Concentric: Studies in Linguistics
35.2 (July 2009):193-223

Documenting Paiwan Phonology: Issues in Segments and Non-Stress Prosodic Features*

Chun-Mei Chen
National Chung Hsing University

The paper addresses two issues in documenting Paiwan phonology and presents empirical analyses of this indigenous language. The empirical analyses of segments support the argument that acoustic variables play a part in the documentation of stop consonants. The variation of VOTs should be taken into account in the documentation of phonemes. Accent in second person pronouns and address forms represents not only the linguistic features of the language but also the cognitive space of the Paiwan speakers. Empirical studies are needed to verify the phonetic variation and phonological representations in a speech community with varieties. The documentation of Paiwan phonology cannot be accomplished without the examination of variations among the dialects.

Keywords: Paiwan, phonology, segments, non-stress prosodic features

1. Introduction

This paper deals with the major segmental features of Paiwan and includes an account of the salient prosodic features in the sub-dialects of Paiwan. The documentation of Paiwan segments has been controversial, as many phonological and phonetic variations have been attested among the Paiwan dialects and sub-dialects (Ho 1977, 1978, Chang 2000, and Pulaluyan 2002). What are the phonemes? What are the allophones? What are the phonological or phonetic variations among the dialects and sub-dialects? The present study addresses the segmental issues and provides a preliminary documentation of Paiwan phonology.

According to the Ethnologue report, some Austronesian languages in Taiwan are nearly extinct. Though the Paiwan language is not nearly extinct, it is currently less spoken among the younger generations in the community. The documentation and preservation of the Paiwan language has thus become an urgent issue. Textbooks of the Paiwan language with segmental charts and texts were published by the Pingtung County Government (Su 1993), and preliminary grammar books of the language have been available (Chang 2000 and Pulaluyan 2002). Yet, none of the existing field reports bears on both empirical evidence and systematic documentation of phonology of the Paiwan dialects. Both the diverse lexicon and the pronunciation have caused a

* The author would like to thank many individuals who contributed to the data and the ideas presented in this paper, particularly the three anonymous reviewers of *Concentric* for their many insightful comments on earlier drafts. Preliminary parts of this research were presented at the 11th Annual Conference of the Pragmatics Society of Japan and the 1st International Conference on Language Documentation and Conservation. This research project was funded by the National Science Council (NSC 97-2410-H-005-036).

communication barrier among Paiwan speakers. The various pronunciations have been found in some recent intertribal families in which the couples speak different Paiwan dialects. Not only stress patterns but also other types of prosodic features play important roles in word meanings, narratives, and discourse of the Paiwan language. Given that some sound patterns are rather widely distributed while others are rather restricted, and that some phonetic varieties in one region have equivalences or correspondences in another, the description of variations of Paiwan dialects has become a necessity for a comprehensive field report of Paiwan. The present study draws evidence from synchronic data of segmental and prosodic patterns found in the Paiwan dialects and proposes an account for the variation and distinction among the dialects.

Paiwan is an Austronesian language spoken in Southern Taiwan, and has approximately 66,000 speakers. Most Paiwan speakers are aware of the segmental varieties within their community, but none of the existing studies has drawn a clear picture on phonetic variation and the documentation of phonology in Paiwan. Ho's (1978) comparative study of five Paiwan dialects has shown both phonological (*c, *ɟ, *ɖ, *r, *k, *w) and phonetic (*ʎ, *r, *k, *q) variation. Ferrell (1982) has reported that phonologically Central and Southern Paiwan villages tend to form a loose grouping. Yet, neither Ho's (1978) nor Ferrell's (1982) study has provided empirical evidence to show the phonetic or phonological variation among the Paiwan dialects. As a result, field researchers have adopted diverse transcription systems to construct the Paiwan phonology.

It has been widely agreed that without some knowledge of the sounds, one cannot describe the phonology of a language (cf. Ladefoged 2003). Phonemes are the sounds that contrast in words, while allophones are the realizations or the contextual variants of phonemes. In this paper, phonemes in Paiwan were constructed by means of minimal pairs, and allophones were attested among the Paiwan speakers. Earlier documentation about the Paiwan language relied on the perception of the field researchers (Ho 1977, 1978, Chang 2000, and Pulaluyan 2002), and Ladefoged (2003) warned field workers of never fully trusting anyone else's description of the sounds of a language. Many factors may have been involved in the documentation of a language, such as different dialects, ages, gender, or language fluency of the speakers. The language under investigation might have changed since earlier accounts of it. As a result, recordings have become a prerequisite for the investigation of sounds in a language. Sets of minimal contrasts are always the best resource for the construction of consonantal and vowel inventories.

More recent field reports (Chen 2004, 2006) have shown the preservation of bilabial, alveolar, palatal, velar and uvular stops in Southern Paiwan, whereas palatal

and uvular stops were absent in Northern Paiwan. In the present study, Voice Onset Time (VOT) measures were taken for the voiceless non-aspirated stops of Paiwan. On the other hand, non-stress prosodic features in Paiwan have not been well studied yet. Non-stress prosodic patterns have generally been analyzed in terms of phonetic pitch. Interpreting pitch curves has been a difficult task for fieldworkers, and analyzing the pitch of an utterance is a complicated process. In this paper, the description of the prosodic patterns is given in a paradigm, and the issues in documenting non-stress patterns have been tackled. High pitch prominence in Paiwan second person pronouns and address forms provides direct evidence for the importance of prosody in face-to-face interaction.

The most significant contribution of the current study lies in the presentation of segmental and prosodic features of the Paiwan phonology, and the empirical analyses of the indigenous language. The preservation of the sound files of the Paiwan dialects also helps both the Paiwan speakers and researchers understand more about the dialects, the language, and language diversity.

2. Sound files for the documentation

A collection of written texts of Paiwan has been published as a source of lexical and grammatical information (cf. Early and Whitehorn 2003). Written texts preserve a corpus of natural texts of the endangered language and the information about the culture of Paiwan. Yet, a voice corpus designed for the purpose of phonological documentation and analysis of the Paiwan dialects is still under construction. “The Academia Sinica Formosan Language Archive” divides the Paiwan dialects into the *tj*-dialect and the *t*-dialect. The archive has preserved voice tokens of the Formosan languages, but the data of Paiwan in the archive provide little information about the prosodic variation among the Paiwan dialects. Empirical studies of Austronesian prosodic structure are relatively rare. Zorc (1993) has claimed that in the synchronic description of any language, word accent and intonation must be distinguished and accounted for. Nevertheless, before accent and intonation can be distinguished, more empirical studies on stress or accent patterns are needed. In addition, more linguistic and paralinguistic factors have to be taken into consideration in the documentation and preservation of Formosan phonology.

In the present paper, the sound files from the Paiwan dialects includes 1560 Paiwan word tokens, 74 sentence tokens, 30 pieces of natural discourse, and 29 narratives. All the sound files were collected in elicitation and natural-occurring speech, with a view to understanding how the Paiwan people communicate. In other words, none of the tokens was collected in the laboratory. None of the verbal arts of

aboriginal languages can be completely preserved without the collection of sound files and the documentation of prosody. Collecting the sound files is to preserve the verbal art of the language and at the same time to achieve the insights to be gained from patterns that orthographic transcription or traditional written texts would not provide, and to make generalizations.

Sound files or spoken corpora differ from written texts in a few aspects. Oral corpora contain prosodic information (Vizcaíno 2007). Jefferson (1985) has noted that in the study of conversational interaction it was crucial to record all audible aspects of the speech and not just the plain text. Her system included non-speech vocalizations such as laughter, paralinguistic effects such as lengthening of syllables and emphatic stress, and segmental features of pronunciation. Wichmann (2007) has noted that Jefferson's work is "of vital importance in showing that in an interactional setting prosodic, paralinguistic and non-linguistic features have a role to play in negotiating meaning" (p.76). Recent work on the interface between phonetics and conversation such as Ford and Couper-Kuhlen's (2004) study shows that there is far more in the speech signal to be accounted for than that could ever be captured in an orthographic transcription. Wichmann (2007) argues that sound files are of crucial importance, as sounds are not just an additional resource for the study of prosody but an integral part of the message. As far as fieldworkers are concerned, the compilation of sound files is the prerequisite for the documentation of prosody in any indigenous language. For the documentation of phonology in Paiwan, an indigenous language with regional variation, a collection of sound files has become a necessity.

The Paiwan aborigines occupy the mountain and foothill areas of Pingtung and Taitung Counties, Taiwan. According to Ferrell's (1982) report, the high interior mountains in the northern part of Pingtung County are considered by many Paiwan aborigines to represent their place of origin, and villages found in the interior mountainous area are the ones which commonly figure in origin myths and oral literature. Japanese aboriginal offices used for tribal classification in Ogawa and Asai's (1935) study have lost their indexical function today for dialectology, ever since the withdrawal of Japanese governance.

