EPENTHESIS, METATHESIS, AND VOWEL-GLIDE ALTERNATION: PROSODIC REFLEXES IN MABALAY ATAYAL

By

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ABSTRACT

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The Atayal language has had minimal analysis done at the prosodic level and that which has been done has merely been descriptive. Theoretically, former analyses of prosody have been carried out in a serial manner, dealing first with syllabification, then going on to analyze footing and stress assignment. This serial approach prevented the analyst from observing the causal relationship between footing and such prosodic reflexes as epenthesis, metathesis, and vowel-glide alternations, as seen in the Mabalay data. Those analysts who made the connection had no formal theory in which to express it. Optimality Theory, as set forth by Prince and Smolensky (1993) and McCarthy and Prince (1993a), approaches the problem from a parallelist perspective, allowing us to see the effects of integrated prosodic constraints directly on the surface forms. This research ties epenthesis, metathesis, and vowel-glide alternations together as prosodic reflexes predominantly of footing constraints. This Atayal dialect uses these as strategies to achieve its goal of forming a perfect iamb. Dialect comparison reveals a reranking of the constraints attains different target

structures. This fits with OT's basic assumption that constraints are universal and languages differ due to differences in ranking.

In dedication to my mom:

Together we ‘discovered’ the relationship between

the two things we loved most – music and language.

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Writing a thesis can be a big undertaking – a grueling task blessed with moments of exhilaration as one discovers the ' ... beauty and the logic in a world

that God designed' (Barbra Streisand, *Yentl*). I thank God for those moments and for any insight He has given.

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LIST OF ABBREVIATIONS AND SYMBOLS

#	word-final
σ	syllable
µ	mora
( )	foot
☞	Optimal candidate
☞ !!	Unattested, but chosen as optimal
(☞)	Attested candidate, but not optimal according to ranking
*	No ...
1P.EXCL.NOM	First person plural exclusive nominative
1S.GEN	First person singular genitive
2S.GEN	Second person singular genitive
2S.NOM	Second person singular nominative
3S.GEN	Third person singular genitive
BF	Beneficiary
BI	Bahasa Indonesian
C]	Coda
CAUSE	Causative
CL	Compensatory Lengthening
dB	Decibels
Eval	Evaluator
FUT	Future
GA	Generalized Alignment
Gen	Generator
Hz	Hertz
INTR	Intransitive
JUSS	Jussive
LIT.	literally
LOC	Locative
ms	milliseconds
NEG	Negator
OT	Optimality Theory
PA	Particle
PAT	Patient
PFV	Perfective aspect
Sel	Selayarese
TOP	Topic marker
TRANS	Transitive

CHAPTER 1

INTRODUCTION TO MABALAY ATAYAL

1.1 The Atayal Language Family

Like many people groups around the globe, the Atayal call themselves 'people'. This is what Atayal means. Spoken in the northern half of the mountainous areas of Taiwan, Atayal belongs to the Formosan branch of Austronesian languages. Atayalic, with a population of 89,743, is the first major subbranch of Formosan.[1] It consists of Atayal and Sediq. According to Chen (1958), 72% are Atayal speakers and 28% are Sediq. Sediq is too linguistically distant from Atayal to be considered the same language (Rau, 1992:3).

The Atayal language is further subdivided into Squliq and C'uli'[2] dialect groups. The Squliq dialects are all very similar to one another. The C'uli' dialects vary to a much greater degree (Li, 1980). C'uli' dialects are known to be more conservative than Squliq. Although Mabalay is not the most conservative of the C'uli' dialects, its syllable structure and stress assignment differs considerably from the more prestigious Squliq dialects. The dialects differ to a certain degree in their lexicons, and morphologically in their pronouns, as well

[1] The population statistic is according to the Taiwan Provincial Government Aboriginal Committee, 1997.

[2] Squliq is pronounced [səqoˈʒiəq]; C'uli' is pronounced as [saʔuˈʒiʔ] in the Mabalay dialect. It means 'other person /other people'.

as having phonological differences in phoneme inventory and allophones, syllable structure and stress assignment.

Mabalay[3] falls within the range of C'uli' dialects. It has the C'uli' pronouns, /ʃi/ (1s.Nom), /mu/ (1s.Gen), and /ʒaħaʔ/ (3p.Free Nom). It also has C'uli' vocabulary, such as the words listed in (1) below. Concerning C'uli' phonology, see §1.3.

(1) Distinctively C'uli' vocabulary in Mabalay

Squliq	C'uli'	
qani	ħani	this
qasa	ħasa	that
ŋtaʔ	wiʒoŋ	chicken
qħiyaŋ	ħaŋiʒiʔ	shoulder
ktuʔ	naßuas	belly
mihiy	mahiy	hit
muʔ	(sa)ßuʔ	shoot
saßiʒ	saßiʒiʔ	lunchbox

Naturally, dialects overlap. For one word from the distinctive vocabulary list (Li, 1985), Mabalay has the Squliq form; /mataʒaħ/ 'red'. The C'uli' form of this word is /matanaħ/. Recent research (Rau, 1998; 2000 forthcoming) which took lexicon, morphology, and phonology into account shows that the nature of the overlap in Atayalic dialects is a dialect chain. Dialects gradiently move from

[3] Li refers to Mabalay as Maspazi', but Maspazi' is the area, whereas Mabalay is the dialect name.

Sediq to C'uli' to Squliq. These are not so distinct as to form separate branches of a language family tree. More comparative work is needed to see the exact relationship of Mabalay to other dialects in order to state where it falls in the dialect chain.

1.2 My Language Associate: Taya Numin

My language associate for the duration of this research has been Taya Numin (Chinese name, Sun Ruilong). He is 60 years of age. He was born and grew up in Zhulin village, Wufeng county. He has lived in Taoshan village, Wufeng county, Hsinchu prefecture for 20 years. Both villages are in the Mabalay dialect area. His wife, Hili, from Jianshi village, Jianshi county, speaks a neighboring C'uli' dialect. Speakers of her dialect live as close as Chingchuan, the next village. Taya and Hili are raising three of their grandchildren. Both Atayal and Mandarin are spoken at home, but within their social circle they speak Atayal.

1.3 Mabalay Sound Inventory

From a phonological standpoint, Mabalay is for the most part a C'uli' dialect. It has the voiced fricatives, [ß] and [ɣ] rather than the Sediq stops, [b] and [g]. It lacks of the voiceless uvular stop /q/, having replaced it with [ʔ].

It also has [ʒ]. Apart from Mabalay, [ʒ] appears only in Squliq and Matabalay, a C'uli' dialect in Miaoli County (Li, 1980). Like the C'uli' dialects of Skikun and Mnawyan as well as Squliq dialects, Mabalay palatalizes /t/ before /i/, (Li, 1980:238). Mabalay is identifiable by its limited vowel inventory, /i, u, a/, and its use of diphthongs in any syllable. As Li (1980, 1982) found, Mabalay does not reduce its vowels to [ə] in pre-stress syllables. Li states that these vowels are 'replaced' by [a] in Maspazi' (Mabalay). I agree that the surface form is [a] in this dialect; however, since we do not see the vowel that [a] replaced or that reduced to [ə], I prefer to view these as epenthetic [a] ~ [ə].

1.3.1 Consonants

The consonant chart of the Mabalay dialect of Atayal is given Figure 1. If you are familiar with Atayal, you will notice that, unlike other dialects, there is no /q/. According to Li (1980:375), proto-Atayalic */q/ came to be realized as /ʔ/ in Mabalay. In cross-dialect comparison, /q/ of Squliq dialects is sometimes realized as /ʔ/ and at other times realized as /k/. Li explains that the /k/ had to have come by a round about borrowing of lexical words from Squliq dialects and not directly from the proto-language.

The set of alveolars is actually pronounced with the blade rather than with the tip of the tongue. I have, therefore, labeled them laminal-alveolars. /p/, /t/, /k/, and /ʔ/ are the voiceless stops. They have no voiced counterparts. /m/, /n/, and /ŋ/ are the nasals. The voiced fricatives are bilabial /ß/, palatal /ʒ/, and velar /ɣ/; the voiceless fricatives are laminal-alveolar /s/, velar /x/, and pharyngeal ħ/. Note that /s/ although a laminal-alveolar is still further forward than the voiced palatal, /ʒ/. The affricate, /ts/, is a rare phoneme, but as an allophone of /t/ it is fairly common. The liquids are the voiced fricative /ɮ/ and the flap /ɾ/. For my language associate, they both have a fricative quality. /y/ and /w/ are the approximants. A discussion will follow on the transcription of glides and high vowels.

There is some variation in pronunciation. /ɾ/ varies between being a flap and close approximant with a fricative quality. In the speech of younger speakers, [ɾ] is more likely a flap and may even be a trill. Likewise, [ß] is being replaced by [v]. [ß] is the conservative pronunciation, while [v] is the innovative replacement in the speech of younger speakers. Younger speakers also replace word final [$ɮ^n$] with [n].

	Labial	laminal-alveolar	palatal	velar	pharyngeal	glottal
plosive	p	t		k		ʔ
nasal	m	n		ŋ		
fricative	β		ʒ	ɣ		
		s		x	ħ	
affricate		ts [4]				
lateral		ɮ				
flap		ɾ				
approx			y	w		

Figure 1: Mabalay C'uli' Atayal Consonants

1.3.2 Consonantal Allophones

The voiceless stops and affricate have no aspiration word initially, but are lightly aspirated elsewhere. For example, /pstɑʒiɮ/ 'jump' is actually pronounced [pəʃ.t̠^{h}ɑ.ʒiɮ^{n}].

The voiced lateral fricative [ɮ] is realized with a nasal release word finally, [ɮ^{n}], for the older generation or simply as [n] for the younger generation. The two sounds were in free variation in my consultant's speech, with a preference for the conservative [ɮ^{n}]. Thus, the pronunciation of /knayriɮ/ 'young woman, female' is [ka̳nayriɮ̠^{n}] ~ [ka̳nayrin̠]. It is significant that it is the

[4] This phoneme was phonemic in only two words: [məntsowaiʔ] 'relatives' and [samaʔits] 'cut (hair)'. In all other cases it is an allophone of /t/. /t/ → [tɕ] /__ i . /t/ is in free variation with /c/ word-finally, but my language assistant would not accept [samaʔit].

nasal feature that is surviving as the other voiced fricatives, [ß], and [ɣ], are restricted from being in coda position. /ɮ/ seems to be aligning itself with them. However, unlike [ß] and [ɣ], it can still be a coda word internally, as in /m- aɮwatux/, which is pronounced as [maɮ̲.wa.tox] 'bark INTR'.

Unlike Li (1980) and Rau (1992), I did not find any cases where /p/ was a word final allophone of /ß/.[5] When I checked the words they gave as examples of [p] ~ [ß] alternation, the Mabalay word was either not a cognate or the underlying /ß/ had been reanalyzed as /p/.

Syllable finally, the voiced velar fricative, /ɣ/, is realized as [w] in order to satisfy the coda condition. For this reason, /ßħyaɣ-un/ 'chase PAT' is realized as [ßaħ.yɐ.ɣ̲ʊn], but its counterpart, /m-ßħyɑɣ/ 'chase INTR' is realized as [ma.ħɐ.yaw̲] ~ [mə.ħɐ.ʒaw̲].

[ʒ][6] is a commonly heard sound in the Mabalay dialect as it is not only a phoneme, but is also in free variation with /y/. While this is obviously the case

[5] In at least one word, we see that words ending in [ß] adjust to the coda condition by realizing [ß] as [w] word finally. This is evident in /ʔɑsuß/ 'divide '. It is pronounced as /w/ word finally, [mɑ-ʔɑsuw] 'divide INTR', but when suffixed by /-un/ [ß] surfaces. /ʔɑsuß-un / is pronounced [ʔɑsußun] 'divide LOC'.

[6] Actual IPA symbol is a voiced palatal fricative, [ʝ].

when /y/ appears before /i/, I maintain that it is also a phoneme in its own right since it can also appear before the back vowels in words such as [ßaʒuɑk] ‘pig’ and [ʒamʊiʔ] ‘shake’. The back vowels could not be conditioning palatalization. /y/ is realized as a palatal [ʒ] before a high front vowel. Before a mid vowel, /y/ may still have some fricative qualities and be pronounced as a very close [y̝],[7] perhaps even in free variation with [ʒ], but before a low vowel it is pronounced [y]. [ʒ] before low vowels is phonemic. Where no free variation has been noted, I will transcribe /y/ or /ʒ/ appropriately. Free variation I will transcribe as underlyingly /y/. Thus, /ʔayuŋ/ ‘soup’ is pronounced [ʔay̠oŋ] or [ʔaʒoŋ], /huʒiɮ/ ‘dog’ is always pronounced [ħoʒiɮ^{n}] ~ [ħoʒin], while /wayaɮ/ ‘ANTERIOR ASPECT MARKER’ remains [way̠aɮ^{n}] ~ [way̠an].

