel. Echo vowels are treated as epentheses to avoid consonantal coda in Budai Rukai, and they are extrametrical in the representation of stress. Primary stress in Budai Rukai falls on (i) monosyllabic roots; (ii) the penultimate syllable of disyllabic roots; (iii) the penult or the antepenultimate syllable of trisyllabic or longer roots. While long vowels have been treated as phonetic geminates (cf. Li 1995), the duration of a stressed vowel is 1.4 times longer than that of an unstressed vowel for the tokens recorded in the Sanhe village. Phonetic representations have shown that the effect of stress on pitch and intensity was significant. Stress may affect vowel durations in the Budai dialect spoken in the Sanhe village, and measures on stressed and unstressed vowels in disyllabic and trisyllabic elicitation tokens to some extent support the view that final lengthening is a universal tendency.

Main stress in Sandimen Paiwan falls on the final syllable only in the case of a monosyllabic prosodic word. Otherwise, main stress is on the penult. Penultimate stress is the typical pattern in Sandimen Paiwan, while monosyllabic roots also bear stress when they occur at the rightmost position in a prosodic word (cf. Chen 2009a). Yet, the contact-induced prosody attested in the Sanhe village has applied the optional extrametricality rule, and echo vowels were treated as proper vowels in the varieties of Budai Rukai. Antepenultimate stress becomes penultimate stress in trisyllabic or longer prosodic words, with a release from extrametricality.

Phonetic representations of Budai stress have shown that pitch and intensity are robust phonetic correlates of stress prominence in Budai Rukai. The tokens produced by male speakers in Sanhe have shown the high pitch alignment with the penult. The high pitch values attested at the penult also provide evidence for the existence of prosodic varieties in the Sanhe village. The prosodic varieties of Budai Rukai attested in Sanhe are in the process of going the way from the antepenultimate to the

penultimate stress in trisyllabic nouns. Long vowels in Budai Rukai may be a phonetic realization of stress, but not all long vowels are stressed. Stressed long vowels are aligned with higher pitch, while vowels with lower pitch could be long word or phrase finally. The findings provide accounts for the final unstressed long vowels attested in previous documentation. Stress may affect vowel durations in the Budai dialect spoken in the Sanhe village, and final lengthening may occur in isolated elicitation. Stress assignment between the Budai dialect spoken in the Budai areas and the Sanhe village differ in various percentages of penultimate stress. Budai words in the Budai areas retained the antepenultimate stress in trisyllabic words, whereas Budai words in the Sanhe village were more frequently produced with the penultimate stress in trisyllabic words.

Budai Rukai speakers who have frequent contact with the Paiwan speakers tend to produce the Paiwan stress patterns or have acquired the Paiwan stress patterns in their Rukai speech. Yet, canonical Budai stress patterns were not completely lost, as the tokens produced by the speakers in Budai villages have shown the conservative forms as opposed to the innovations. Geographical adjacency is the primary factor for the phonological similarities shared by Paiwan and Budai Rukai. Results also suggest that speaker variability affected the stress shift in Budai Rukai. The factor of speaker variability must account for the stress shift attested in the Paiwan dominant speech community.

Finally, let us read the following piece of news from the *United Daily News* issued on September 24, 2009 after Typhoon Morakot: "Nearly 40 students of the Budai Rukai indigenous people will be living in the Beiye Elementary School in the speech community of Paiwan, after the school resumes in September……maybe the kids can speak their native language of Budai Rukai and learn to speak Paiwan as bilinguals." It is expected that the contact-induced prosody will be going on and on.

References

Ansaldo, Umberto. 2004. Contact, typology and the speaker: The essentials of language. *Language Sciences* 26:485-494.

Beckman, Mary E. 1986. *Stress and Non-Stress Accent*. Dordrecht: Foris.

Blust, Robert. 1997. Rukai Stress Revisited. *Oceanic Linguistics* 36:398-403.

Broselow, Ellen. 2009. Stress adaptation in loanword phonology: Perception and learnability. *Phonology in Perception*, ed. by Paul Boersma and Silke Hamann, 191-234. Berlin: Mouton de Gruyter.

Berkovits, Rochele. 1994. Durational effects in final lengthening, gapping, and

contrastive stress. *Language and Speech* 37:237-250.

Byrd, Dani, Jelena Krivokapić, and Sungbok Lee. 2006. How far, how long: On the temporal scope of prosodic boundary effects. *Journal of the Acoustical Society of America* 120:1589–1599.

Cambier-Langeveld, Tina. 1997. The domain of final lengthening in the production of Dutch. *Linguistics in the Netherlands*, ed. by Jane Coerts and Helen de Hoop, 13-24. Amsterdam: John Benjamins.

Chen, Chun-Mei. 2006. A Comparative Study on Formosan Phonology: Paiwan and Budai Rukai. Doctoral dissertation, University of Texas, Austin.

Chen, Chun-Mei. 2009a. The phonetics of Paiwan word-level prosody. *Language and Linguistics* 10:593-625.

Chen, Chun-Mei. 2009b. Documenting Paiwan phonology: Issues in segments and non-stress prosodic features. *Concentric: Studies in Linguistics* 35:193-223.

Chen, Ting-Hsiang and Blanka Shew-Jiuan Su. 2004. Guojia fazhan daji xia de yuanzhumin yizhu juluo: Pingdongxian Sanhecun pincou de diqu neihan [The creation of a new aboriginal spatial mosaic: A study of the aboriginal re-settlement at San-Ho village, Ping-Tung County]. *Dili Xuebao* [*Journal of Geographical Science*] 37:99-122.

Crystal, Thomas H., and Arthur S. House. 1982. Segmental durations in connected speech signals: Preliminary results. *Journal of the Acoustical Society of America* 72:705-716.