Four male and six female Paiwan speakers aged 48-72 participated in the present study. All of them are fluent speakers of the Paiwan language and considered the representatives in the Paiwan villages studied. They were recommended by either village members or the chieftains. The study assesses linguistic varieties in five Paiwan villages, including Sandimen, Majia, Piuma, Shimen, and Mudan. Previous research (Chen 2006) has shown that certain features are not distinctive between northern and central geographical regions, while some Paiwan speakers who live around central southern regions may acquire both Central and Southern Paiwan

dialectal features. As far as the Paiwan villages in the present study are concerned, the phonological features attested in Sandimen and Majia indicate that these two Paiwan village dialects belong to the *t*-dialects, the "Northern Paiwan" dialects. The phonological features attested in Shimen and Mudan indicate that these two Paiwan village dialects belong to the *tj*-dialects, the "Southern Paiwan" dialects. However, the sub-grouping of the Piuma Paiwan village is controversial, due to its relocation and the contact with other sub-dialects of Paiwan. Therefore, the Piuma Paiwan is not classified into any specific Paiwan dialect in the present study.

The task of representing a language, or even part of a language, may be problematic (Biber et al. 1998). Upon collecting the data, the full extent of variation in the language is unknown, and variables in spoken languages need to be covered in order to capture all the variation in the language. Word lists prepared for elicitation included nouns, verbs, phrases, and sentences. Nouns were the major category in word lists, and they were divided into nature, plants, animals, people, body parts, time, pronouns, and numerals. Each Paiwan speaker was asked to elicit the Paiwan words or phrases on the word list. The recording was conducted in a quiet place. Unlike most laboratory phonology studies, a sound treated booth for recording in the Paiwan villages was not available. Informed consent was obtained prior to the recording. All the digital-recording sound files were stored in a safe place after the field trips.

As Kennedy (1998) has noted, the optimal design of a corpus is highly dependent on the purpose for which it is intended to be used. When compiling the Paiwan sound files, the author had a clear idea of what kinds of analyses were likely to be undertaken. The collection of the sound files in the Paiwan villages focused on segmental and prosodic variation. When the natural-occurring texts were recorded, an attempt was made to avoid excessive bias in the selection of the spoken texts. The sound files collected from the Paiwan speakers include words, phrases, sentences, and natural-occurring discourse.

3. Documenting the segments

3.1 Morphology

A thumbnail sketch of Paiwan morphology is given prior to the construction of consonantal and vowel inventories. The reason for doing so is to better facilitate our understanding of Paiwan phonology and phonetics. Segmental and syllabic structure information will be explained in this description of Paiwan morphology.

Paiwan morphemes can be classified into roots and bound forms. Roots are independent free morphemes that can be used independently as complete words or

utterances. Roots include primary nouns,[1] verb stems, stative verb stems and particles. Bound forms must be used in combination with other morphemes. At least four classes of bound forms were attested: ligatures (as construction markers), intensifiers, personal pronouns, and derivational morphemes (as affixes). Derivational morphemes in Paiwan include bound prefixes, suffixes, infixes, and circumfixes. On the other hand, inflectional affixes are usually attached to verb stems, and the processes of inflection and derivation are sometimes undistinguishable. Words in Paiwan are independent forms comprised of independent morphemes or the combination of free stems and bound morphemes.

Roots in Paiwan are generally in the shapes of CVC, CVCV(C), and CVCVCV(C). Roots are the independent morphemes as affix targets. Affixes may prefix, infix or suffix to a minimal independent word. Examples of Paiwan roots are shown in (1).

(1) Examples of Paiwan Roots

	Shapes	Roots	GLOSS
a.	CVC	sis	'meat containing a bone'
b.	CVCV	l̦ima	'hand'
c.	CVCVC	vuqaʎ	'to be white'
d.	CVCVCV	qaraba	'flat worm'
e.	CVCVCVC	kadikad	'stirrer'

On the other hand, shapes of affixation are predictable, usually in the form of V, CV, VC, VCV or CVCV. Roots in Paiwan carry the main components of meanings in a word. Words are defined as independent forms carrying meanings. They are either independent morphemes such as roots or the combination with bound form morphemes. Words in Paiwan can be classified into nouns, verbs, stative verbs/adjectives, adverbials and particles.

3.2 Phonemes

Piuma Paiwan has twenty-three consonant phonemes and one loan consonant phoneme /h/. The glottal stop is somewhat marginal. As far as synchronic phonology is concerned, the glottal stop phoneme exists, though the number of words with the glottal stop has been decreasing in Piuma and Southern Paiwan dialects.

The consonant inventory of Piuma Paiwan is shown in Table 1.

[1] Primary nouns are simple morphemes in Paiwan. They cannot be segmented into simpler components (cf. Ferrell 1982).

Table 1. Piuma Paiwan consonants

	Labial[2]	Alveolar	Retroflex	Palatal[3]	Velar	Uvular	Glottal
Plosive	p b	t d	ɖ	c ɟ	k g	q	ʔ
Fricative	v	s z					(h)
Affricate		ts					
Trill		r[4]					
Nasal	m	n			ŋ		
Lateral			ɭ	ʎ			
Approximant	w			j[5]			

Northern Paiwan has twenty consonant phonemes, in which palatal sounds /c/, /ɟ/, and /ʎ/ are absent, and one loan phoneme /h/ is attested. Uvular /q/ is also absent. In Northern Paiwan villages, the glottal stop phoneme /ʔ/ is the reflex of /q/, derived from historical sound change. The phoneme status of glottal stop is ascertained in Northern Paiwan. On the other hand, Southern Paiwan has twenty-three consonant phonemes and one loan phoneme /h/. The status of the phoneme /r/ is controversial[6] in earlier historical reconstruction. The majority of the speakers in the Mudan village of Southern Paiwan prefer the velar fricative sound [ɣ], though other Southern villages adopt the sound [r] in the same phonological environments. Field notes of Shigeru Tsuchida (1981-1982) have indicated that the [ɣ] sound is usually preserved in more conservative or isolated villages.[7]

The merger of Paiwan consonantal phonemes is shown in Table 2. Although sound change does occur among the Paiwan villages, it is rather difficult either to identify the origin of the historical change, or to single out one specific reason for the synchronic variation attested in the Paiwan villages.

[2] The labial category includes two places of articulation: bilabial and labiodental.

[3] Palatal sounds [c], [ɟ] and [ʎ] are transcribed as [tj], [dj] and [lj] respectively in earlier literature of Paiwan and in the majority of the Paiwan language teaching materials.

[4] Piuma Paiwan /r/ has the allophonic alternation of voiced velar fricative [ɣ].

[5] The phoneme /j/ is often conventionally transcribed as /y/.

[6] Dahl (1973) and Ho (1977) gave the voiced velar fricative /ɣ/ a higher ranking than the trill /r/ in the reconstruction of PAN, i.e., the historical derivation is from /ɣ/ to /r/. According to Ho (1977), the phoneme /ɣ/ is rather old, and /ɣ/ has become /r/ in the majority of Paiwan dialects. Yet, given that the phoneme /r/ has become essential among the Paiwan speakers, and that the phonological description in the current study is synchronic, the phoneme /r/ is adopted in the Southern Paiwan inventory.

[7] According to Tsuchida's (1981-1982) reconstruction, the velar fricative sound [ɣ] attested in Eastern Paiwan might be the reflex of *l in Proto-Paiwan.

Table 2. The correspondence of Paiwan phonemes

Consonant	Northern	**Piuma**	Southern	GLOSS
*c[8] > t	tula	**cuʎa**	cuʎa	'eel'
* ɟ > d	damuʔ	**ɟamuq**	ɟamuq	'blood'
*ʎ > l	ləl̪ət	**ʎəl̪ət**	ʎəl̪ət	'lip'
*q > ʔ	isiʔ	**isiq**	isiq	'urine'
*k > ʔ	kivaŋvaŋ	**kivaŋvaŋ**	ʔivaŋvaŋ	'to play'

As shown in Table 2, the merger between alveolar and palatal stops occurs in Northern Paiwan, but it does not indicate that none of the Paiwan speakers living in the Northern region can articulate palatal stops. The merger reported here is more a tendency than a concrete classification. On the other hand, the dialectal variation between /q/ and /ʔ/ in Paiwan has been reported in many earlier field studies (Ho 1977, 1978, Chang 2000, Su 1993, and Pulaluyan 2002). For instance, *qil̪as* 'moon' is pronounced as *ʔil̪as* or *il̪as* 'moon' in Northern Paiwan villages.

The surface distribution of the Paiwan consonants is given in Table 3.