Palatalization also occurs when blade-alveolar /t/ is followed by a high front vowel or glide. In such a case, /t/ comes to be realized as the palatal affricate [t͡ɕ]. Thus, /tiuɣɑɮ/ ‘three’ comes to be realized as [t̠ɕ^{y}oɣaɮ^{n}], /mtisaɮ/ as [mət̠͡ɕ^{h}isaɮ^{n}]. Word finally, /t/ varies between being pronounced as a blade-alveolar affricate, [ts], or blade-alveolar stop, [t]. Word final

[7] The diacritic [y̝] indicates that [y] is raised higher than a typical [y] and, therefore, has a fricative quality.

[ts] occurs only at the end of a phonological phrase or in slower speech when phonological linking between words is absent. The two variant pronunciations of /paʔut/ ’ask’ are [paʔʊt̠s̠] and [paʔʊt̠].

Laminal-alveolar /s/ also undergoes slight palatalization when followed by a high front vowel or glide, moving back only as far as [ʃ]. It also pulls back to the [ʃ] position when filling a coda position. This can be noted in words like Maspazi’: /mspaʒi/ ‘Wufeng’ sounds like [maʃ̠.pa.ʒiʔ]. In ‘yesterday’ /saxisa/ there is no conditioning so the pronunciation is [s̠axis̠aʔ], but in /msiaʔ/ ‘laugh’ /s/ is palatalized by the following high front vowel and is pronounced [maʃiaʔ].

There is one point on which my language associate’s pronunciation differs from the Mabalay dialect analyzed by Li (1981:240-41). My consultant never produces [t] before /i/, but rather [tɕ] and word finally his [t] and [ts] vary in accordance with the phonological phrase boundary as stated above. These rules are both operative in neighboring Skikun. If this is due to dialectal influence, then my language assistant must have adopted the rule and not just borrowed a few words as his pronunciation is consistent.

The consonant phoneme inventory then is given in Figure 1. Along with it, the following allophones are present in the language: [v, ɹ̠ ~ r], which will vary with speakers age, and [p^{h}, t^{h}, k^{h}, ɮ^{n}, ʒ, tɕ, ts] and [ʃ].

1.3.3 Vowels

Mabalay has three phonemic vowels /i, a, u/[8] and the diphthongs /ai, au, ia, ua, ui/ and /iu/. Below are some examples of these phonemes:

(2)	[i]	paumin	'eyebrows'
		matsisaɮ^{n}	'chat, play'
	[u]	ʔuɾiʔ	'white hair'
		ʔuʒiy	'too, also'
	[a]	ʔaɮaʔiʔ	'child'
		patas	'tattoo'

These vocalic phonemes each have allophones. [i] is realized as [ə] or at least has a schwa on- or off-glide when in the same syllable as [ħ], as shown in (3).

(3)	/ħikuʔ/	[ħəkuʔ]	'elbow'
	/mħißuŋ/	[məħəɪßoŋ]	'yellow'
	/ħi/	[ħəiʔ]	'body'

[8] Li (1980) analyzes /e/ and /o/ as phonemic, but in Li 1981 analyzes them as allophones of /i/ and /u/. In very few words of Mabalay, [e] and [o] cannot be accounted for as allophones of /i/ and /u/. In such cases, the occurrences of [e] and[o] have come about by vowel coalescence. /ai/ can be realized as [e] and /au/ can be realized as [o]. I have not gone into the analysis of coalescence as it occurs only in certain lexical items in this dialect. It does not appear to be regular yet, but is in the process of change.

	/sußiħ/	[soßi<u>ə</u>ħ]	‘near’

/u/ is realized as /u/ in CV syllables and before glottal, as in (4), as /ʊ/ before a coronal coda, as in (5), and as [o] before velars and pharyngeal /ħ/, as in (6). The velar phonemes are pulling the high, back vowel lower.

(4)	/suxan/	[s<u>u</u>xan]	‘tomorrow’
	/puniʔ/	[p<u>u</u>niʔ]	‘fire’
	/su/	[s<u>u</u>ʔ]	‘you - 2S.GEN, 2S.NOM’
	/tukah/	[t<u>u</u>kɐħ]	‘hip’
(5)	/kamut/	[kam<u>ʊ</u>ts]	‘kill (by cutting)’
	/ßɮiħun/	[ßaɮiħ<u>ʊ</u>n]	‘door’
	/ɾauɮ/	[ɾa<u>ʊ</u>ɮ^{n}]	‘rake’
(6)	/tunux/	[tun<u>o</u>x]	‘head’
	/paɮaʔuħ/	[paɮaʔ<u>o</u>ħ]	‘white’
	/tahayɮuw/	[taħɐyɮ<u>o</u>w]	‘Chinese’
	/mħißuŋ/	[məħəiß<u>o</u>ŋ]	‘yellow’

The low vowel /a/ is realized as [ɐ] when it is in the same syllable as /ħ/. Thus, /mtɮaħ/ ‘red’ is pronounced [mətaɮ<u>ɐ</u>ħ].

The primary vowels, /i, a, and u/, are by far the most predominant vowels in the Mabalay dialect. The epenthetic vowel is /a/; it may be realized as [ɛ] before an alveolar consonant. The chart given in Figure 2 shows the phonemic vowels of Mabalay.

1.3.4 Diphthongs

The Mabalay dialect permits a complex nucleus in any syllable.

(7) [ßa.ɮa̲i̲ʔ] ‘good’
[ka.ħa̲u̲.niʔ] ‘tree, wood’
[sa̲i̲.nu.nox] ‘hair’

Other dialects contract the low rising diphthongs into a simple nucleus. Such vowel coalescence is rare in Mabalay, appearing in certain lexical items but not yet in a phonologically predictable manner. For comparative data, see Li (1980). Li (1980) and Egerod (1966) differ in how they transcribe the high vowels and semi-vowels. Egerod claimed there was no phonemic distinction and transcribed them all as vowels. Li argued from the viewpoint of syllable structure, pointing out that we can see the canonical syllable structure more clearly if we differentiate the vocalic syllable peaks from the consonantal margins.

I am following Li’s argument for the most part. However, Li transcribes the falling sonority diphthongs as vowel plus glide, except in final syllables where he transcribes them as diphthongs in his Maspazi’ data. For example, /la̲w̲ziʔ/ ‘eyes’ where I have transcribed it [ɮa̲u̲ʒiʔ]. The rising and equal sonority diphthongs are described by Li as two syllables with a hiatal glide. For example, the LOCATIVE form of [ħiɮiʔ̳] – /ħiɮi + an/ – Li transcribes as /hiliy̲án/ ‘accuse LOC’ (with an epenthetic hiatal glide), where I have transcribed it [ħiɮián]. I have chosen this transcription, first of all, because I do not hear any consonantal restriction between the two vowels. Even more significant, this transcription accounts for the stress always falling on /a/, even in falling sonority vowel sequences at morphemic boundaries. For example, my transcription of /ßakħa + un/ 'break PAT' is [ßakħáun], not [ßakħáwun]. Had I chosen [ßakħáwun], we would have problems with the stress assignment which is otherwise always on the final syllable in Mabalay. With the [ßakħáun] transcription, stress is consistent with the rest of the data, carried by the most sonorant of the two vowels in the final syllable. Alternatively, had I chosen to mix the two transcriptions, on the one hand transcribing rising vowel sequences /au/ or /ai/ as diphthongs (as I did in [ßakħáun] 'break PAT'), and on the other hand falling or equal height vowel sequences like /ia/ and /iu/ as /iya/ and /iyu/ (as Li did in [ħiʒiyún] 'accuse PAT'), although stress would be properly assigned, I would have trouble explaining why hiatal glides appear between vowels at morpheme boundaries in some cases, but not in others. The diphthong analysis handles the data more consistently for this dialect. The theoretical implications of this will be presented in §3.3.2.3.

(8)	[ai]	/ßais/	[ßais]	'accompany'
		/ßʒaiʔ/	[ßaʒaiʔ]	'good'
		/sainunux/	[sainunox]	'hair'
	[au]	/samauk/	[samauk]	'smell'
		/ħaußin/	[ħaußin]	'cut (meat)'

	/ħaur-un/	[ħaurʊn]	'hit (by car) PAT'
[ia]	/ʔɮiap/	[ʔaɮiap]	'hunt'
	/ʔsia/	[ʔaʃiaʔ]	'water'
	/ɾɣiax/	[ɾaɣiax]	'mountain'
[ua]	/ßaʒuak/	[ßaʒuak]	'pig'
	/tuaħi/	[t^{w}aħəiʔ]	'run back'[9]
	/ßuax/	[ßuax]	'rice'
	/ʒuaw/	[ʒuaw]	'thing, situation'
[ui]	/ʒamuiʔ/	[ʒamʊiʔ]	'shake, rock'
[iu]	/ɮɮiuŋ/	[ɮaɮioŋ]	'river'
	/tiuɣaɮ/	[tɕ^{y}oɣaɮ^{n}]	'three'

The two vowels of the final syllable diphthong are given equal weight; both seem moraic. Stress is carried on the most sonorant vowel, the low vowel /a/, as it has intrinsic prominence. When the diphthong consists of two high vowels, stress is usually placed on the back vowel, as in /ʒamuiʔ/ → [ʒamʊ́iʔ] 'shake, rock' and /ɮɮiuŋ/ → [ɮaɮióŋ] 'river'.

In word final position, -y or -w are possible codas. They are seen as glides rather than vowels underlyingly. In this way, all but a few functive words end in a coda. Thus, [tɕikay] 'a while' has an input of /tikay/, the input of [kinħɐtuy] 'stumble' is /kinħatuy/, and [ʔuɾaw] 'dirty' has an input form of /uraw/.

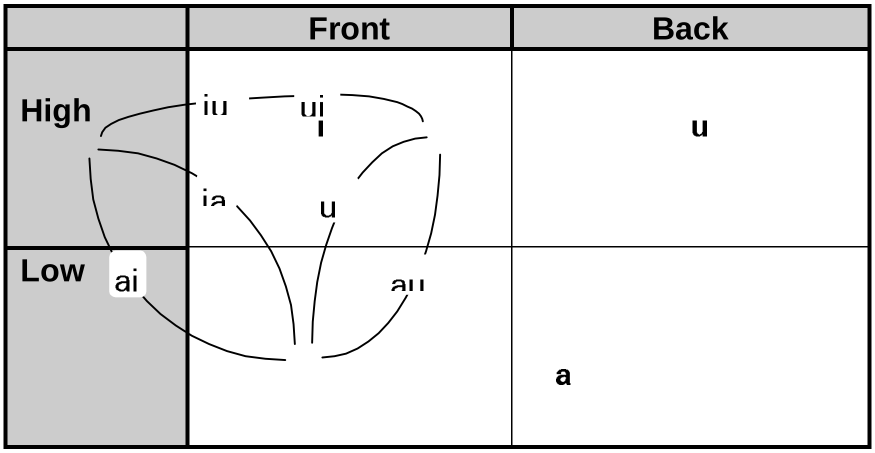


Figure 2: Mabalay C'uli' Atayal Vowels

The following phonetic and phonemic transcriptions will be used throughout the remainder of this paper.

(9) Orthographic, Phonemic and Phonetic Transcriptions

IPA	**Phonemic**	**Phonetic**	**Gloss**
i	/ima/	[ʔimaʔ]	'who'
a	/ɮaukaħ/	[ɮokaħ]	'strong'
u	/uɾi/	[ʔuɾiʔ]	'white hair'
ai	/ßais/	[ßais]	'accompany'
au	/samauk/	[samauk]	'smell'
ia	/ʔamɮiap/	[ʔamɮiap]	'hunt INTR'
ua	/ßuax/	[ßuax]	'rice'
iu	/ɮapiuŋ/	[ɮapioŋ]	'guests'
ui	/ʒmuiʔ/	[ʒamʊiʔ]	'shake'
p	/piɾai/	[piɾay]	'turn'
t	/pstaʒil/	[paʃ.t^{h}a.ʒiɮ^{n}]	'jump'
k	/kamut/	[kamʊts]	'kill'

[9] Diphthongs are realized as secondary articulation plus vowel when they occur in the penult. This has been verified on spectrogram. Spectrogram printouts can be seen in the appendix.