Fry, Dennis B. 1955. Duration and intensity as physical correlates of linguistic stress. *Journal of the Acoustical Society of America* 27:765-768.

Fry, Dennis B. 1958. Experiments in the perception of stress. *Language and Speech* 1: 126-152.

Fry, Dennis B. 1965. The dependence of stress judgments on vowel formant structure. *Proceedings of the Fifth International Congress of Phonetic Sciences*, 306-311. Basel and New York: S. Karger.

Hayes, Bruce. 1981. A Metrical Theory of Stress Rules. Doctoral dissertation, Massachusetts Institute of Technology, Cambridge.

Hayes, Bruce. 1995. *Metrical Stress Theory: Principles and Case Studies*. Chicago: University of Chicago Press.

Ho, Dah-an. 1983. The position of Rukai in Formosan languages. *Bulletin of the Institute of History and Philology* 54:121-168.

Hsin, Tien-Hsin. 2000. Aspects of Maga Rukai Phonology. Doctoral dissertation, University of Connecticut, Hartford.

Hyman, Larry M. 2006. Word-prosodic typology. *Phonology* 23:225-257.

Kang, Yoonjung. 2010. Tutorial overview: Suprasegmental adaptation in loanwords.

Lingua 120:2295-2310.

Kohler, Klaus J. 1983. Prosodic boundary signals in German. *Phonetica* 40:89-134.

Li, Paul Jen-Kuei. 1973. *Rukai Structure*. Taipei, Academia Sinica.

Li, Paul Jen-Kuei. 1975. *Rukai Texts*. Taipei, Academia Sinica.

Li, Paul Jen-Kuei. 1977. The Internal Relationships of Rukai. *Bulletin of the Institute of History and Philosophy* 48:1-92.

Li, Paul Jen-Kuei. 1995. Rukai: Introduction and Wordlist. *Comparative Austronesian Dictionary: An Introduction to Austronesian Studies*, ed. by Darrell Tryon, 297-305. Berlin: Mouton de Gruyter.

Liberman, Mark, and Alan Prince. 1977. On stress and linguistic rhythm. *Linguistic Inquiry* 8:249-336.

Nakai, Satsuki, Sari Kunnari, Alice Turk, Kari Suomi, and Riikka Ylitalo. 2009. Utterance-final lengthening and quantity in Northern Finnish. *Journal of Phonetics* 37:29-45.

Peterson, Gordon E., and Ilse Lehiste. 1960. Duration of syllable nuclei in English. *Journal of the Acoustical Society of America* 32: 693-703.

Remijsen, Bert. 2002. Lexically contrastive stress accent and lexical tone in Ma'ya. *Laboratory Phonology Vol.7*, ed. by Carlos Gussenhoven and Natasha Warner, 585-614. Berlin: Mouton de Gruyter.

Remijsen, Bert, and Vincent J. van Heuven. 2005. Stress, tone and discourse prominence in the Curaçao dialect of Papiamentu. *Phonology* 22:205-235.

Ross, Malcolm. 1992. The sound of Proto-Austronesian: An outsider's view of the Formosan evidence. *Oceanic Linguistics* 31:23-64.

Shelley, George L. 1978. Wudai Dukai, the Language, the Context and Its Relationships. Doctoral dissertation, Hartford Seminary, Hartford.

Tsuchida, Shigeru. 1976. *Reconstruction of Proto-Tsouic Phonology*. Study of Languages and Cultures of Asia and Africa, Monograph Series, No.5. Tokyo: Tokyo University of Foreign Studies.

Turk, Alice E., and Stefanie Shattuck-Hufnagel. 2007. Multiple targets of phrase-final lengthening in American English words. *Journal of Phonetics* 35:445-472.

Wightman, Collin. W., Stefanie Shattuck-Hufnagel, Mari Ostendorf, and Patti J. Price. 1992. Segmental durations in the vicinity of prosodic phrase boundaries. *Journal of the Acoustical Society of America* 91: 1707-1717.

Zeitoun, Elizabeth. 2000. *Lukaiyu Cankaoyufa* [*A Reference Grammar of Rukai*]. Taipei: Yuanliu Publisher Co.

Zeitoun, Elizabeth. 2007. *A Grammar of Mantauran Rukai*. Taipei: Academia Sinica.

Zorc, R. David. 1983. Proto-Austronesian accent revisited. *Philippine Journal of Linguistics* 14:1-24.

[Received 3 January 2011; revised 27 April 2011; accepted 30 June 2011]

Department of Foreign Languages and Literatures
National Chung Hsing University
Taichung, TAIWAN
Chun-Mei Chen: chench@dragon.nchu.edu.tw

霧台魯凱接觸衍生韻律的語音實證

陳春美
國立中興大學

本篇論文調查原住民語言霧台魯凱重音韻律接觸的型態。透過對於重音接觸語音表述的實證，韻律接觸的假設得到進一步證實。霧台魯凱方言的對比重音，正在發展可預測性的倒數第二音節型態重音，此類新型態的發展，在近期的移居地或遷村後的部落特別顯著。調查結果發現，常與排灣族人接觸的霧台魯凱族人傾向於發出排灣語的型態重音，在此類的韻律變體中，選擇性的排除韻律公制已被應用，歷史發展的附和元音被視爲本體真實元音。在三音節及更長的韻律字當中，韻律接觸型態已由倒數第三音節轉移至倒數第二音節重音型態，由排除韻律公制中釋放。研究結果顯示，霧台魯凱族人之間的韻律變化性也會影響韻律接觸的重音移轉。

關鍵詞：語音實證、接觸衍生韻律、霧台魯凱、重音