Table 3. Surface distribution[9] of the Paiwan consonants

Consonants	Word-Initial				Word Internal	Word Final
	#___i	#___u	#___a	#___ə	V__V	___#
p	**pitsul̪** 'muscle of arm'	**puḍu** 'kidney'	**padaj** 'rice'	**pədi** 'portion'	**sapuj** 'fire'	**kurap** 'skin disease'
b	**bibi** 'duck'	**buniq** 'mud'	**bakits** 'bucket'	**bəruŋ** 'hole'	**bubuŋ** 'bubble'	**qubqub** 'frog'
t	**titsa** 'rake'	**tutu** 'breasts'	**taqəd** 'to sleep'	**təquŋ** 'horn'	**putut** 'drill'	**parut** 'true'
d	**dimpuŋ** 'flour'	**duku** 'poison'	**dal̪iʎ** 'bottle'	**dəməs** 'glutton'	**gadu** 'mountain'	**taqəd** 'to sleep'
c	**cimiz** 'chin'	**cuʎur** 'angle'	**cababaŋ** 'blister'	**cəbək** 'lake'	**pacəz** 'wood chisel'	**səmuc** 'choking'
ɟ	**ɟiɟi** 'buttocks'	**ɟurits** 'paste'	**ɟal̪an** 'road'	**ɟəkap** 'footprint'	**suɟu** 'lover'	**qaʎuɟ** 'to lose'
k	**kil̪iʎ** 'cricket'	**kupu** 'cup'	**kasuj** 'trousers'	**kəʎa** 'torso'	**səkəz** 'to stop'	**vaik** 'to go'

[8] The symbol "*" here represents the Proto-Paiwan phonemes reconstructed by Ho (1978).
[9] Words in parentheses were attested in Piuma Paiwan only.

g	**gidi** ‘side’	**gusam** ‘weed’	**gaŋ** ‘crab’	**gəmgəm** ‘fist’	**sagi** ‘file’	**səgsəg** ‘tabu field’
q	**qipu** ‘earth’	**quzu** ‘leaf’	**qaʌup** ‘to hunt’	**qətsəv** ‘counter-part’	**biqu** ‘curve’	**tidəq** ‘interval’
ʔ[10]	**ʔiʌa** ‘to hide’	**ʔuqaʌaj** ‘man’	**ʔaʔa** ‘crow’	**ʔəɭuz** ‘pillar’	**vituʔan** ‘star’	**umaʔ** ‘house’
v	**vikiŋ** ‘curve’	**vukid** ‘forest’	**vasa** ‘taro’	**vəku** ‘wart’	**kuvaʌ** ‘blanket’	**qətsəv** ‘counter-part’
s		**suʌa** ‘ice’	**saŋas** ‘first’	**sənaj** ‘song’	**sasaw** ‘outdoors’	**qurəpus** ‘cloud’
z		**zuma** ‘other’	**zaman** ‘torch’	**zəɭət** ‘bow-string’	**imaza** ‘here’	**kuraz** ‘rake’
ts		**tsuvuq** ‘bamboo sprout’	**tsaɭa** ‘to fry’	**tsədas** ‘sunlight’	**patsaj** ‘to die’	**kurits** ‘millet’
(h)[11]	**hikuki** ‘airplane’	**huni** ‘ship’	**haku** ‘box’		**kuhugan** ‘five minutes’	
tʃ	**tʃima** ‘nail’	**(tʃuru)** ‘tip’	**(tʃaviʌ)** ‘year’		**(matʃa)** ‘eye’	**(qaʌitʃ)** ‘skin’
ʃ	**ʃiɭi** ‘pillow’				**ɭiʃi** ‘bride price’	
ʒ	**ʒitsu** ‘this’				**ʃiʒi** ‘goat’	
n	**niqaj** ‘newly-born monkey’	**nuɭi** ‘glue’	**namaqar** ‘weak’	**nəka** ‘not exist’	**nana** ‘sweet potato’	**pakan** ‘to feed’
m	**mimi** ‘calf’	**muka** ‘papaya’	**matsam** ‘piquant’	**məkuj** ‘cucumber’	**qimi** ‘cheeks’	**səɭəm** ‘the dark’
ŋ	**ŋiɭu** ‘pain’	**ŋuɟus** ‘nose’	**ŋadan** ‘name’	**ŋəɖuq** ‘segment’	**kuŋaj** ‘dirt’	**qiʌaŋ** ‘dirt’
r	**rigi** ‘horse’	**rugus** ‘twig’	**ragəd** ‘pebble’	**rəŋeəŋ** ‘obstacle’	**parut** ‘true’	**maqipər** ‘unlucky’
ʎ	**ʎisuk** ‘to pull out’	**ʎunaj** ‘small knife’	**ʎatu** ‘to boil (meat)’	**ʎəɭət** ‘lip’	**riʌaj** ‘skinny person’	**kuriʌ** ‘dried food’

[10] Words presented in this row were collected from Northern Paiwan.
[11] The loan consonant /h/ is put in the parenthesis here.

ɖ	**ɖimuɭ** ‘fist’	**ɖukuŋ** ‘bend’	**ɖaqa** ‘branch’	**ɖəkan** ‘straw rope’	**ɖaɖaj** ‘toy’	**piaɖ** ‘dish’
ɭ	**ɭigu** ‘glory’	**ɭuqəm** ‘luck’	**ɭaɭaja** ‘flag’	**ɭədəp** ‘to dive’	**ʃiɭi** ‘pillow’	**ɖaquɭ** ‘goiter’
w	**wi** ‘yes’	**wuvaj** ‘feminine name’	**wara** ‘dried rice-straw’		**sawni** ‘short while’	**ʃiaw** ‘soup’
j	**jisu** ‘Jesus’	**jui** ‘feminine name’	**jaʃi** ‘coconut’		**vavajan** ‘woman’	**quzəmaj** ‘dim’

As shown in Table 3, the palatal consonants in Northern Paiwan occur before a high front vowel only; i.e., the occurrence of palatalized allophonic series is conditional. On the other hand, the palatalized /tʃ/ in Piuma Paiwan is not conditional and occurs word-initially, medially and finally. In Southern Paiwan, however, the condition of a following high front vowel does not always cause palatalization in all the attested words.

The vowel inventory of Paiwan is shown in (2).

(2) i u

ə (o)

a

Vowel characteristics of Paiwan vowels are given in Table 4.

Table 4. Summary of Paiwan vowel characteristics

Vowel	Characteristics
i	high front unrounded
u	high back rounded
ə	central unrounded
a	low central unrounded
(o)	mid-high back rounded

Paiwan has four native vowels, and the back mid-high vowel /o/ is a loan vowel, with relatively lower frequency of occurrence. Blust (1988) has noted that almost all Austronesian specialists admit just four Proto-Austronesian vowels: /a/, /ə/, /i/, and /u/. Many of the words with the phoneme /o/ are associated with Japanese, Taiwanese, or Mandarin loanwords. Therefore, /o/ is included in the vowel inventory as a loan vowel

here.

Words illustrating Paiwan vowels are listed in Table 5.

Table 5. Words illustrating the vowels of Paiwan

VOWEL	PAIWAN	GLOSS
i	l**i**ʎ**i**ŋ	‘shadow’
u	l**u**k**u**ts	‘campanula’
ə	l**ə**s**ə**q	‘tear’
a	l**a**v**a**	‘flying squirrel’
(o)	l**o**p**o**n	‘Japan’

On the other hand, the author did not find any vowel length as a linguistic distinctive feature among the Paiwan village dialects. Among the native vowels, only /a/, /i/ and /u/ can occur word-initially. Schwa never appears word-initially as a single syllable or in diphthongs.

Minimal pairs exhibiting contrasts between the vowel phonemes are given in (3).

(3)	/i/ vs	/u/	**i**ta	‘one’
			uta	‘also’
		/a/	ʎav**i**	‘millet seed’
			ʎav**a**	‘flying squirrel’
		/ə/	mal**i**mu	‘to be covered’
			mal**ə**mu	‘sudden’
	/a/ vs	/i/	ɟaq**a**s	‘material for charcoal’
			ɟaq**i**s	‘forehead’
		/u/	g**a**ŋ	‘crab’
			g**u**ŋ	‘cattle’
		/ə/	kakan**a**n	‘dining table’
			kakan**ə**n	‘food’
	/u/ vs	/ə/	quʎ**u**ŋ	‘color’
			quʎ**ə**ŋ	‘bundle’
		/o/	l**i**p**u**n	‘masculine name’
			l**i**p**o**n	‘Japan’

In addition to single vowels, vowel sequences of two different vowels were also attested. Internal vowel clusters are usually divided into different syllables, with a few cases of diphthongs, which belong to a single nucleus slot in the syllable structure. Vowel clusters in Paiwan are given in (4).