ʔ	/ʔɮaʔi/	[ʔaɮaʔiʔ]	‘child’
m	/musa/	[musaʔ]	‘go’
n	/naßuw/	[naßuw]	‘drink’
ŋ	/mŋiɮis/	[maŋiɮiʃ]	‘cry’
ts	/mntsuwaiʔ/	[məntsowaiʔ]	‘blood-relative’
ß	/mʔaßi/	[mʔaßiʔ]	‘sleep’
ʒ	/ßaʒuak/	[ßaʒuak]	‘pig’
ɮ	/ɮɮiuŋ/	[ɮaɮioŋ]	‘river’
ɣ	/ɣʔiɮuh/	[ɣaʔiɮʊħ]	‘banana’
s	/sainunux/	[sainunox]	‘hair’
x	/tunux/	[tunox]	‘head’
ħ	/ħuʒiɮ/	[ħoʒiɮ^{n}] ~ [ħoʒin]	‘dog’
ɾ	/ɾamaw/	[ɾamaw]	‘help’
w	/wayaɮ/	[wayaɮ]	‘gone’
y	/yaya/	[yayaʔ]	‘mother’

1.4 Mabalay Syllable Structure

In Mabalay Atayal, we see the following syllable shapes.

(10) CV inventory of Mabalay syllables:

CV	[pu.niʔ] ‘fire’, [ʔa.ɮ^{y}a.pun] ‘hunt PAT’, [ʔa.ɮa.ʔiʔ] ‘child’
	[k^{y}a.ɮun] ‘speak PAT’, [s^{w}a.yaɮ^{n}] ‘agree’
CVC	[bin.kis] ‘ancestors’, [puŋ] ‘hear’
CVVC	[ʔam.ɮiap][10] ‘hunt INTR’, [ʔuas] ‘song’, [ßak.ħaun] ‘break PAT’

All syllables have an onset. Onsets can be filled by a consonant with a secondarily articulated glide. In any syllable of the word, the nucleus can be filled by a single vowel or by a diphthong . Codas are permissible in all

[10] The difference between the diphthong and secondary articulation will be explained in §3.3.2.3. Secondary articulation occurs when the diphthong becomes penultimate due to suffixation.

syllables, but the penultimate syllable is usually light. /ß, ɤ, ʒ/ and /ɾ/ never form a coda. Lexical words, except for those with JUSSIVE suffix /-i/, end in a consonant.[11] Function words may or may not end in a consonant.

In the careful speech of wordlists, only nasals can form word internal codas. Apart from having diphthongs and an epenthetic /a/ instead of /ə/, the Mabalay syllables of careful speech are very much like those of other dialects. However, at a natural rate of speech, word internal codas are common. They include /p, t, k, ʔ, m, n, ŋ, s, ħ/ and /ɮ/. This analysis is based on the natural rate of speech as produced in text elicitation.

1.5 Mabalay Stress

In Mabalay, stress falls on the final syllable of the word. This has been verified in an acoustic analysis, to which the reader can refer in the appendix. In this respect, Mabalay differs from the Wulai dialect, where stress is on the penultimate syllable when the penultimate vowel is long (approximately 80% of the data); otherwise, stress is on the ultimate syllable, (Rau, 1992). The Taoyuan dialect also has long vowels, but they do not affect stress (Li, 1980). In Mabalay, there are no long vowels to affect stress.[12] Diphthongs are bimoraic,

[11] The JUSSIVE suffix, /-i/, may be followed by an epenthetic glottal, but not necessarily.

[12] Long vowels do occasionally surface in reduplication. For example, [s-am-papaːpak] 'noisy'.

but do not attract stress. They are treated as other syllables – stressed only when in the word final syllable – with stress carried on the most sonorant of the two vowels.

(11) [βe.ħʊ́y] 'wind (n.)'
[ɣam.náuʔ] 'joke INTR'
[ħɐ.mau.βí n] 'cut (meat) INTR'
[ma.ki.ʒ̊óħ] 'hot (weather) INTR'
[pin.sa.ʔu.nán] 'have been together PFV LOC'

The pronominal enclitics are generally not stressed. These are nominative and genitive pronouns which attach to the end of the first word of the verb phrase. Genitive pronouns likewise attach to the end of the first word of the noun phrase. These are not suffixes, but clitics. They are not part of the prosodic word and, therefore, do not enter into the footing and stress assignment at the prosodic word level. For an Optimality Theoretic analysis of clitics, refer to Selkirk, 1995.

1.6 Epenthesis versus Syncope and Reduction

In the analysis to follow, I take the view that some Atayal vowels are epenthetic. They do not appear in the input, but are supplied in the output due to prosodic constraints.

Egerod (1965) speaks of vowel reduction and deletion in Atayal, saying,

> Usually only the vowel in a non-final syllable is lost, but occasionally an extra reduced form is found with loss of vowel in the final syllable (1965:255).

Active	**Passive**	
biruʔ	bruan	write
tsiriq	triqan	fight
tehok	thkan	arrive

From his data one can see that his reference to ‘loss of vowel’ is actually to the reduction of a penultimate vowel to [ə] when it becomes antepenultimate due to suffixation. He is not speaking of deletion per se. In Mabalay Atayal, such vowels do not reduce, but keep their full vowel form. Thus, when I speak of epenthesis, I am not speaking of the same vowels that Egerod sees as reduced. The vowels to which I refer as epenthetic do not have an alternative full form. They are always realized as [a] in Mabalay and would be realized as [ə] in other dialects.

Li (1980) implies that [ə] is epenthetic, but in Li (1981) has changed his view to that of vowel reduction. The following quotes show his oscillating point of view.

A phonetic vowel [ə] occurs between consonants, e.g., /hpah/ [həpæh] 'flower', /bbuʔ/ [ßəßuʔ] 'jungle, bush', /qhniq/ [qəhəniəq] 'bird'. Since it is always predictable and never appears in the stressed syllable, it is treated as non-phonemic and hence not written in my transcription; here I follow Egerod. Hence we may get long consonant clusters in Squliq, i.e., /mspiʔ/ 'dream', /mqzinah/ 'run', /mspliq/ 'diarrhea' (Li, 1980:355).

A free form usually contains only one or two vowel nuclei in Squliq. A form with three vowel nuclei is rare (Li, 1980:357).

This implies that any other syllable peaks are epenthetic. Li's canonical forms – CCVC, CCCVC, CCCVCVC, and so on – also show that the vowel is absent from the input. However, in 1981, Li refers to this as vowel reduction instead.

All Sediq dialects share the same vowel-deletion rule before stress, which generally falls on the penultimate syllable. In fact, vowel-deletion or weakening in the unstressed syllables is a common phonological feature in the entire Atayalic group except for a few conservative dialects, such as Mayrinax and Matabalay (Li, 1981:239).

In general, all unstressed vowels before stress are reduced to the schwa [ə] in every dialect except Toŋan and Maspaziʔ ... in Maspaziʔ they are replaced by a vowel [a] (Li, 1981:239).

A phonetic vowel [ə] generally occurs between consonants in nearly every dialect in the entire group except Toŋan (Li, 1981:239).

I hold to the epenthetic view. The vowel is epenthetically supplied due to syllables needing peaks, not allowing consonant clusters, and permitting certain segments as word-internal syllable codas. The epenthetic site is further refined by footing constraints. The Atayal dialects differ in the epenthetic site due to differing constraints on the shape of the syllable and to differences in foot form – iambic versus trochaic.[13] Thus, many dialects have only CV syllables in the antepenult and more forward syllables of the word. Mabalay Atayal's broader acceptance of segments as word internal codas reduces the number of epenthetic nuclei needed in this dialect.

It seems that, dialectal differences aside, we agree on the surface form. It also appears that syncope versus epenthesis has not been an issue of former discussion. Vowels that appear in one dialect but not in another, such as [mə̳.sə̳.ɮo.ħəy] 'landslide' (Taoyuan dialect) versus [ma̳ʃ.ɮo.ħəy] 'landslide' (Mabalay dialect), or in one morphological form of a word and not in another, such as [ka̳tariʔ] 'kneel (INTR) and [k-in-tariʔ] 'kneel (PFV)', have not entered into previous analyses. In such cases, I find epenthesis to be the better analysis.

If it were syncope rather than epenthesis, there would be no motivation behind a rule causing the vowel to delete when the word is infixed. Why not have words like *[pina̳ɣián] 'dry (clothes)'? *[pi.(na.ɣián)] forms a perfect iamb,

[13] Differences in foot form may be what is causing vowel coalescence in the final syllable of Squliq dialects, see Li, 1981. More research is needed.

but [pin(ɣián)], the attested form, does not.[14] Why delete (violating Max, in OT terms) and yet not achieve the ideal foot form?

An alternative analysis might place the infix after /a/, as in *[pa̲in.ɣián]. It could then be posited that syncope occurs because a tri-moraic syllable has been formed; syncope then results in the attested output, [pin.(ɣián)]. The problem with this is that this infixation position goes against OT theory. The prefix chose an infixed position to gain the onset and does not need to infix any further into the word. Violations must be minimal. Otherwise, they are sure to prove fatal.

Epenthesis	**Infixed form**	
ßa̳ħaʔ-an	ß-in-ħaʔ-an PFV	'wash (clothes)'
pa̳ɣi-an	p-in-ɣi-an PFV	'dry (clothes)'
ka̳tariʔ	k-in-tariʔ PFV	'kneel'
sa̳puħ-i	s-in-puħ-an PFV	'sweep'
ka̳ʒkaħ-iʔ̳ JUSS	k-am-ʒa̳kaħ	'kick'[15]

A further argument in favor of epenthesis has to do with vowel quality. Syncope could delete a vowel of any quality, /i, u, a/, but the 'deleted' vowel in

[14] Arguments for iambic footing in Mabalay will be presented in §3.2. Not all Atayal dialects have iambic footing as we see in Chapter 4 on Dialectal Comparison.

[15] [kamʒakaħ] 'kick INTR' and [kaʒkahiʔ] 'kick JUSSIVE' may actually be better viewed as having a~ʒ metathesis. This would also work in the final grammar, but for the sake of argument at the syllable level, I posit an underlying stem form of /kʒkaħ/.

Mabalay is always /a /. Epenthesis, on the other hand, always inserts a vowel of the same quality. Mabalay has chosen /a/ to be the default epenthetic vowel.

All examples of possible syncope were accompanied by epenthesis. The position of the inserted and deleted vowels is such that all the syncope / epenthesis data can be interpreted as metathesis.

Optimality Theory is very output oriented. Regardless of the input, the constraints will produce the same surface form. This is why borrowed words whose input can differ significantly from the native words of a language will still be output so as to adhere to the native language constraints. For this reason, the constraints will produce the same output form whether a segment is considered epenthetic or part of the input form. Thus, the input forms /ßʒuak/ and /ßaʒuak/ will both give an output of [ßaʒuák] 'wild pig'. The prosodic constraints make well-formed syllables and feet their target.

1.7 Affixation

1.7.1 Suffixation

Mabalay has prefixes, infixes, and suffixes. The suffix attaches to the end of the verb root, making the suffix part of the prosodic word. As the final syllable in the prosodic word, it receives stress. The suffixes referred to in this paper include /-an/ LOCATION focus on transitive verbs (and nominalizer), /-un/ PATIENT focus on transitive verbs, and /-i/ JUSSIVE[16].

(12) Suffixes:

/sħaŋ + an/	[saħaŋan]	'catch up LOC'
/ßaitaʔ + an/	[ßaitaʔan]	'kill (by stabbing)'
/ʔras + un/	[rasʊn]	'take PAT'
/ßaʔ + un/	[ßaʔʊn]	'know PAT'
/ßu + i/	[ʔiniʔ ßuy witox]	'NEG shine-JUSS sun' (The sun is not shining.)
/puŋ + i/	[ʔiniʔ mu puŋi]	'NEG 1S.GEN hear-JUSS' (I did not hear it.)

1.7.2 Prefixation

Prefixes attach to the beginning of the word becoming part of the prosodic word. The prefixes referred to in this paper include /m-/ INTRANSITIVE, /s-/ INSTRUMENTAL (BENEFACTIVE), /p-/ FUTURE / INTENTION, /p-/ CAUSATIVE, /n-/ PERFECTIVE, and verb forming /k-/.

(13) Prefixes:

/m- sɣɣay/	[maʃɣaɣay]	'part from each other'
/s- ßaʔ -i/	[saßaʔi]	'BF-know = teach'

[16] JUSSIVE refers to the morphemic form used for imperatives. Quite often the same form is used for more than just imperatives as is the case in Atayal – the same /-i/ form is used in negative constructions. JUSSIVE then is the more inclusive term. See Lyons, 1977.

/p- ʔuas/	[p̲aʔuas]	'FUT-sing'
/p- ʔabi -un/	[p̲aʔaßiʊn]	'CAUSE-sleep-PAT'
/n- ʔuaħ -an/	[n̲ʷaħan]	'PFV-come-LOC'[17]
/k- ßaʒaiʔ/	[k̲aßaʒaiʔ]	'make, build, repair'

1.7.3 Infixation

Atayal infixes include 'INTRANSITIVE' /-am-/ and 'PERFECTIVE' /-in-/ ~ /-an-/. /-an-/ appears to be an allophone of /-in-/; generally, /-in-/ appears before consonants and /-an-/ appears before vowels. Infixes appear immediately after the first consonant of the word, even if that consonant is itself an affix.

In Optimality Theory, infixes are actually prefixes that are infixed after the initial consonant for prosodic reasons. The vowel initial prefix is in need of an onset. Infixation is the solution Atayal chooses to resolve the problem of an onsetless prefix. For a detailed analysis of infix placement in OT, see McCarthy and Prince, 1993b.

(14) Infixes

/in- + pħapuy/	[pi̲n̲ħɐpuy]	'cook-PFV'
/in- + pksius/	[pi̲n̲kaʃius]	'stir-fry-PFV'
/an- + kaniʔ/	[ka̲n̲aniʔ]	'eat-PFV'
/an- + kat/	[ka̲n̲ats]	'bite-PFV'

[17] The underlying form has a stem initial glottal which undergoes stem initial consonant loss. If analyzed as /waħ/, a prefixed /m-/ would result in [ma̳waħ].

/am- + ɣiaħ/	[ɣamiɐħ]	'open, turn on-INTR'
/am- + ʔiuw/	[ʔamiow]	'change, become-INTR'

In this analysis, /m-/ and /am-/ are viewed as separate morphemes even though both mark the verb as morphologically intransitive. While most verbs take one or the other, some verbs take either with a slight difference in meaning. In general, /m-/ is used with stative verbs and infixed /am-/ involves more participants and is more dynamic, but these categories are not sharply defined (Rau, 1992). Some verbs that regularly take the infixed form, such as ħamiɮiʔ 'accuse sb', take the prefix /m-/ when using partial reduplication; maħaħiɮiʔ 'make accusations back and forth'. I've also noted that dialects often differ on which intransitive marker is chosen. Where Squliq takes one form, Mabalay may take the other.

(15)

Squliq (Li, 1980)	Mabalay	
mħiɮiʔ	ħɐmiɮiʔ	'accuse'
mʒuiʔ	ʒamʊiʔ	'shake, rock'
msuyap	ʔamsuyap	'yawn'
ħmimuq	maħəimuʔ	'lick'
smʔasiy	maʃʔaʃiey	'cough'
smɣaɣay	maʃɣaɣay	'farewell'

This would indicate that there is no semantic difference between the two forms. However, since there is no phonological way to determine which form to use, I have treated them as separated morphemes and supplied the correct form in the input.

1.8 Organization of the Thesis

This concludes our introduction to the Mabalay dialect of C'uli' Atayal. Chapter 2 reviews the literature on epenthesis, metathesis, and vowel glide alternations – the phonological reflexes of prosody in Mabalay. Chapter 3 is the core analysis. In it, we will first see how much can be accounted for at a syllable level of prosody, then move on to the next higher prosodic level of footing. We will find that this higher level of analysis is necessary to account for the phonological phenomenon we see in the data. Chapter 4 makes a preliminary dialectal comparison of two Squliq dialects with Mabalay. In chapter 5, I will highlight the significant points of this study and discuss their implications. The appendix gives an acoustic analysis of Mabalay stress.

CHAPTER 2

A REVIEW OF THE LITERATURE

2. Introduction

The main focus of this thesis is to unify what has been seen as three separate processes – epenthesis, metathesis, and vowel-glide alternation – under prosodic theory. Not wanting to write in a vacuum, I will first review how former theories have analyzed these phonological phenomena. Having reviewed the theoretical development pertaining to their analysis, we will then introduce the theory within which this study is framed, Optimality Theory as presented by Prince and Smolensky (1993), and McCarthy and Prince (1993a).

In this chapter, I discuss the former approaches to epenthesis, metathesis, and vowel-glide alternations in §2.1, focusing on work by Broselow (1982), Itô (1986, 1989), Ultan (1971), Hock (1985), Besnier (1987), Kenstowicz et al (1979), and Hayes (1989). In §2.2 some OT analyses of epenthesis, metathesis and vowel-glide alternations are reviewed. In §2.2.1 we see how Prince and Smolensky (1993) and Broselow (1999) analyze the interaction of epenthesis with footing. We also review Mester and Padgett's (1994) use of OT to mimic the effects of Itô's (1989) directional syllabification. §2.2.2 overviews McCarthy's (1995) OT analysis of metathesis in Rotuman. §2.2.3 reviews Rosenthall's (1997) analysis of vowel-glide sequences. §2.3 presents an outline of Optimality Theory and some commonly used correspondence and markedness constraints. The sub-theories of Correspondence and Generalized Alignment are also introduced.

2.1 Former Approaches to Epenthesis, Metathesis, and Vowel-Glide Alternation

We will now review former analyses of epenthesis, metathesis, and vowel-glide alternations as these are the phenomena we see in the Mabalay Atayal data, as in:

(a) Epenthesis: /ßħaʔ -an/ → [ßa̳ħaʔan] 'wash (clothes)'
(b) Metathesis: /p- $k_1a_2$niʔ -i/→ [p$a_2k_1$niʔi] 'CAUSE-eat-JUSS'
(c) Vowel-Glide Alternation: /psiaʔ -an/ → [paʃ^{y}aʔan] 'funny'

These analyses, which show the progression of theoretical thought which has lead up to the development of Optimality Theory, reveal the weakpoints of the former theories and the superiority of OT.

2.1.1 Epenthesis

2.1.1.1 Linear Theory

As we take a look at the history of how phonological theories have analyzed epenthesis, we find that generative phonology first dealt with it by linear rules, as shown in (16).

(16) $\varnothing \rightarrow ə$ / C __ C 'Insert a schwa between two consonants.'

(16) would be a typical epenthesis rule. The rules were ordered arbitrarily before or after syllabification. Later skeletal rules such as (17),

(17) $\varnothing \rightarrow$ V / C$^{|}$__ 'Insert a vowel after a stray consonant.'

removed some redundancy by supplying the melody later through default rules. The reference to the stray consonant implies prior syllabification. Syllabification was seen as a process that could apply cyclically. There was no connection made between epenthesis and prosody, largely because the syllable was seen as part of the linear string of segments in a CV skeleton and not as a unit of prosody. McCarthy (1979) argued for continuous syllabification which led to greater insight concerning the interconnectedness of epenthesis and syllabification. Still, skeletal rule epenthesis was not intrinsically connected to syllabification. There was no theoretical way to motivate or block the processes. The theory was unrestrained; due to the arbitrary nature of linear rules, it predicted unattested types of epenthesis. Rules such as (18),

(18) $\varnothing \rightarrow$ C / C$^{|}$__ 'Insert a consonant after a stray consonant.'

are intuitively unnatural. After all, the consonant is unsyllabified because it needs a nucleus, so why insert a consonant? Though intuitively unnatural, such rules were entirely possible theoretically. The skeletal rules needed additional filters to prohibit these unnatural rules. For a while we relied on Goldsmith's (1976) No-Crossing constraint to prohibit epenthesis into geminates. Geminates, it claimed, were doubly linked and could, therefore, not be split by epenthesis. While geminate integrity[18] is unquestioned, No-Crossing has come under attack as a viable explanation of it. In non-concatinative phonology, vowels and consonants are on separate tiers (McCarthy, 1979). It follows then that an epenthetic vowel placed between doubly linked consonants would not cross any association lines. Adherence to the No-Crossing constraint demanded a further process of tier conflation to explain geminate integrity. Even apart from separated tiers, in an analysis where vowels and consonants are on the same tier, double linking could not actually block insertion of a bare V-slot. Without a 'look-ahead' ability at the problems this would later present when the melody would be supplied by default rules, epenthesis into geminates could not be blocked. Such filters were good observations, but they lacked explanatory force in that they did not follow from skeletal rule theory.

2.1.1.2 Broselow (1982)

As a great improvement on linear phonology, proposals were made all of which connected epenthesis to syllabification (Selkirk, 1981; Broselow, 1982; Lapointe and Feinstein 1982; and Itô 1986). Broselow (1982) was one step ahead of the rest. She had the insight that there are three kinds of epenthesis; epenthesis can be syllabically, metrically, or segmentally conditioned.

[18] This term was first used by Hayes, 1986.

Syllabically conditioned epenthesis is epenthesis that provides a nucleus for a degenerate syllable. In Broselow's approach, the underlying form was syllabified but had some empty surface slots. Syllabic epenthesis inserted the missing melody. Segmentally conditioned epenthesis is epenthesis that is required to keep two incompatible segments apart. Metrically conditioned epenthesis builds on the syllable – since syllables are at a lower level of the prosodic hierarchy, metrically conditioned epenthesis will not form a degenerate syllable – but the syllable formed by epenthesis needs to fit into higher prosodic units as well, in particular, the foot. When feet are quantity sensitive, epenthesis can be called on to produce a light syllable in the unstressed syllable of the foot.

2.1.1.3 Itô (1986)

Itô (1986, 1989) developed syllable theory which brought the syllable into the realm of prosody. As such, it would have to be licensed by higher levels of prosody. Syllable Theory states syllables make up the level of the prosodic hierarchy immediately dominated by the foot. Each language has a syllable template that is based on universal principles of wellformedness. These include sonority, nucleus, the onset principle, and the coda filter.

Syllable theory integrated syllables and syllabification with the prosodic principles of maximality, directionality, prosodic licensing and extraprosodicity. Maximality states that units are of maximal size within the constraints on their form. Thus, if a language stipulated a syllable template that included the possibility of a coda, then in the process of syllabification an available segment that would make a suitable coda should be syllabified as such.

Directionality, as I have mentioned, is a parameter set by the language at either right-to-left or left-to-right. In terms of Selkirk's (1981) Onset/Rime parameter setting, which Itô opposed, right-to-left syllabification maximizes the onset while left-to-right syllabification maximizes the rime, or coda. The Cairene and Iraqi Arabic templates allow CV(V)C syllables. When the R-L syllabification of Cairene Arabic is applied to a $CVC_1C_2C_3VC$ sequence, it results in $CVC_1.C_2\underline{\underline{V}}.C_3VC$, syllabifying C_2 as an onset. In terms of an Onset/Rime parameter setting, the unsyllabified C_2 could have been either a coda or an onset, but the Cairene dialect, having set the parameter to Onset, would also syllabify C_2 as an onset. Alternatively, the Iraqi dialect, which sets the parameter at Rime, would syllabify C_2 as a coda. By switching to L-R directional syllabification and applying it to the same underlying form, the same result, $CV.C_1\underline{\underline{V}}C_2.C_3VC$, can be obtained. Itô pointed out that the difference between the Onset/Rime parameter and the directionality parameter becomes obvious when the two theories are applied to quadriconsonantal clusters. The Onset/Rime parameter setting cannot decide between a surface form with singular epenthesis, as in (19a), and double epenthesis, as in (19b).[19]

[19] Broselow (1992:21) argues for the Onset/Rime analysis. In its favor, she points out that directional syllabification fails to make correct predictions about where the epenthetic site will be when consonant clusters are at word edges, but the Onset/Rime analysis can.

(19) (a) $\mathrm{CVC_1.C_2\underline{\underline{V}}C_3.C_4VC}$

(b) $\mathrm{CVC_1.C_2\underline{\underline{V}}C_3\underline{\underline{V}}.C_4VC}$

Selkirk (1981) had to invoke a principle of Syllable Number Minimization to produce the correct output of singular epenthesis in both dialects. Directionality and Maximality, on the other hand, correctly choose singular epenthesis regardless of the direction. According to Itô, Selkirk's Onset/Rime parameter 'insightfully capture[d] the cross-linguistic pattern whereby each epenthetic vowel rescues as many consonants as possible,' (Itô, 1989: 243). But to Itô, Syllable Number Minimization was merely the outcome of Maximality.