(4) Vowel clusters

a-series	au	ts**au**ts**au**	‘person’
	ai	k**ai**laŋan	‘stone mortar’
i-series	ia	c**ia**l̩	‘abdomen’
	iu	cəpuʌ**iu**l̩	‘hot spring’
u-series	ua	ɟ**ua**kits	‘to adhere’
	ui	k**ui**ɟi	‘leaf hat’
ə-series	əa	aʌavəv**əa**n	‘spring’

There are a few restrictions of which vowels may occur together as diphthongs. In a V_1V_2 sequence, V_2 must be a different vowel from V_1. When two vowels of the same phoneme occur adjacent to each other, the vowel sequence is phonetically realized as a single vowel without lengthening. Given that schwa never occurs in diphthongs, Northern and Southern Paiwan native vowels have a sonority scale in vowel sequences as follows: a > i, u. In other words, low vowels are more sonorous than high vowels. A-series vowel clusters are falling-sonority sequences, in which case the second vowel of the sequence usually becomes an off-glide at the word-final position, such as *qad<u>a</u>w* ‘sun’ and *qav<u>a</u>j* ‘millet cake’. In rising-sonority sequences /ia/ and /ua/, with the first vowel less sonorous than the second, the preceding high vowels are realized as prevocalic glides, as shown in *qaj<u>a</u>qaj<u>a</u>m* ‘bird’ and *u<u>wa</u>ts* ‘vessel’. However, a high vowel preceding or following a schwa cannot be realized as an off-glide or prevocalic glide in any phonological and phonetic environments. In Piuma Paiwan, vowel sonority affects the assignment of stress.

3.3 Syllables

The minimal Paiwan syllable consists of just a vowel, while the maximal syllable structure is CVVC, in which VV is a diphthong. The types of Paiwan syllables are exemplified in (5).

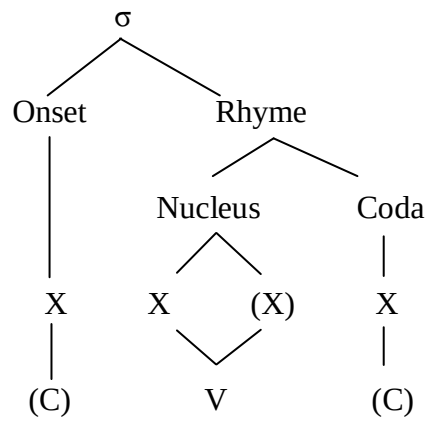
(5)

Syllable Type	Paiwan	Gloss
V	i	‘at/in’
VV	ui	‘yes’
CV	va	‘lung’
CVC	vat	‘husked rice’
CVVC	vaik	‘to go’

No CC onset cluster was found. VV- and VC-syllables are very restricted in Paiwan; they are either exclamations or colloquial expressions, and no more than five

words were found in each type. The metrical syllable structure of Paiwan is illustrated in (6), in which "σ" represents a syllable unit. Rhyme is independent, because both V and VV-syllables were found.

(6)



Any of the five Paiwan vowels may occur at the nucleus position, and any of the native consonants may occur in both onset and coda positions. Each single vowel or diphthong forms a syllable nucleus.

All of the possible consonant and vowel arrangements for monosyllabic words are illustrated in (7).

(7) Monosyllabic words

		σ		
	(C)	V (V)	(C)	
V		i		'at/in'
VC		i	s	'exclamation (of disgust)'
CV	s	a		'and'
CVC	p	u	k	'tree bean'
VV		ui		'yes'
CVV	v	au		'feminine name'
CVVC	ʎ	ua	ŋ	'cattle'

Polysyllabic words occur with a maximum of two consonants appearing in medial clusters. Such clusters always syllabify so that the initial consonant occurs as the coda of one syllable, and the second consonant occurs as the onset of the next syllable. The combination of syllable types in Paiwan disyllabic words is given in (8).

(8) Disyllabic words

	σ			σ			
	(C)	V (V)	(C)	(C)	V (V)	(C)	
V.CV		u		t	a		‘also’
V.CVC		i		ɟ	u	m	‘point’
CV.V	k	a			i		‘language’
CV.CV	k	ə		ɖ	i		‘few’
CV.VV	ɭ	i			au		‘many’
CV.CVV	p	a		d	ai		‘uncooked rice’
CV.CVC	v	ə		n	a	n	‘deer’
CV.CVVC	m	a		s	au	ŋ	‘to be bent down’
CVC.CVC	ʎ	u	s	p	i	t	‘thin’
CVC.CVV	q	u	ŋ	ts	ui		‘tobacco pipe’
CVV.CV	ts	au		b	u		‘straw hat’
CVV.CVC	c	ai		n	a	n	‘honeybee’
CVV.CVV	ts	au		ts	au		‘person’
CVV.CVVC	t	ai		t	ai	ʎ	‘one of the pair’

Diphthongs /au/, /ai/, /ui/ are phonetically realized as [aw], [aj], and [uj] at the syllable-final position, in which case glides [w] and [j] serve as the codas of the syllables. Thus, the surface syllable form CVG is allowed. On the other hand, /ui/ is realized as [wi] at the syllable-initial position, in which case the surface syllable form GVC is allowed.

3.4 Stress rules

A Paiwan word typically has a single primary stress in its elicitation form. Word stress usually falls on its penultimate syllable, when the word consists of a single root or derived suffixed forms. Roots, stems, and derivation forms in Paiwan can form a prosodic word to which stress can apply. In the present study, prosodic words consist of a stem plus a suffix sequence. A prosodic word usually carries independent components of meaning.

The penultimate position is the optimal parameter for stress assignment in Northern and Southern Paiwan. Main stress in Piuma Paiwan, on the other hand, falls on the penultimate syllable of a word, when the penult of the word does not have a schwa. If a word has a schwa in the penult, it will receive a final stress. A schwa syllable can bear stress only when it is the final syllable of a word, and the word has another schwa in the penult. Some examples are shown in (9).

(9)	Piuma Paiwan Word	Stress	Gloss
a.	/ σ σ́ /	tsəkə́ʌ	‘spouse’
b.	/ σ σ́ /	ɭəsə́q	‘tear’
c.	/ σ σ σ́ /	vətsəqə́ɭ	‘short necklace’
d.	/ σ σ σ σ́ /	quʌipəpə́	‘moth’
e.	/ σ σ σ σ σ́ /	qəzəməzəmə́c	‘night’

The weak quality of schwa was supported not only by its phonetic nature but also by its more restricted distribution than the other vowels in Paiwan. Schwa never appears word-initially as a single syllable. In V.CV syllable, the first V cannot be a schwa, e.g., *ita* ‘one’, *uta* ‘also’, *ata* ‘and’, but no *əta* (**əta*). In addition, schwa never occurs in diphthongs, as /ai/, /au/, /iu/, /ia/, /ua/, /ui/ were attested, but no sequences of /aə/, /uə/, /iə/, /əa/, /əi/, /əu/ were found. A schwa and its adjacent vowel must be assigned into different syllables. Further discussion about stress patterns in Paiwan can be found in Chen’s (2009) recent study.

Schwa does not affect the stress assignment in Northern and Southern Paiwan. Examples of contrastive stress patterns between Piuma Paiwan and Southern Paiwan are given in (10).

(10)	Word	Southern Stress	Piuma Stress	Gloss
a.	saɟəɭuŋ	saɟə́ɭuŋ	saɟəɭúŋ	‘heavy’
b.	kədᶎəməɭ	kədᶎə́məɭ	kədᶎəmə́ɭ	‘to know’
c.	kədᶎi	kə́dᶎi	kədᶎí	‘small’
d.	cəvəs	cə́vəs	cəvə́s	‘sugarcane’
e.	qasəɭu	qasə́ɭu	qasəɭú	‘pestle’
f.	ka-ɭəvə-ɭəv-an	kaɭəvəɭə́van	kaɭəvəɭəván	‘sky’
g.	s-əm-u-qəʌəv	səmuqə́ʌəv	səmuqəʌə́v	‘to open (a door)’

The metrical algorithm (cf. Hayes 1995) set up for penultimate stress in Northern and Southern Paiwan is presented in (11). It also applies to every possible prosodic word without a schwa penult in Piuma Paiwan. The symbol “#” represents the beginning or end of a word.

(11) Penultimate Stress in Paiwan Words

a. Foot Construction: Form syllabic trochee foot at the right edge

b. Word Layer Construction: End Rule Right

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

Words in (12) are generated by the rules shown in (11).

(12) a.

(x)	
(x)	
σ	
vát	
‘husked rice’	

b.

(x)	
(x .)	
σ σ	
pú ɖu	
‘kidney’	

c.

(x)		
(x .)		
σ σ σ		
pa ɭiŋ	uʌ	
‘surroundings’		

d.

(x)				
(x .)				
σ σ σ σ				
va cu ʌá	jan			
‘iron’				

e.

(x)					
(x .)					
σ σ σ σ σ					
ma ma zɑ	ŋí	ʌan			
‘chieftain’					

Diphthongs do not attract stress, and secondary stress was not attested in polysyllabic prosodic words of all the dialects investigated, including Northern Paiwan, Piuma Paiwan, and Southern Paiwan.

3.5 Alternation between glide /w/ and fricative /v/

The alternation between glides and fricatives was attested in Paiwan. More specifically, the alternation between /w/ and /v/ was found in all the Paiwan villages investigated in the current study. Earlier fieldwork reports on Paiwan (Ferrell 1982, Chang 2000) have agreed with the derivation from /w/ to /v/, but not from /v/ to /w/. Moreover, the alternation has been described as a free alternation in their reports. It has been found that in Piuma Paiwan, however, the phoneme /v/ consistently dominates the syllable coda slot in all the cases examined, in the word-final position, across morpheme and word boundaries. On the other hand, the glide /w/ in Southern Paiwan does not seem to alternate with the fricative in the word-final position or across word boundaries, but it consistently alternates with the fricative /v/ in suffixed words.