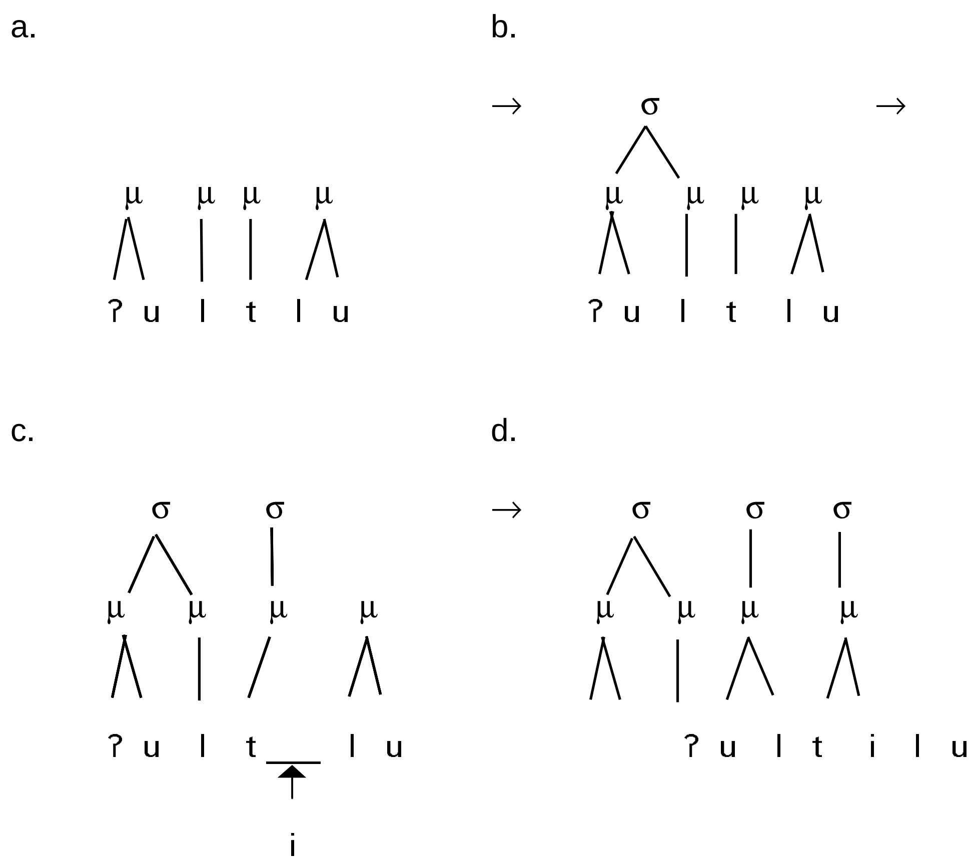
> Locally maximizing each prosodic constituent turns out to be equivalent to globally minimizing the overall number of constituents of that type in a given string (Itô, 1989:247).

Prosodic Licensing states that the mora is part of a syllable, a syllable is part of a foot, and a foot is part of a prosodic word. Since every unit must be licensed by being included in the next higher level of the prosodic hierarchy, this principle ensured exhaustive syllabification.

Itô saw Maximality and Directionality as key principles necessary for the accurate prediction of the epenthetic site. In 1986, she presented a prosodic theory of epenthesis accounting for epenthesis by forming a syllable template and applying it directionally either from left to right or from right to left to syllabify a word as the language had set the directionality parameter. Degenerate syllables then required epenthesis to produce an acceptable surface form.

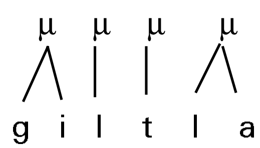
Itô exemplified the process of directional syllabification on two dialects of Arabic. From a CVCCCV underlying form, Cairene Arabic produced a CVC.CV.CV surface form while Iraqi Arabic produced CV.CVC.CV. This is attributed to a difference in the directional setting. Cairene Arabic set the parameter at Left-to-Right syllabification while Iraqi Arabic set it at Right-to-Left. The syllabification process is diagrammed below:

(20) Cairene (Left-to Right Syllabification): [ʔultilu] ‘I said to him’
(Itô, 1989:247)

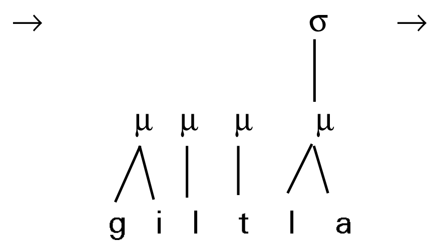


(21) Iraqi Arabic (Right-to-Left Syllabification): [gilitla] ‘I said to him’
(Itô, 1989:246)

a.



b.



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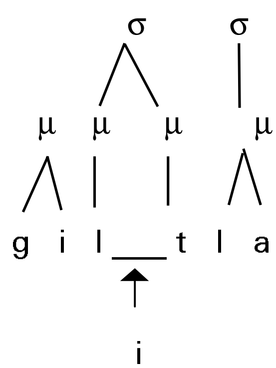
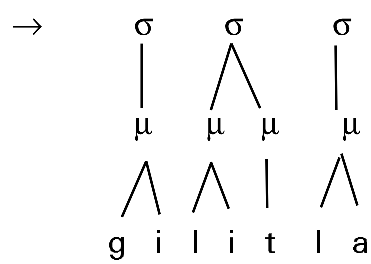


d.



2.1.1.4 Critique

Itô relied on the Directionality parameter because it was independently required in stress theory, root-and-pattern morphology, and reduplication. It correctly predicted the epenthetic site.[20] Pragmatically, it works, but it is not without problems.

One problem with Itô's directional syllabification is that it assigns moraic weight to the onset – the onset and nucleus share the same mora, yet onsets are generally understood to be non-moraic (Hayes, 1989). If the onset were linked directly to the syllable rather than the mora, the theory would have to assume a 'one syllable look-ahead' ability during the syllabification process. It seems that this is what Itô was trying to avoid.

A second problem pointed out by Broselow (1992) is that while accurately predicting the epenthetic site, it did so without paying attention to stress placement. Directional syllabification in Iraqi and Syrian Arabic can produce a heavy penult, yet place stress on the light antepenult. Normally, a heavy syllable would attract stress in these languages. This problem results from attempting to understand epenthesis apart from higher levels of prosody. Itô had ignored Broselow's prior insight that epenthesis can be metrically conditioned as well as syllabically induced.

[20] Itô also showed that Directional syllabification did not need to rely on the No-Crossing constraint to block epenthesis into geminates. This is because they were already successfully syllabified. Epenthesis did not occur, not because it was blocked, but because there was no prosodic motivation for it to occur.

2.1.2 Metathesis

2.1.2.1 Linear Theory

Within linear theory, metathesis rules were written $C_1C_2V_3V_4 \rightarrow 1324$ and ordered with other rules. This offered no more insight than it did for epenthesis. Viewing it from a slot and filler perspective, the theory offered no connection between the occurrence of metathesis and syllable form.

2.1.2.2 Ultan (1971) and Hock (1985)

Metathesis had often been viewed as sporadic, unmotivated and hence hardly analyzable. By the '70s it was seen as '...a more or less systematic process that tends to preserve segments or features that would otherwise be lost or changed through the effects of other processes, notably reduction, assimilation, epenthesis, et al,' (Ultan, 1971). As to the nature of the process itself, Ultan claimed that very few metathetic processes were truly segmental inversion, but rather were better analyzed as a vowel copy process followed by deletion of the underlying vowel. Since process was more important than the output form in the analysis of that time, Ultan's statement freed analysts to look at metathesis in other ways.

Hock (1985) presented the idea that some metathesis is regular. He hypothesized that in order to be able to apply regularly, it had to serve a structural purpose, such as to eliminate a cross-linguistically disfavored sequence, or to fit a preferred syllable structure. Principles from Universal

Grammar such as the Sonority Principle (SP) and markedness have been seen as triggers of metathesis (Hock, 1985).

(22) SP triggered metathesis in Persian

(1) word final apocope caused obstruent or nasal +liquid to occur word-finally
(2) the cluster metathesizes so that sonority decreases in the coda

caxra	>	carx	‘wheel’
suxra	>	surx	‘red’
asru	>	ars	‘tear’

(data from Geiger and Kuhn 1895-1901:53, reprinted in Hock, 1985: 534)

(23) Markedness motivated metathesis in Old Spanish

Old Spanish eliminated dental stop plus /l/ clusters via metathesis as it developed from Latin.

Latin:			Old Spanish:	
titulum	*ti<u>dl</u>e	>	ti<u>ld</u>e	‘title’
tsapitulum	*kabi<u>dl</u>e	>	tsabi<u>ld</u>e	‘chapter’
spatula	*espa<u>dl</u>a	>	espa<u>ld</u>a	‘sword’

(data from Hock, 1985: 533)

Hock, however, could not account for Rotuman metathesis. Rotuman has metathesis in some Incomplete Phase morphological forms, but other Incomplete Phase forms had no metathesis, deleting a vowel instead or not changing their form from what it was in the Complete Phase form.

(24) Rotuman Incomplete Phase forms:

metathesis:	*tikó	=	tikó	‘flesh’	(Complete Phase)
	*tí ko	>	tiok	‘flesh’	(Incomplete Phase)
deletion:	*hága	>	hag_	‘feed’	(Incomplete Phase)
no change:	*fáfa	=	fáfa	‘await’	(Incomplete Phase)

(data from Hock 1985; cf. Haudricourt 1958; Biggs 1959; Ultan 1971.)

Hock noted that Malone (1971) tried to account for the sporadic appearance of metathesis in Rotuman by diachronically placing it prior to pretonic syncope. Metathesis was one of many dissimilation process operating on ts clusters. Later pretonic syncope deleted the motivation of metathesis, making it appear sporadic. Hock was not satisfied that Malone’s explanation made metathesis regular in Rotuman.

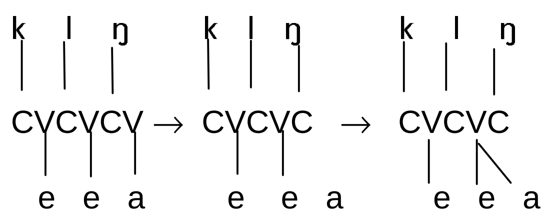
While Hock could not hypothesize a reason for metathesis in every instance of it, his work was a great improvement on that of those who saw it as sporadic. Still, he saw no rhyme or reason for the Rotuman metathesis.

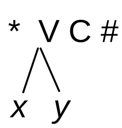
2.1.2.3 Besnier (1987)

Besnier (1987) improved on the existing analysis of Rotuman with an analysis that was able to relate all the Incomplete Phase forms to one another by showing that they did meet one structural purpose. That structural purpose was to fit a CV template. She gives an autosegmental account of metathesis in Rotuman. Following McCarthy’s (1981) lead, she separated consonants and vowels into two tiers. Taking the complete phase as the underlying form, the incomplete phase is derived by the deletion of the final V-slot of the CV tier.[21] This leaves the final vowel floating. With no intervening consonants preventing it, it links to the next V-slot. Rules based on the features of the doubly-linked vowels are ordered in a bleeding pattern. If the two vowels conflict in height, they form a diphthong. If they conflict in backness, they form an umlaut. If neither of these rules apply, the features of the once floating vowel are lost – basically, the vowel is deleted.

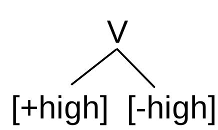
(25) keleŋa (Complete Phase) → kelyaŋ (Incomplete Phase)

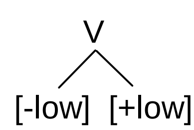
'to appear to'



(26) 

where *x* and *y* are vocalic segments

(27a) 

(27b) 

[21] Complete Phase and Incomplete Phase are labels assigned by Churchward (1940) to two morphological forms. Complete Phase is definite and specific; Incomplete Phase is indefinite, unspecific, or both, (Besnier, 1987).

If the two doubly-associated vowels are in conflict with respect to one height feature according to the two patterns in (27), the first segment changes its [+syllabic] feature to [-syllabic]. The second segment, if not already [+back], becomes [+back]. Other such height and backness rules follow this rule resulting in surface forms of umlaut or deletion. The common denominator tying the three phenomena together is that they have all undergone metathesis.

2.1.2.4 Critique

Hock showed that markedness theory can account for some cases of metathesis at a featural level, while the sonority principle accounts for some syllable level metathesis. Besnier's account of Rotuman made the link between phonology, morphology and metathesis. Still, no higher prosodic levels had been hypothesized to be motivators of any cases of metathesis.

Besnier looked at morphologically conditioned metathesis. Her account unites the processes of deletion, metathesis, and umlaut, which the Incomplete Phase forms have undergone in one operation: deletion of a V-slot. However, accounting for all three with a unified process has the consequence that repair rules are needed. Apart from this drawback, McCarthy (1995) points out that this analysis is not restrictive enough. Some of the doubly-linked vowels created by metathesis are falling sonority diphthongs, as in /vao/ '(fishing) net'. This violates a universal restriction on light diphthongs; light diphthongs must rise in sonority. McCarthy further critiques Besnier's analysis, saying that it also predicts a shortening of long vowels in the Incomplete Phase, which is not attested – words with long vowels make no distinction of phase. In spite of these shortcomings, the analysis has much more insight than previous linear accounts[22], as it makes the connection that metathesis occurs at the interface of morphology and phonology.

Getting back to Itô's directional syllabification, if it were applied to metathesis, it would necessitate treating metathesis as epenthesis – by removing potential metathesized vowels from the input.[23] The following diagrams show that while Left-to-Right directional syllabification works for Mabalay Atayal 'metathesis' sometimes, as in (28), it is incapable of consistently producing the attested output for all metathesized forms, as can be seen by its failure in (29).

(28) Mabalay Atayal:

[kaɮkaħ-i]	'kick-JUSSIVE'
[k-am-ɮakaħ]	'kick-INTR'
[kaɮkaħ-un]	'kick-PAT'

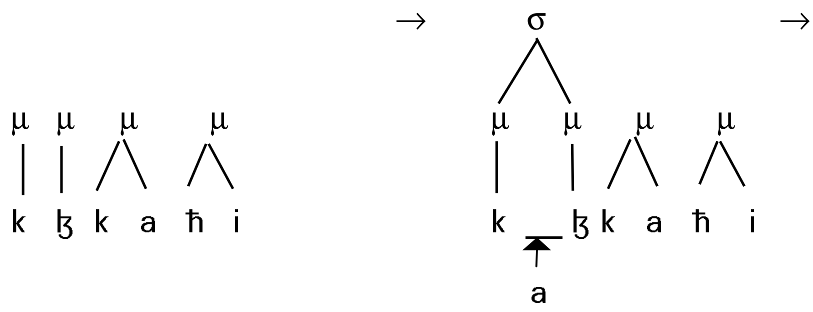
If the input were /kɮkaħ -i/, (not /kɮakaħ -i/) → [ka̳ɮ.ka̳.ħi] 'kick-JUSS'

Conclusion: Left-to-Right syllabification correctly predicts the epenthetic site. Metathesis can be interpreted as epenthesis.

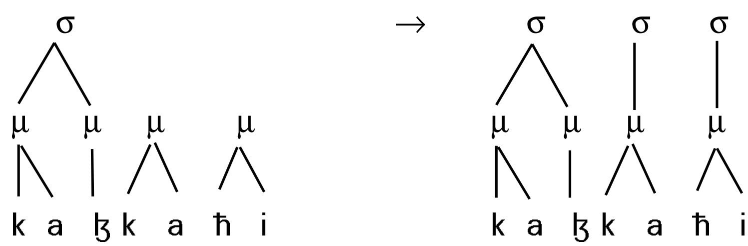
[22] Cairns, (1976), Janda (1984), and Hoeksema and Janda (1988) present segmental accounts.

[23] Broselow (1992:34) explains directional syncope, then argues for the superiority of Onset/Rime analysis in accounting for the interactions of stress, syncope, and epenthesis.

a. b.



c. d.



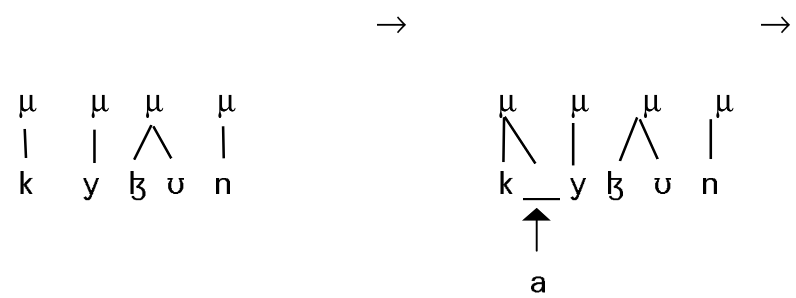
(29) Mabalay Atayal:

[kayaɮ^{n}]	'speak'
[kyaɮ-un]	'speak-PAT'
[k-am-ayaɮ^{n}]	'speak-INTR'

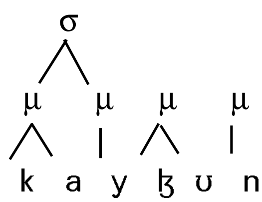
If the input is /kyɮ -un/, (not /ka$_1$y$_2$ɮ -un/) → *[ka̳y.ɮʊn], but the output form should be [kya̳.ɮʊn] 'speak-PAT'.

Conclusion: This shows that directional syllabification does not always induce a 'metathesis' effect.

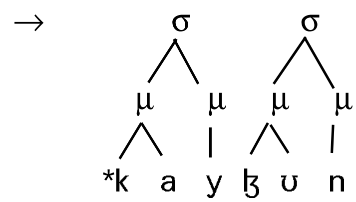
a. b.



c.



d.



Should be [(kya.ɮʊ́n)] 'speak PAT'

Even though we removed the potentially metathesized vowel from the input and treated the process as simple epenthesis, we got an incorrect output in (29). To remedy this, we would need a filter specifying that a consonant plus glide is an acceptable onset. But since codas are also permissible, Maximization would then not know whether to maximize the onset or the coda. This was left up to directional syllabification. Since left-to-right syllabification will always choose to maximize the coda of the first syllabified syllable, even with such a filter it will still produce *[ka̳y.ɮún] from /kyɮ -un/. Left-to-right syllabification of the base, /kyɮ/ 'speak-JUSS', would also maximize the coda, incorrectly producing *[ka̳yɮá̳] in place of the attested surface form, [kayáɮ^{n}].

We see that Directional Syllabification cannot consistently account for metathesis as epenthesis.

2.1.3 Vowel-Glide Alternation

2.1.3.1 Linear Theory

Kenstowicz et al (1979) give examples of vowel-glide alternation in Ki-Rundi and Makua, a Bantu language. In Ki-Rundi (data from Meeussen, 1959), /i/ and /e/ are realized as /y/ and /u/ and /o/ are pronounced as /w/ when in prevocalic position, as the following examples show. The infinitive prefix, /ku-/, is pronounced as /ku-/ before a consonant initial verb, but as /kw-/ when the vowel initial reflexive prefix ii- intervenes between it and the verb root.

(30) Ki-Rundi (Meeussen, 1959)

ku-bóh-a	'to tie'	kw-ii-boh-a	(reflexive)
ku-dah-a	'to make vomit'	kw-ii-dah-a	(reflexive)
ku-reg-a	'to accuse'	kw-ii-reg-a	(reflexive)

The glide formation rule accounting for this alternation is written in linear style:

(31) Glide formation in Ki-Rundi (Kenstowicz et al, 1979: 295)

$$\begin{bmatrix} \text{-cons} \\ \\ \\ \end{bmatrix}$$

→ [-syll] / ___ [+syll]

-low

This rule shows us that glide formation is caused by linear position alone, whenever a [-low] vowel is followed by a vowel. Assuming that the description is adequate for Ki-Rundi, it still has not provided much insight. It is merely a process the underlying form must go through to arrive at a surface form.

In Makua, a Bantu language, the high back vowel /u/ becomes a glide prevocalically. The following vowel lengthens as a consequence of the glide formation process and the tone originally associated with /u/ becomes associated with the first half of the long vowel.

(32) Makua (Kenstowicz et al, 1979: 122-23)[24]

/u- aap-a/	[w-aáp-á]	'to whisper'
/u- oop-a/	[w-oóp-á]	'to beat'
/u- iiw-a/	[w-ií w-á]	'to come uninvited'
/u- uu-vah-a/	[w-uú-váh-a]	'to give you (child) sth.'
/u- vah-a/	[u-váh-á]	'to give'
/u- ki-vah-a/	[u-kí -váh-a]	'to give me sth.'

The glide formation rule is written as in (33).

[24] The acute mark over the vowel, V́, represents high tone; no mark means low tone. Thus a long vowel, written as two identical vowels, one with and one without a high tone accent, represent falling and rising tones, i.e. áa is a falling tone; aá is a long vowel with rising tone.

(33) Glide formation in Makua (Kenstowicz et al, 1979: 123)

$$\underset{1}{\begin{bmatrix} u \\ \alpha T \end{bmatrix}} \quad \underset{2}{V} \longrightarrow \begin{bmatrix} 1 \\ -syll \end{bmatrix} \begin{bmatrix} 2 \\ \alpha T \end{bmatrix} \quad 2$$

The rule states that '...given a sequence /u/ plus a vowel, the /u/ will become nonsyllabic and the following vowel will be doubled. The first element of the doubled vowel is assigned the same tone as the /u/ vowel, while the second element retains the original tone,' (Kenstowizc et al, 1979: 123).

In this analysis, we see a little more insight in that the vowel lengthening is seen as a consequence of glide formation. However, the insight does not follow from the theory. The ordered rules require no close connection. Although the analysts have a hunch that there is a close relationship between vowel length and glide formation, the theory offers no explanation for why that should be.

2.1.3.2 X-Theory

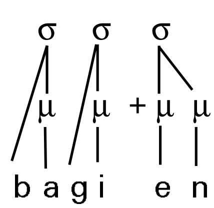
X-Theory, likewise, had no way to account for compensatory lengthening, as shown by Hayes (1989). The compensatory length could be shown to fill an X-slot vacated by glide formation. This linked glide formation and compensatory lengthening in a consequential manner, but had no more insight as to why that was than did linear theory.

2.1.3.3 Mora Theory

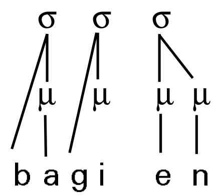
Hayes (1989) noted that cross-linguistically a vowel may or may not lengthen following coda deletion or glide formation. It was language specific, and in fact, other processes might apply instead, such as the spreading of the following consonant leftward to create a geminate after coda deletion in Lesbian and Thessalian Greek. Although language specific, Compensatory Lengthening (CL) is not an ordinary linearly ordered rule, but it applies immediate following every deletion rule – just as syllabification is applicable on demand. He noted that only languages with a syllable weight distinction allow CL. From these observations, Hayes deduced that an adequate theory of CL has to allow for it, but not require it. He saw that Hyman (1984) and McCarthy and Prince's (1986) moraic theory surpasses X-Theory in the formal description of prosody; through this theory, CL could be expressed as part of syllabification, licensing empty moras. Alternatively, the mora could be deleted by Stray Erasure (Steriade, 1982; Harris, 1983).

Hayes gives a moraic account of a consonant gemination form of CL in Ilokano (1989).

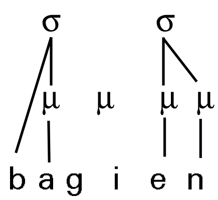
(34)



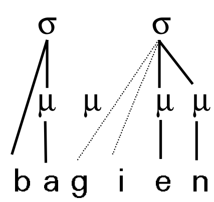
Input



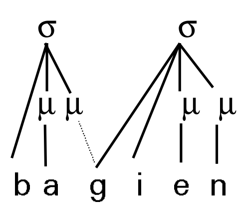
Glide Formation
A delinked mora results in a glide.



Parasitic Delinking
Syllable structure is deleted when the syllable contains no overt nuclear segment.



Syllabification



Compensatory Lengthening
Fill empty moras by spreading from the right.

When two vowels meet at a morpheme boundary in Ilokano, provided that the first vowel is high, it delinks from its mora and forms a glide. The syllable of which it once formed the nucleus is now degenerate. Lacking a nucleus, the syllable structure is deleted. The ongoing process of syllabification takes in the stray segments as its onset. Because they syllabify as onset, syllabification does not incorporate the stray mora. The stray mora is then filled by spreading from the right in Ilokano resulting in a geminate – a consonant linked to the onset of the second syllable and the coda of the first. The stray mora explains the gemination and its link to glide formation.

2.1.3.4 Critique

Moraic theory is necessary to motivate the relationship between vowel-glide alternation and compensatory lengthening. Even so, note that Hayes offers no motivation for the occurrence of the glide formation in the first place. He also noted that only languages with a syllable weight distinction allow CL. He was careful not to say such languages necessarily had CL. Atayal is such a language; Mabalay Atayal does not have compensatory lengthening even though it does have vowel-glide alternations. Hayes can offer no insight as to why the mora would delete in a language like Mabalay Atayal instead of having CL because he is only looking at the syllable level of prosody. We need to go beyond the syllable level to motivate glide formation.

2.2 OT Approaches

(The reader unfamiliar with OT is encouraged to skip ahead at this point to §2.3 to preview the theory before reading §2.2.)