There are no restrictions on the distribution of the fricative /v/ in Paiwan, while the glide /w/ does not occur before a schwa. The distribution of the glide /w/ is more restricted, though it also occurs word-medially and word-finally. There are many cases of morphophonemic alternation between /w/ and /v/ in Paiwan. Some examples are illustrated in (13). In these examples, the symbol "#" indicates a lexical word boundary, whereas "-" indicates a morpheme boundary.

(13)	GLOSS	Piuma Paiwan	Southern Paiwan
a.	'drunk'	mapuɭav	mapuɭaw
	'I'm drunk.'	mapuɭav#aŋa#kən	mapuɭaw#aŋa#kən
b.	'thirsty'	mapusav	mapusaw
	'I'm thirsty.'	mapusav#aŋa#akən	mapusaw#aŋa#akən
c.	'many'	ɭiav	ɭiaw
	'many things'	ɭiav#a#nəmaŋa	ɭiaw#a#nəmaŋa
d.	'to wash'	səmənav	səmənaw
	'to wash bowls'	səmənav#ta#capaq	səmənaw#ta#capaq
e.	'fish'	tsiqav	tsiqaw
	'big fish'	tsiqav#a#qatsa	tsiqaw#a#qatsa
	'container for fish'	pu-tsiqav-an	pu-tsiqa**v**-an
f.	'tree'	kasiv	kasiw
	'tree!' (Imperative)	kasiv-u	kasi**v**-u
g.	'roof'	qaʌiv	qaʌiw
	'ceiling'	q-in-aʌiv-an	q-in-aʌi**v**-an
h.	'soup'	siav	siaw
	'soup-bowl'	pu-siav-an	pu-sia**v**-an
i.	'high'	vavav	vavaw
	'highest'	vava-vavav-an	vava-vava**v**-an

Shown in (13a-d), glide coda /w/ has become fricative /v/ in Piuma Paiwan. Fricative /v/ occurs in the word-final position after /i/ and /a/, whereas the glide /w/ does not occur word-finally in Piuma Paiwan. The labial glide becomes the labial fricative with or without suffixation in Piuma Paiwan. Examples in (13e) show the boundary contrast between lexical words and morphemes in Southern Paiwan. Examples in (13e-i) show the alternation between /w/ and /v/ in Southern Paiwan. The alternation between /w/ and /v/ occurs within a prosodic word, across a morpheme boundary but not across a lexical word boundary in Southern Paiwan. In Northern Paiwan, on the other hand, either /w/ or /v/ coda is acceptable in the roots or stems, but /v/ is the only legitimate segment after suffixation across a morpheme boundary

within a prosodic word. The sounds [w] and [v] are allophones in free variation when they follow /i/ or /a/ at the word-final position in Northern Paiwan. Yet, the alternation between [w] and [v] at the word-final position was not attested in Southern Paiwan. Rather, only the alternation between /w/ and /v/ within a prosodic word was attested in Southern Paiwan.

On the other hand, the alternation between /w/ and /v/ must occur in suffixed forms in Northern and Southern Paiwan. The alternation occurs when the glide is the second member of the diphthong only. The labial glide becomes the labial fricative when it follows /i/ or /a/ at the stem-final position followed by suffix morphemes beginning with a vowel within a prosodic word.

4. Evidence from empirical studies

As we have noted that Northern, Piuma, and Southern Paiwan have different numbers of consonantal segments, some distinctive features may be attested within a single marginal region but not another. Ho (1978) has pointed out the difficulties in mapping the phonemic distribution of /c/ and /ɟ/ in geographical terms. Ferrell (1982), on the other hand, noted that for centuries the Paiwan aborigines had been in contact with speakers of the other Austronesian languages such as Rukai and Puyuma to the north. He also noted that although Paiwan dialect divisions involved notably differences in realizations of the voiceless velar, uvular and glottal stop, and of trill and retroflex, Paiwan speakers from all areas communicated among themselves easily, despite regional variations in pronunciation. Nevertheless, the situation described in Ferrell's (1982) report has been changing rapidly, especially in innovative Paiwan villages. Nowadays the contact in the Paiwan area is not only with other Austronesian languages but also with Chinese or Taiwanese dialects, and younger generations do not speak the Paiwan language fluently and frequently. Various pronunciations have been found in some recent intermarriages in which the couples are from different regions of the Paiwan community and currently living in modern cities. The language of communication in these families is Mandarin, if the couples are not able to communicate with each other in Paiwan. Sound change has occurred, and younger Paiwan aborigines have been continuously producing phonetic varieties. The description of phonetic variation has become a necessity for a comprehensive phonology of Paiwan.

Anderson (1985) has made clear that the phonetic representation is more abstract than a physical record of an utterance. Keating (1985) also points out sound patterns can operate as abstract phonological rules, and she proposes three candidates for

inclusion in the set of phonetic universals—intrinsic vowel duration,[12] extrinsic vowel duration,[13] and voicing time. The three assumed phonetic universals are not automatic results of speech physiology. They are at least in part determined by language-specific rules. In the case of voicing time, for instance, none of the patterns found is universal, and the patterns are a key to the relation among physical motivation, phonetic rules, and the grammar. Later studies on sound patterns (Keating 1990, Pierrehumbert 1990, and Cho and Ladefoged 1999) have also revealed that there are language specific phonetic rules which must be part of the grammar of each language. Accordingly, certain categorical phonetic patterns associated with feature values and segmental structure in Paiwan should be accounted for here. The categorical phonetic representation could be the output of the phonology, or at least, part of the grammar of the Paiwan language.

Voice Onset Time (VOT) measures were taken for the voiceless non-aspirated stops. The purpose of the investigation of the Voice Onset Times (VOTs) is to support the description of consonantal phonemes and the variation among the dialects. The VOTs of voiceless stops in the word-initial position were examined in an effort to see how VOTs vary according to places of articulation and the different dialects (Northern, Piuma, and Southern Paiwan).

VOTs have been known to vary with different places of articulation, and it has been found that the further back the closure, the longer the VOT (Fischer-Jørgensen 1954 and Peterson and Lehiste 1960), and that the more extended the contact area, the longer the VOT (Stevens, Keyser, and Kawasaki 1986). The relative size of the supra-glottal cavity behind the point of constriction has been suggested to contribute to VOT differences (Maddieson 1997). In general, stops with a more extended articulatory contact have a longer VOT. The differences of the VOT have become parameters for the distinction of voiceless stops in laboratories and fieldwork.

There is a general tendency for the VOT to be longer when the closure for a stop is articulated further back in the vocal tract (Fischer-Jørgensen 1954, Cho and Ladefoged 1999, and Taff et al. 2001). If a VOT is affected by the distance between the open end of the vocal tract and the source of the compression, the VOT for a velar stop will tend to be longer than that for a bilabial stop, and the VOT for a uvular stop will tend to be longer than that for a velar stop. In other words, the VOT for a Paiwan uvular stop will be the longest among the voiceless stops as follows: uvular > velar >

[12] In most languages, low vowels such as [a] are longer than high vowels such as [i]. Though the similar pattern of intrinsic vowel durations is not a necessary one, general principles such as economy of effort and motor control must be more subtle than absolute mechanical constraints. Physical factors influence vowel duration, but they do not control it. For more discussion, see Keating (1985:118-120).

[13] General findings show that vowels are shorter before voiceless obstruents than before voiced obstruents or sonorants. Keating (1985) illustrates that a supposed phonetic universal is not in fact universally attested. Extrinsic vowel-duration patterning cannot be automatic or predictable.

palatal > alveolar, given that the parameter of the VOT is straightforward. Cho and Ladefoged (1999), however, have pointed out that the factors influencing the VOT vary from language to language. Although some differences in the VOT may be determined by aerodynamic factors, others simply reflect the behavior associated with a particular language, as studies on VOTs have revealed the inconsistent variation between the stops (Cho and Ladefoged 1999 and Taff et al. 2001).

Paiwan has bilabial, alveolar, palatal, velar and uvular stops. The VOTs of Paiwan stop consonants were investigated by reference to the words in Table 6. All the forms in Table 6 were attested in Piuma Paiwan and Southern Paiwan, whereas words with palatal and uvular stops were not attested in Northern Paiwan. Among the data collected from Northern Paiwan, only words with labial, alveolar and velar stops were measured. Words were recorded in isolation form, one repetition per item, with about 3 seconds of pause in between. Only tokens without background noise were taken for VOT measures.