Broselow (1982) had good insight; not all epenthesis can be accounted for at the syllable level of prosody. There is also metrically conditioned epenthesis – epenthesis conditioned by good foot form. It seems that she was ahead of her time as it is only recently that formal theory has been able to express it. Since Optimality Theory is not process oriented, but looks at all possible outputs of a given input at once, and since it ranks those output candidates based on a hierarchy of universal constraints from all levels of prosody at one and the same time, syllabification and footing can be seen together. Because Itô's (1986, 1989) theory was process oriented, she had no way to look at footing during the process of syllabification and epenthesis. Directional syllabification does not permit us to see that actually syllabification and footing are working together in determining epenthetic sites.

Recent insights see epenthesis, metathesis and vowel-glide alternation as prosodically induced. The same theory should, therefore, be able to account for them all. They are expected to work together to the same end, all else being equal (Davis and Zawaydeh, 1997). That end is wellformed prosodic units, which includes more than just syllables.

2.2.1 Epenthesis

2.2.1.1 Prince and Smolensky (1993)

In their original manuscript presenting Optimality Theory, Prince and Smolensky (1993) address several issues pertaining to syllabification and footing. In chapter 3, they question the validity in seeing constraints as blockers or triggers. They note that epenthesis is often seen as triggered by something – epenthesize only when necessary. Syncope, on the other hand, is often viewed as blocked by something – delete except when it leads to an ill-formed syllable, stress clash, or an OCP violation. The problem with viewing epenthesis and syncope in these terms is that it implies that something needed to be repaired.

Since OT evaluates all outputs in parallel with no opportunity for later repair, we should not think of epenthesis and syncope in these terms any more.

Repair is necessary in bottom-up constructionism where syllabification into ideal syllable precedes repair. Structures that a language finds permissible though marked, such as an onsetless syllable, are not formed until the later repair stage where it may be found to be necessary for other reasons such as stress assignment. Bottom-up constructionism first incorporates mora into CV syllables, then syllables into feet. It is a process approach. Within an OT framework, it would be equivalent to ranking all of the syllable form constraints above the foot form constraints. Of course this would not work in parallelist OT as there could be no follow up step for the necessary repair. Prince and Smolensky conclude that the problem is in this hierarchy. Syllable and foot form constraints are actually interacting to a much greater degree.

For instance, Tongan, a language of the Pacific, shows an interaction between stress and syllable structure. Tongan syllables are CV, CVV, or V. All heavy syllables are stressed with main stress falling on the penultimate mora of the word. This means the stress pattern is established by bimoraic trochees marked off in a right-to-left direction. A CVV sequence is normally parsed as one syllable, but in the penult it is parsed as two syllables, CV.V.CV, showing that, for Tongan, ONSET is a violable constraint. This is due to a foot placement constraint, EDGEMOST, ranking above ONSET in this quantity sensitive language.

(35) EDGEMOST
The most prominent foot in the word is at the right edge.

The bimoraic trochaic foot is held to a right edge alignment due to the high rank of edgemost. In a $CV_1V_2CV_3$ string, this would place stress on V_2. However, due to the Principle of Syllable Integrity (Prince, 1976), which maintains that foot parsing may not dissect syllables, a penultimate CVV gets parsed instead as CV.V.~. Onset is violated in order to satisfy Edgemost and the bimoraic trochee. The onsetless syllable will only ever be optimal in the penult of a CVVCV string due to this constraint ranking. Prince and Smolensky maintain that this should not be viewed as repair triggered by footing. The V.V parse was always an option; it is not a repair strategy.

The advantage of OT in analyzing Tongan is that it can see syllable and footing constraints together. A process approach is blind to footing during syllabification and must, therefore, rely on later repair. The analysis of Finnish and Yupik languages (Prince and Smolensky, 1993) also benefit from viewing syllabification and footing in parallel. In Finnish, the left side of a trochaic foot is aligned at the left side of a prosodic word. When the word begins with a LH syllable sequence, the light syllable is stressed. This means the foot placement constraint, ALIGN(FT L, PRWD L), must rank higher than the Weight to Stress Principle (WSP). In Yupik languages, codas are generally not moraic. However, in the first foot – which is the prosodic head of the word, CVC will count as heavy

(Prince and Smolensky, 1993:31; Hayes, 1995:242, Broselow, Chen and Huffman, 1997). This is due to EDGEMOST(HEAD-F, L, WD) >> *MORAIC-C.

A common thread runs through all three languages. 'The higher-level foot-placement constraint influences the basic interpretation of syllable structure,' (Prince and Smolensky, 1993:31). There are no examples of epenthesis or metathesis due to footing constraints, but the basic principle is the same. This thesis will extend the application of this principle to epenthesis and metathesis as exemplified in Atayal.

2.2.1.2 Broselow (1999)

Broselow's most recent work on the interaction between epenthesis and stress is done in an OT framework. She asserts that loanwords should not require a reranking of the native language constraint ranking, but may require some additional Output-Output correspondence constraints to account for differences in the input forms. The native language grammar has some undetermined rankings; loanwords could serve to illuminate the rankings more precisely.

In Selayarese, a Makassar dialect of Indonesia, stress is normally penultimate regardless of syllable structure, but when the input of a monomorphemic word ends in /r/, /l/, or /s/, a vowel follows and stress is on the antepenultimate syllable. These word-final vowels disappear when the PrWd is suffixed showing that they truly are epenthetic.

(36)	[hállasa]	[hallási]	/hallas +i/	'suffer/make suffer'
	[lámbere]	[lambéraŋ]	/lamber+aŋ/	'long/ longer'

It follows that these segments make unacceptable codas. The epenthetic word-final vowel causes them to parse as onsets. Interestingly, in such words, the stress is on the antepenultimate syllable. In other words, the epenthetic vowel is not part of the Prosodic Word.

Two syllable loanwords from Bahasa Indonesian (BI) that end in /l/, /r/, or /s/ are treated in like manner forming σσE (where E stands for epenthetic vowel) showing that the same constraint ranking applies to loanwords.

(37) σσE: final epenthetic vowel invisible to stress

BI	Sel	
bótol	bótolo̳	'bottle'
kábar	kábara̳	'news'
bərás	bérasa̳	'rice'

Because BI has many permissible codas, the input is more complex for Selayarese than it is with its native words. This calls on Selayarese to reveal its 'undetermined' rankings.

Word internal BI codas are also followed by an epenthetic vowel when borrowed into Selayarese. In σEσ outputs, these word internal epenthetic vowels are part of the prosodic word and receive stress if in the penult.

(38) σEσ penultimate epenthetic vowel is visible to stress assignment

BI	Sel	
kártu	karátu	‘card’
bákri	bakári	proper name
rámli	ramáli	proper name

In σEσE outputs, the stress rules also see the word final epenthetic vowel and assign stress to the penult accordingly.

(39) σEσE: final epenthetic vowel visible to stress assignment

BI	Sel	
kórnel	koronéle	‘corner kick (in soccer)’
tápsir	tapasére	‘interpretation’
kártsis	karatísi	‘ticket’

What is the difference between the two syllable loanwords of the σσE pattern and those of the σEσE pattern? Why is the epenthetic vowel visible to one and not the other in stress assignment? Basically, the language is trying to avoid incorporating an epenthetic vowel into the head foot. In σσE words, the footing avoids including the epenthetic vowel, but in σEσE words, the footing cannot avoid both epenthetic vowels. If it cannot be helped, then stress is assigned to the penult as usual. Broselow (making reference to Alderete, to appear) handles this with a HEAD DEP constraint.

(40) HEAD DEP:
The head foot of a word may not contain an epenthetic vowel.

When ranked below ALIGN HEAD and LAPSE and above ALIGN PRWD, Alderete's constraint proves necessary to the analysis of Selayarese stress and epenthesis patterns.

(41) ALIGN HEAD-R:
No foot may intervene between the most prominent foot and the right edge of a prosodic word.

(42) LAPSE:
Two adjacent syllables cannot be left unfooted.

(43) ALIGN PRWD-R:
The right edge of a prosodic word must be aligned with the right edge of a foot.

(44) Bahasa Indonesian Loanwords in Selayarese

	/botol/ ‘bottle’	Align Head	Lapse	Head Dep	Align PrWd
a.	bo{tólo̳}			*!	
b. ☞	{botó}lo̳				
	/kartu/ ‘card’				
a. ☞	ka{rá̳tu}			*	
b.	{kará̳}tu			*	*!
	/bələbas/ ‘ruler’				
a.	{bála}{basa̳}	*!			
b.	{bála}basa̳		*!		
c. ☞	ba{lába}sa̳				
d.	{bala}{básа̳}			*!	
	/solder/ ‘weld’				
a.	{sólo̳}{dere̳}	*!			
b.	{sólo̳} dere̳		*!		
c.	so{ló̳de}re̳			*	*!
d. ☞	{solo̳}{dére̳}			*	

Broselow develops the analysis further. The reason why /r/,/l/, and /s/ are the only consonants triggering epenthesis is because other consonants are able to change their identity into acceptable Selayarese codas, /ʔ/ and /ŋ/, instead. By ranking *Coda(Cor/Lab/Obs) >> Ident(Cont/Nas) >> Dep(V) >> Other Ident, Max(Place), coronals, labials and obstruents change to /ʔ/, nasals change to /ŋ/, but /l/, /r/, and /s/ have to rely on epenthesis. We will find a similar breakdown of the CODA and IDENT constraints is necessary in order to inter-rank them to account for the difference in Atayal dialects (see §4.1.2).

Broselow's (1999) work shows that epenthetic vowels can affect footing and stress assignment. The interaction of epenthesis and foot structure is the only way to account for the placement of stress in the output forms.

2.2.1.3 Mester and Padgett (1994)

Mester and Padgett (1994) apply Generalized Alignment[25] to Itô's Arabic data to show that OT can mimic the effects of directional syllabification while capturing the insight of Prince and Smolensky (1993). They accomplish this through a syllable alignment constraint. ALIGN (SYLL L, PRWD L), abbreviated as SYLL-ALIGN(L), corresponds to the right-to-left syllabification of Iraqi Arabic. It produces the Onset Pattern: the stray C is taken as the onset. An epenthetic vowel follows. SYLL-ALIGN(L) mimics directionality by calculating violations gradiently in terms of mora. Their tableau duplicated here demonstrates how this works.

(45) ALIGN(L) corresponds to R-L syllabification of Iraqi Arabic
(Mester and Padgett, 1994)

[25] Generalized Alignment, a theory subsumed under OT, took the original morphology-phonology alignment constraints and extended them to morphology-morphology and phonology-phonology as well. Alignment(αR, βL) has been generalized to include alignment of any edge with any edge. The reader is referred to § 2.2.2.2 of this chapter for an introduction to GA.

/cvcccv/	FILL	SYLL-ALIGN(L) S1	S2	S3	S4	NO CODA
☞ a. cv.cVc.cv	*		μ	μμμ		*
b. cvc.cV.cv	*		μμ	μμμ !		*
c. cv.cV.cV.cv	**(!)		μ	μμ	μμμ (!)	

The same constraint only right-aligned, SYLL-ALIGN®, mimics the left-to-right syllabification of Cairene Arabic.

(46) ALIGN® corresponds to L-R syllabification of Cairene Arabic
(Mester and Padgett, 1994)

/cvcccv/	FILL	SYLL-ALIGN® S1	S2	S3	S4	NO CODA
a. cv.cVc.cv	*	μμμ	μ !			*
☞ b. cvc.cV.cv	*	μμ	μ			*
c. cv.cV.cV.cv	**(!)	μμμ	μμ	μ		

Although syllable alignment can produce directionality effects, Mester and Padgett are disturbed that GA is too lax theoretically. They found that Opposite Edge alignment constraints such as ALIGN (SYLL L, PRWD R) or ALIGN (SYLL R, PRWD L) would also select the proper candidate. What is more, instead of counting mora, you could count segments and arrive at the same results. This puts it on par with a linear analysis in which the epenthetic site can be determined by counting segments. Although it works, it offers no promising insight. Counting syllables, on the other hand, will not work. The question then is, what is it that determines what is to be counted? Their point is that GA needs to be tightened up so that only ALIGN constraints having true linguistic significance are available for use.

They also comment that '...it is not unthinkable that the ultimate analysis of Cairene and Iraqi Arabic cases does not even involve directionality, but other factors (as argued in Broselow 1992),' (Mester and Padgett, 1994:84). In other words, perhaps we do not really want to mimic directionality. Derivational phonology prevented Itô from linking epenthesis to anything higher than the syllable. OT permits us to look beyond the immediately dominating level of prosodic hierarchy. We ought to take advantage of the insight this theory can bring.