Table 6. Words for the VOT investigation in Paiwan stop consonants[14]

CV	Paiwan	Gloss	Paiwan	Gloss	Paiwan	Gloss
pi	piku	'elbow'	pitsuɭ	'bamboo joint'	piqaj	'tumor'
pu	puk	'tree bean'	puq	'limestone'	pudək	'navel'
pa	padaj	'rice plant'	pana	'river'	paruk	'betel kernel'
pə	pənaŋuɭ	'to hit (with stick)'	pətsqi	'to defecate'	pəntəq	'to break'
ti	tima	'who'	tikaj	'maggot'	tidiv	'front tooth'
tu	tutsu	'now'	tutu	'breast'	tuvuʌ	'plow'
ta	tatsu	'clothing louse'	tataqan	'grind-stone'	takəts	'pygmy deer'
tə	təquŋ	'horn'	təʌar	'light'	tənvəɭa	'to answer'
ci	cigərav	'larynx'	ciŋaŋaɖuj	'lizard'	cikuraj	'pheasant'
cu	curuvu	'many (people)'	cuvu	'sprout'	cuguʌ	'tree name'
ca	cakit	'hunting knife'	caguʌ	'rock'	caʌitiw	'waterfall'

[14] The words in the table were collected in Piuma Paiwan. The segments /c/ and /q/ were not attested in Northern Paiwan, for /c/ and /q/ have become /t/ and /ʔ/ respectively in Northern Paiwan. The glottal stop /ʔ/ is usually invisible on the spectrographic displays, and it was therefore excluded from the examination.

cə	cəvus	'sugarcane'	cəvəs	'Zelkova tree'	cəvət	'short apron'
ki	kinsa	'cooked rice'	kina	'mother'	kipkip	'eyelashes'
ku	kutsu	'head louse'	kuku	'doggy'	kuka	'chicken'
ka	kapaz	'root'	kamuraw	'pomelo'	kasiv	'tree'
kə	kəɖi	'small'	kəviŋ	'scabies'	kəmuʃav	'to roast'
qi	qiʃas	'moon'	qipu	'earth'	qiri	'fish type'
qu	quɟaʃ	'rain'	quzu	'tendril'	quʃav	'color'
qa	qaʃits	'skin'	qavu	'ashes'	qatia	'salt'
qə	qətsap	'chopsticks'	qərəpus	'cloud'	qətim	'tree juice'

The recorded data were sampled at 20,000 Hz using the PCquirer spectral analysis system. The interval between the onset of the release burst and the first glottal pulse was measured on simultaneous waveform and spectrographic displays. A total of 312 elicitation tokens (60 x 4 speakers, plus 36 x 2 speakers) from six Paiwan native speakers (two speakers from Northern Paiwan, two speakers from Piuma Paiwan, and two speakers from Southern Paiwan were measured; for each dialect one female and one male were selected). The data were statistically analyzed by T-tests and two-factor ANOVAs.

The results are summarized in Figure 1 and Figure 2. Northern Paiwan tokens were separated from Piuma Paiwan and Southern Paiwan tokens in the figures, due to the merger of voiceless stops in Northern Paiwan. The VOTs for labial stops tend to be shorter than the other two stops in Northern Paiwan, as shown in Figure 1. One-factor analyses of variance have revealed that the effect of place was significant ($F [2,69]=38.77$, $p<0.0001$). In *post hoc* analyses, the labial stops were distinct from alveolar and velar stops at $p<0.0001$, and there was a significant VOT difference ($p<0.0001$) between alveolar and velar stops. No significant differences were found between the male and female speakers for each dialect.

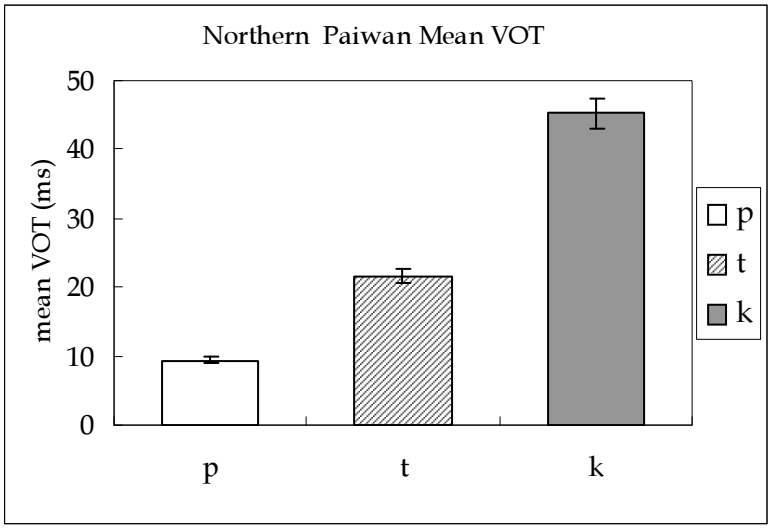


Figure 1. Mean VOT of Northern Paiwan stops

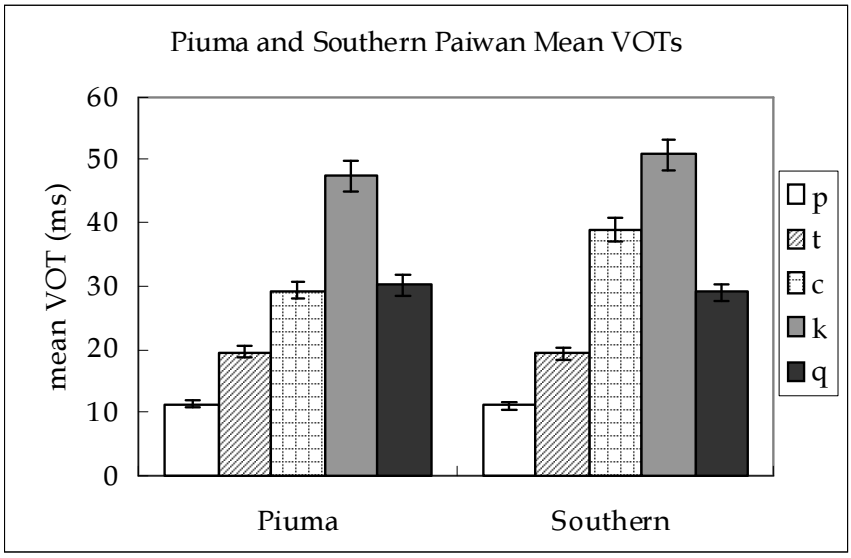


Figure 2. Mean VOT of Piuma and Southern Paiwan stops

On the other hand, the VOTs for labial stops tend to be shorter than the other four stops in Piuma and Southern Paiwan, as shown in Figure 2. ANOVA analyses of variance for each dialect have revealed that the effect of place was significant (Piuma Paiwan: $F[4,115]=83.49$, $p<0.0001$; Southern Paiwan: $F[4,115]=88.24$, $p<0.0001$). In *post hoc* analyses, the labial stops were distinct from alveolar, palatal, velar and uvular stops at $p<0.0001$, and there was significant VOT difference ($p<0.0001$) among alveolar, palatal and velar stops in Piuma Paiwan and Southern Paiwan.

The VOTs for palatal stops in Southern Paiwan are about 24% longer than those in Piuma Paiwan. Palatal stops are distinct from uvular stops at $p<0.0001$ in Southern Paiwan. In Piuma Paiwan, there was no significant VOT difference between palatal

and uvular stops. Yet, velar stops were distinct from uvular stops at $p<0.0001$ in both Piuma and Southern Paiwan. Among the Paiwan dialects, VOTs for velar stops in Northern Paiwan are the shortest and those in Southern Paiwan are the longest.

The results agree with the general observation that stops with back articulated closure such as /k/ and /q/ have longer VOTs than /p/ or /t/. While a significant difference ($p<0.0001$) was found among the voiceless stops in Northern and Southern Paiwan, no significant VOT difference was found between Piuma Paiwan and Southern Paiwan. The results indicate that phonologically Piuma Paiwan and Southern Paiwan villages tend to form a grouping, whereas one observes a more heterogeneous grouping of northern villages. Phonetically, the shorter contact area might result in a short VOT for uvulars in Paiwan. Yet, alveolar /t/ and palatal /c/ in Paiwan are not only two separate phonemes; they also have independent phonetic representations.

Cho and Ladefoged (1999) investigated VOTs in 18 languages, and they found that either velar or uvular stops had the longest VOTs in five languages that had contrasts between velar stops and uvular stops. In the Paiwan language, velar stops have the longest VOTs among the voiceless stops. However, Cho and Ladefoged (1999) found that the differences between bilabial stops and coronal stops were not significant. The present study has shown that the effect of place was significant among the Paiwan village dialects. It does not support Cho and Ladefoged's (1999) findings, as the differences between labial stops and coronal stops in Paiwan were significant. VOTs of the palatal stop /c/ were not included in Cho and Ladefoged's (1999) study and most of the studies on VOTs (Fischer-Jørgensen 1954 and Taff et al. 2001). The VOT measures of the palatal /c/ in the present study provide phonetic output of the Paiwan consonants and should be included in the specific components of the Paiwan grammar.

Another problem of documenting the Paiwan consonants is the transcription symbol *tj*. Many fieldworkers have adopted the symbol *tj* for the voiceless palatal stop *c*. The approximant /j/ has a high second formant (F2) like the high front vowel /i/ on the spectrogram (cf. Ladefoged 2003), and when F2 is the highest, the tongue is in the highest front position. Yet, the phonetic representation of an approximant does not occur in the spectrogram of [c], as shown in Figure 3. No vowel-like formant was found besides the release burst of the palatal stop in the figure. It is clear that the conventional transcription of the voiceless palatal stop as *tj* does not reflect the phonetic representation of the voiceless palatal stop *c*. The spectrogram supports the description of the consonantal phonemes in Section 3, and it also provides evidence for the independent representation of the voiceless palatal stop *c* in Paiwan.

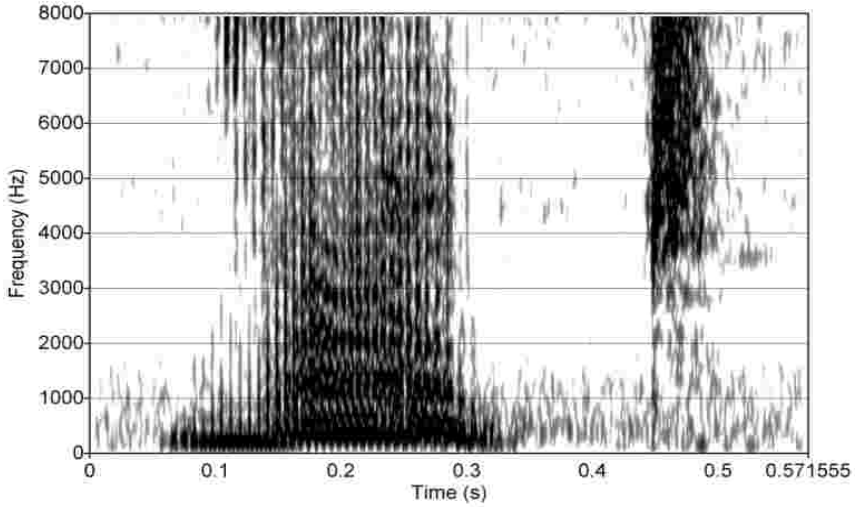


Figure 3. Example spectrogram of stop [c] in the word *vuc* 'squirrel'

5. Non-stress prosodic features

As far as documenting the Paiwan phonology is concerned, it is essential to include functional interpretations of prosodic features. Non-stress prosodic features were attested in the following categories: second person pronouns, proper nouns, and address forms. Canonical stress rules cannot account for the non-stress prosodic features reported here. Non-stress prosodic features were generally ignored in the majority of field reports, as none of the documentation in print has reported the special prosodic features in second person pronouns. Yet, the prosodic features are systematic and consistent among Paiwan speakers in Northern, Southern, and Piuma Paiwan villages. Non-stress prosodic features in address forms were attested in the village dialects. It represents not only the linguistic features of the language but also the cognitive space of the Paiwan speakers.

Generally speaking, stress patterns are predictable in Paiwan pronouns, as long as pronouns are treated as well-formed prosodic words. However, it has been observed that second person pronouns in Paiwan demonstrate different patterns of peak prominence from other categories of pronouns in the same context. The prosody in independent pronouns is shown in Table 7. In the following paradigm, "H" indicates a high tone. All the pronoun tokens were recorded in isolation.

Table 7. Paradigm of pronouns

Free Pronoun	**Nominative**	**Genitive**	**Accusative**
1sg	tiakən (σ́ σ)	niakən (σ́ σ)	canuakən (σ σ́ σ)
2sg	tisun (σ σ) | **H**	nisun (σ σ) | **H**	canusun (σ σ σ) | **H**
3sg	timaɟu (σ σ́ σ)	nimaɟu (σ σ́ σ)	caimaɟu (σ σ́ σ)
1pl (inclusive)	ticən (σ́ σ)	nicən (σ́ σ)	canuicən (σ σ́ σ)
1pl (exclusive)	tiamən (σ́ σ)	niamən (σ́ σ)	canuamən (σ σ́ σ)
2pl	timun (σ σ) | **H**	nimun (σ σ) | **H**	canumun (σ σ σ) | **H**
3pl	tiamaɟu (σ σ́ σ)	niamaɟu (σ σ́ σ)	caiamaɟu (σ σ σ́ σ)

As shown in Table 7, second person free pronouns in Paiwan, either singular or plural, have a high pitch accent falling on the final syllable, not the stressed syllable. The pitch accent attested here has something to do with the spatial concept of the Paiwan speakers. Second person pronouns were elicited as calling persons face-to-face. The words were not used when the recipients were not present. In other words, second person pronouns were treated as address forms, to call a listener or addressee with face-to-face distance from the speakers. Similar pitch accent was also attested in Paiwan proper names.

High pitch accent in address forms falls to the final syllable of the proper nouns or kinship terms, regardless of the quality of the vowel and the position of the stressed syllable. The assignment of the vocative accent occurs in the context where the face-to-face relationship between the speaker and the listener has been established.

Proper names and kinship terms of Piuma Paiwan with their address forms and vocative accent are illustrated in (14). In the following examples, shortening often occurs in diminutive forms.

(14) Paiwan Names	Address Form	Pitch Accent
a. Báɭis	Baɭis	Baɭís
b. Cəbəɭáŋ	Ibaŋ / əɭaŋ	Ibáŋ
c. ɭaváus	ɭavaus	ɭavaús
d. ɭúzəm	ɭuzəm	ɭuzəm
e. Zíbuɭ	Zibuɭ	Zibuɭ

f. Múni	Muni		Muni
g. Íl̩iŋ (=ə́l̩əŋ)	Il̩iŋ (=əl̩əŋ)		Il̩iŋ
h. Kikil̩əkíl̩au	Il̩au		Il̩au
i. Cal̩úbak	Ubak		Ubak
j. l̩úʌ́i	Uʌ́i		Uʌ́i
k. kína	ina	‘mother’	ina
l. káma	ama	‘father’	ama

Vocative pitch accent falls on the address forms in prosodic words. A syllable associated with a pitch accent at the right edge of a prosodic word is more prominent than any syllable that is not associated with a pitch accent. The high boundary tone at the right edge of the address forms is not an imperative accent. Imperative vocalic morphemes always follow verb stems, and the vocative high pitch accent occurs at the right edge of proper names or kinship terms in a vocative context. The examples of vocative accent in Paiwan address forms provide direct evidence for the important role of prosody in face-to-face interaction. A high pitch accent in address forms usually falls on the right edge of the prosodic word, regardless of the word stress in the proper names.

The vocative accent in second person pronouns, proper nouns, and address forms was attested in Paiwan discourse and everyday conversation. The phenomenon indicates that the vocative accent dealing with social relationships in Paiwan is observably transparent in Paiwan speech, from words to conversation. Paiwan speakers are very cautious about their mutual relationships in a tribal society. Much more information about the traditional culture of Paiwan and the interaction between the speakers has been revealed in narrative, discourse, and conversation. Prosody could be cohesive in Paiwan, as we have seen a number of contrastive and distinctive prosodic features. It is hoped that many more linguistic and paralinguistic patterns can be found.

Blevins (1993) investigates the nominal accent in Lithuanian and proposes a tonal analysis of the nominal accent. In her argument, the general status of diacritic accents is dubious. Accents are to be represented as underlying high tones in Standard Lithuanian. In the present paper, the Paiwan nouns were not classified into different classes, and the paradigm of the free pronouns in Paiwan has shown the special prosodic features of the second pronouns. By examining the high pitch accent in address forms and proper names, the relationship between the usage of the accent and the context has been established. Vocative accent in Paiwan occurs in face-to-face interaction, and it is related to the cognitive space of the Paiwan speakers.

Wolff’s (1993) work indicates that in Proto-Austronesian (PAN) the stress patterns

fell on the penult of the root if it was long (or accented) and on the final syllable of the root if the penult was short (or unaccented). His work implies the accent contrast on the last two syllables in PAN. Syntactic categories in Paiwan, however, do not trigger the high pitch prominence alignment at the right edge of a prosodic word. Contexts in face-to-face interaction trigger the high pitch prominence.

6. Conclusion

Phonetic details have long been considered irrelevant in the documentation of phonology. The majority of field reports on Formosan languages give rather minimal details on their prosodic properties, usually one or two lines of vague description. However, the present study has supported the argument that acoustic variables play a part in the documentation of stop consonants. The results have shown that alveolar /t/ and palatal /c/ in Paiwan are not only two separate phonemes but also have independent phonetic representations. The variation of VOTs should be taken into account in the documentation of phonemes.

The documentation of phonology and prosodic patterns of the Paiwan language is based on sound files. Instrumental studies were also conducted to verify the phonological description and show the phonetic representations of the sound patterns. In other words, both descriptive characteristics and empirical evidence were gathered in the study. There is no doubt that the documentation of prosody of an unknown language could never be accomplished without an exhaustive segmental phonology of the language. In the present study, dialectal variation among the Paiwan dialects has been described and verified. Prosody of Paiwan is built on phonological patterns of the language. With syllabic foot construction in a prosodic word, canonical stress patterns in Paiwan have been disclosed.

Li (1974) argues that reflexes of Formosan and Philippine languages for PAN *y and *w in the word-final position are mostly *y* and *w* respectively, while in the non-final positions their reflexes vary from approximants to fricatives or liquids. Li (1974) has concluded in his study that the simplest solution for the alternation between glides and fricatives or liquids is to treat glide approximants as the proto-phonemes, and derive historically all the various fricatives and liquids in the daughter languages. The Formosan languages under Li's (1974) examination have quite parallel developments for the two proto-phonemes, PAN *y and *w. The alternation between glides and fricatives in Paiwan indicates that village dialects of Paiwan have demonstrated different degrees of innovation in the daughter language.

The investigation on Paiwan pronouns and address forms has revealed that pitch accent on nouns has something to do with the spatial concept of the Paiwan speakers.

Address forms were not used when the recipients were not present. In fact, vocative accent in Paiwan occurs in words, sentences, and discourse. Canonical stress rules or cyclic phonological rules cannot account for the distribution of word-level prosodic features.

The phonological variations and phonetic representations reported in the paper should be taken into account in the documentation of phonemes of an indigenous language. Empirical studies are needed to verify the phonetic variation and phonological representations in a speech community with varieties. The comparison among the Paiwan village dialects has reinforced the understanding of the variation spreading within the Paiwan community. Phonetic representations are relevant to the documentation of phonology of the Paiwan language, and prosodic features might be crucial in the communication of the Paiwan speakers. The documentation of Paiwan phonology cannot be accomplished without the examination of the variations among the dialects and the description of the prosodic features in the village dialects. The documentation of the prosodic features in Paiwan will never be accomplished without an exhaustive segmental phonology of the language.

References

Anderson, Stephen. R. 1985. *Phonology in the Twentieth Century*. Chicago: University of Chicago Press.

Biber, Douglas, Susan Conrad, and Randi Reppen. 1998. *Corpus Linguistics: Investigating Language Structure and Use.* Cambridge: Cambridge University Press.

Blevins, Juliette. 1993. A tonal analysis of Lithuanian nominal accent. *Language* 69.2:237-273.

Blust, Robert. 1988. *Austronesian Root Theory: An Essay on the Limits of Morphology*. Philadelphia: John Benjamins Publishing Company.

Chang, Hsiu-Chuan. 2000. *Paiwan Yu Cankao Yufa* [*A Reference Grammar of Paiwan*]. Taipei: Yuanliu Publishing Co.

Chen, Chun-Mei. 2004. Phonetic structures of Paiwan. *Proceedings of the 11th Meeting of Austronesian Formal Linguistics Association (AFLA 11)*, 30-44. Berlin: Zentrum für Allgemeine Sprachwissenschaft, Typologie und Universalienforschung (ZAS).

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

Chen, Chun-Mei. 2009. The phonetics of Paiwan word-level prosody. *Language and*

Linguistics 10.3:593-625.

Cho, Taehong, and Peter Ladefoged. 1999. Variation and universals in VOT: Evidence from 18 languages. *Journal of Phonetics* 27.1:207-229.

Dahl, Otto Christian. 1973. *Proto-Austronesian.* Lund: Studentlitteratur.

Early, Robert, and John Whitehorn. 2003. *One Hundred Paiwan Texts.* Canberra: The Australian National University.

Ferrell, Raleigh. 1982. *Paiwan Dictionary*. Canberra: The Australian National University.

Fischer-Jørgensen, Eli. 1954. Acoustic analysis of stop consonants. *Miscellanea Phonetica* II:42-59.

Ford, Cecilia E., and Elizabeth Couper-Kuhlen. 2004. Conversation and phonetics: Essential connections. *Sound Patterns in Interaction: Cross-Linguistic Studies from Conversation*, ed. by Elizabeth Couper-Kuhlen and Cecilia E. Ford., 3-25. Amsterdam/Philadelphia: John Benjamins.

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

Ho, Dah-an. 1977. Paiwan yu Danlu fangyan de yinyun xitong [The phonological system of Butanglu: a Paiwan diaect]. *Bulletin of the Institute of History and Philology, Academia Sinica* 48.4:595-618.

Ho, Dah-an. 1978. Wu zhong Paiwan zu fangyan de chubu bijiao [A preliminary comparative study of five Paiwan dialects]. *Bulletin of the Institute of History and Philosophy, Academia Sinica*, 49.4:565-681.

Jefferson, Gail. 1985. An exercise in the transcription and analysis of laughter. *Handbook of Discourse Analysis*, Vol. 3, ed. by T. A. van Dijk, 25-34. London: Academic Press.

Keating, Patricia A. 1985. Universal phonetics and the organization of grammars. *Phonetic Linguistics: Essays in Honor of Peter Ladefoged*, ed. by Victoria A. Fromkin, 115-132. Orlando: Academic Press.

Keating, Patricia A. 1990. Phonetic representations in a generative grammar. *Journal of Phonetics* 18.3:321-334.

Kennedy, Graeme. 1998. *An Introduction to Corpus Linguistics.* Essex: Addison Wesley Longman Limited.

Ladefoged, Peter. 2003. *Phonetic Data Analysis: An Introduction to Fieldwork and Instrumental Techniques*. Malden: Blackwell Publisher.

Li, Paul Jen-Kuei. 1974. Alternation between semi-consonants and fricatives or liquids. *Oceanic Linguistics* 13.1-2:163-186.

Maddieson, Ian. 1997. Phonetic universals. *The Handbook of Phonetic Sciences*, ed. by J. Laver and W. J. Hardcastle, 619-639. Oxford: Blackwell.

Ogawa, Naoyoshi, and Erin Asai. 1935. *Gengo ni yoru Taiwan Takasagozaku Densetsushu* [*The Myths and Traditions of the Formosan Native Tribes*]. Taihoku: Taihoku Teikoku Daigaku.

Peterson, Gordon E., and Ilse Lehiste. 1960. Duration of syllable nuclei in English. *Journal of the Acoustical Society of America* 32.6:693-703.

Pierrehumbert, Janet. 1990. Phonological and phonetic representation. *Journal of Phonetics* 18.3:375-394.

Pulaluyan, Taligu. 2002. *Pinaiwanan* [*An Introduction to Paiwan*]. Taipei: Ting-An Lin.

Stevens, Kenneth N., Samuel J. Keyser, and Haruko Kawasaki. 1986. Toward a phonetic and phonological theory of redundant features. *Invariance and Variability in Speech Processes*, ed. by J. S. Perkell and D. H. Klatt, 426-463. New Jersey: Lawrence Erlbaum Associates.

Su, Jie-De. 1993. *Pingtung Xian Muyu Jiaocai: Paiwan Yu* [*Native Language Teaching Material of Pingtung County: Paiwan*]. Pingtung: Pingtung County Government.

Taff, Alice, Lorna Rozelle, Taehong Cho, Peter Ladefoged, Moses Dirks, and Jacob Wegelin. 2001. Phonetic structures of Aleut. *Journal of Phonetics* 29.3:231-271.

Tsuchida, Shigeru. 1981-1982. Investigation of Paiwan dialects. Ms. University of Tokyo.

Vizcaíno, María José García. 2007. Using oral corpora in contrastive studies of linguistic politeness. *Corpus Linguistics Beyond the Word: Corpus Research from Phrase to Discourse*, ed. by Eileen Fitzpatrick, 117-142. Amsterdam: Editions Rodopi B. V.

Wichmann, Anne. 2007. Corpora and spoken discourse. *Corpus Linguistics 25 Years on*, ed. by Roberta Facchinetti, 73-86. Amsterdam: Editions Rodopi B. V.

Wolff, John U. 1993. Proto-Austronesian stress. *Tonality in Austronesian Languages*, ed. by Jerold A. Edmondson and Kenneth J. Gregerson, 1-15. Honolulu: University of Hawaii Press.

Zorc, R. David. 1993. Overview of Austronesian and Philippine accent patterns. *Tonality in Austronesian Languages*, ed. by Jerold A. Edmondson and Kenneth J. Gregerson, 17-24. Honolulu: University of Hawaii Press.

[Received 29 September 2008; revised 25 April 2009; accepted 17 June 2009]

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

記錄排灣語音韻系統：
音段與非重音系統韻律特徵的議題

陳春美
國立中興大學

本文旨在探討記錄排灣語音韻系統的兩項議題，以及提出對於少數民族語言的實證分析。音段的實證研究支持語音聲學變因在記錄塞音中扮演部分角色的論點。濁音起始時間的變化在記錄音位時必須被列入考慮因素之一。在第二人稱與稱呼語上非重音系統的韻律特徵所表述的不但是排灣語語言形式上的特徵，也呈現排灣語使用者對於空間上的認知。實證研究在存有變體的語言社群中爲驗證語音變化與音韻表述的必要條件。排灣語的音韻系統記錄，必須調查檢視方言之間語音變化，方能完成。

關鍵詞：排灣語、音韻學、音段、非重音系統韻律特徵