2.2.2 Metathesis

2.2.2.1 McCarthy (1995)

McCarthy (1995) accounts for Rotuman metathesis by extending the theory of faithfulness. He views metathesis as preserving prosodic structure. Metathesis incurs a violation against LINEARITY(LIN), a constraint that preserves the linear order of segments in a string. Metathesis occurs in languages where LINEARITY ranks below MAX ('no deletion') or DEP ('no epenthesis').

The Rotuman foot form is a bimoraic trochee. Apart from words with long vowels, the foot is disyllabic in the Complete Phase because of high ranking SYLL=μ.

(47) SYLL = μ
Syllables are monomoraic.

(48) [vao] ‘(fishing) net, Complete Phase’

/vao/	SYLL=µ	ONSET
a. ☞ .va.o.		*
b. .vao͡.	*!	

But the Incomplete Phase derivational form must end in a heavy monosyllabic foot. This is enforced by the high ranking morphological templatic constraint, INC-PH.

(49) INC-PH:
Every incomplete-phase stem ends in a monosyllabic foot (or heavy syllable).

In tableau (50) below, each of the four possible forms of the Incomplete Phase is represented. The word final heavy syllable common to all the (a) words is preferred to the (b) words composed of two light syllables. This is because the morphological constraint made on the Incomplete Phase ranks above the light syllable constraint, the effects of which are pervasive elsewhere in the language.

(50) INC-PH >> SYLL=µ

vao (Inc.Ph.) pure (Inc.Ph.) rako (Inc.Ph.) mose (Inc.Ph.)	INC-PH	SYLL=μ
a. ☞ .va͡o. ☞ .puer. ☞ .rak. ☞ .mös.		*
b. .va.o. .pu.re. .ra.ko. .mo.se.	*!	

To accomplish this end, the language uses deletion (rako → rak 'to imitate') , metathesis (pure → puer 'to rule'), umlaut (mose → mös 'to sleep'), 'diphthongization' (vao → va͡o 'net'), or makes no change from the Complete Phase form (sika → sika 'cigar').[26] Which strategy is used depends upon the input CV form and vowel quality. The highest preference is for metathesis as it is most faithful to its lexical correspondent in the Complete Phase. Deletion, the least faithful, is a last resort. The ranking MAX >> LIN means that metathesis is preferred to deletion. A third option, that of forming an umlaut vowel through coalescence, is realized when the diphthong created by metathesis would have violated LIGHT DIPHTHONG.

(51) LIGHT DIPHTHONG:
A light diphthong (two vowels linked to one mora) must rise in sonority.

[26] The two derivational forms of the word, Complete and Incomplete Phase, are in a correspondence relation with one another. McCarthy uses Output-Output correspondence because in Input-Output correspondence the input has no prosodic structure.

Thus, [pure] 'to rule' metathesizes to form the Incomplete Phase derivational form, [puer]. Because mid-vowel [e] is more sonorant than high-vowel [u], the resultant diphthong, [ue], does not violate LIGHT DIPHTHONG.

(52) [pue$_2$r$_1$] 'to rule'

pur$_1$e$_2$ (Inc.Ph)	LIGHT DIPH	INC-PH	MAX	LINEARITY
a. ☞ .pue$_2$r$_1$.				*
b. .pur$_1$.			*!	
c. .pu.r$_1$e$_2$.		*!		

A word like [hoti] 'to embark', on the other hand, would violate LIGHT DIPHTHONG were it to metathesize. Its failure to metathesize shows that LIGHT DIPHTHONG ranks high. An umlaut vowel is formed instead. Umlaut formation violates UNIFORMITY ('no coalescence') and LINEARITY (the 'front' feature of [i] metathesizes with [t]). This entails a ranking of LIGHT DIPHTHONG >> UNIFORMITY and LINEARITY.

(53) [höt] 'to embark'

h$\underline{o}_1$t$_2$i$_3$ (Inc.Ph)	LIGHT DIPH INC-PH	MAX	UNIFORMITY	LINEARITY
a. ☞ h$\underline{\ddot{o}}_{1,3}t_2$			*	*
b. ho$_1$t$_2$		*!		
c. ho$_1$i$_3$t	*!			*

McCarthy's account of the various strategies used by Rotuman is tied to the foot form of the Incomplete Phase. This is the earliest account I have found linking metathesis to footing rather than just to segment/feature incompatibility or to achieve a preferred syllable structure. In doing so, he has given a highly motivated and unified account for what seemed like very diverse processes of syncope, metathesis, umlaut, ‘diphthongization’, and vowel length.

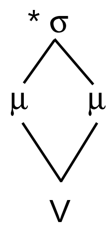
2.2.3 Vowel-Glide Alternation

From the work of Kaye (1983), Kaye and Lowenstamm (1984), and Rosenthall (1994), it has been established that ‘...monomoraic or light diphthongs are always restricted to vowel sequences of rising sonority’, but ‘... heavy diphthongs are not subject to any known universal limitation on the sonority cline,’ (McCarthy, 1995: 8, 9).

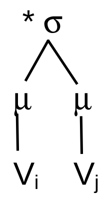
2.2.3.1 Rosenthall (1997)

Rosenthall (1997) examines the surface form of vowel sequences in languages with only monophthongal vowels. Because one vowel in these vowel sequences can alter or delete, we can deduce that they are heavy diphthongs, vowels associated to separate moras in the input. The glide formations and vowel deletions are shown to follow from constraint interaction as defined in OT. OT evaluates the moraic and non-moraic parses of prevocalic vowels in parallel and determines which form best satisfies syllable well-formedness and input/output Correspondence constraints. Different rankings of the same set of constraints can account for the surface forms of prevocalic vowels cross-linguistically. These are the constraints he posits.

(54) NO LONG VOWELS (NLV)



(55) NO DIPHTHONGS (NODIPH):

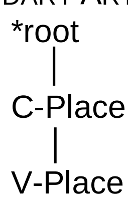


(56) MAX-IO(μ):
Every mora of the Input has a correspondent in the Output.

(57) IDENT-IO(μ):
Correspondent vowels in Input and Output have identical weight.

IDENT-IO(μ) militates against moras reassociating with another segment.

(58) *SECONDARY ARTICULATION (*SECART)



(59) MORAIC-a:[27]

The low vowel, /a/, must be linked to a mora.

[27] Rosenthall actually labels this constraint in dependency phonology style, calling it {A} = V.

As these constraints interact with better known wellformedness and correspondence constraints – DEP, ONSET, MAX-IO, OCP – Rosenthall is able to account for glide formation and compensatory lengthening or vowel deletion in four languages that permit only monophthongal surface vowels – Luganda, Etsako, Yoruba, and Kimatuumbi. In Luganda, a prevocalic high vowel surfaces as its counterpart glide, and a low vowel deletes; compensatory lengthening of the vowel results, as shown in (60). Estako is similar – a prevocalic high vowel surfaces as a glide and a low vowel deletes, but in Estako, the surface vowel is short, as in (61). In Yoruba, the prevocalic vowel is always deleted, as seen in (62). Kimatuumbi prevocalic high vowels surface as their counterpart glides with accompanying compensatory lengthening on the vowel and prevocalic low vowels are parsed heterosyllabically, as shown in (63). The ranking responsible for the surface forms is given below each set of data.

(60) Luganda (Cole, 1967; Clements, 1986)

/li+ato/	[l^yaːto]	'boat'
/mu+iko/	[m^wiːko]	'trowel'
/ka+oto/	[koːto]	'fireplace (dim.)'

Ranking: Max-IOμ, Onset, Dep, NoDiph, Moraic-a
>> NLV, Max-IO
>>*SecArt, Ident

(61) Etsako (Elimelech, 1976)

/oθie/	[oθ^{y}e]	'king'
/alokui/	[alok^{w}i]	'chameleon'
/dɛ # akpa/	[dakpa]	'buy a cup'

Ranking: Onset, NoDiph, Dep, Moraic-a, NLV
>> Max-IO
>> Max-IOμ, *SecArt

(62) Yoruba (Pulleyblank, 1988a,b)

/ni oko/	[loko]	'at the farm'
/bu ata/	[bata]	'pour ground pepper'
/ra ọgẹdẹ/	[rọgẹdẹ]	'buy bananas'

Ranking: *SecArt, NLV, Onset, NoDiph, Dep
>> Max-IO, Max-IOμ

(63) Kimatuumbi (Odden, 1995)

/mi+oto/	[m^{y}oːto]	'fires'
/tu+isiwa/	[t^{w}iːsiwa]	'to the island'
/ma+oto/	[ma.o.to]	'large fires'

Ranking: NoDiph, Max-IO, Max-IOμ, Dep, Moraic-a
>> Onset
>> *SecArt, NLV

Since Rosenthall has been able to establish these as universal constraints on prevocalic vowels, they will be applicable to our analysis of Atayal as well.

2.3 Optimality Theory

2.3.1 General Outline of the Theory

This paper approaches the analysis from the perspective of Optimality Theory (OT) as put forth by Prince and Smolensky (1993) and McCarthy and Prince (1993a). Briefly, OT developed out of research on prosody, universal grammar, markedness theory, and the viewing of phonology as being constraint oriented rather than rule oriented. The basic tenets are these.

1. Constraints are universal. Universal Grammar consists of highly general constraints on wellformedness.

2. The grammar of every language consists of all the universal constraints. Languages differ on how they resolve the conflict between the constraints by ranking the constraints differently, giving one constraint absolute pri ority over another.

3. In OT it is the ranking of the constraints that forms the grammar of any given language. Constraints are not always surface-level true or mutually consistent. They are instead highly conflicting making contrary claims about wellformedness. Each constraint is violable, but violation is minimal. It will only be violated to the degree necessary to satisfy a higher ranking constraint. The

optimal output is the one which best satisfies the hierarchically ranked conflicting constraint set.

4. Parallel evaluation replaces serial derivation. In serial derivations, the onus was placed on grammatical processes to generate the correct output. OT shifts the burden of the theory off of generator (Gen) and onto evaluator (Eval). Many outputs are made available by Gen for Eval to judge in parallel.

Theoretically, OT is not cyclic. An input form is never a partially processed one.[28] For instance, an input does not go through a syllabification Generator before a footing Generator. Syllabification does not precede footing in any way. It is a one step operation from input to output. All possible outputs are produced by Gen in one step and evaluated in parallel.

Neither is OT parametric. Although former parametric constraints transfer easily into optimality theoretic terms, OT does not set parameters, relying instead on hierarchy. For instance, the Onset Principle had a parametric setting of either absolute or relative (Itô, 1989). In a language with an absolute setting, onsets would be obligatory. An input lacking an onset would require an epenthetic one in the output. A language with a relative setting would syllabify an onset into the syllable only if it were available. In OT these two types of

[28] Due to limitations of space, discussions and tableaux may appear to go against this claim. However, theoretically the analyst should keep in mind that identity constraints, constraints from other prosodic levels, and markedness constraints could all be impinging on the aspect in focus. The analyst's responsibility then is to present these constraints if they are crucially interacting with other constraints to produce the phenomenon under analysis.

language are represented by a difference in the ranking of two constraints, ONSET and DEPENDENCY.

(64) ONSET >> DEP: Epenthetic onsets are supplied in the output.

DEP >> ONSET: A syllable with no onset is possible.

How does parallelism work? From a given input, Generator (Gen) supplies a set of possible candidates. Due to limitations on space, the usual practice of OT is to include only serious candidates in discussion and in tableaux. Each candidate is tried by Evaluator (Eval) against the constraint hierarchy. The candidate whose highest violation mark is the lowest on the hierarchy of constraints is selected by Eval as the Optimal Candidate.

The analysis is presented in tableaux. The leftmost constraint is the highest ranked. The constraints are ranked in levels. Solid lines designate divisions between crucially ranked levels; dotted lines represent divisions between equally ranked constraints on the same level. Violations are marked with an asterisk and if fatal they are additionally marked by an exclamation mark. Shading represents the irrelevance of whatever violations follow.

2.3.2 Constraint types relevant to this analysis

2.3.2.1 Correspondence Theory

Correspondence theory is that part of OT that accounts for faithfulness between the input and the output. First used to account for reduplication by showing a correspondence (or lack thereof) between the base and the reduplicant, it was then generalized to show faithfulness between input and output, replacing the original approach of containment theory. The full correspondence relations are, in fact, fourfold. There are input-output (I-O), base-reduplicant (B-R), reduplicant-stem(input) (I-R), and Output-Output (O-O)[29] correspondence relations. The reader is referred to McCarthy and Prince (1995) for a full explanation of the relations called on to account for reduplicated forms and to Benua (1995) for O-O correspondence. We will focus only on the input-output relations in this paper.

In the former containment theory, no elements were literally removed or added. Syncopated segments were still present in the output, but syllabically unparsed. Thus, syncope was seen as a violation of PARSE-segment which demanded that every segment in the output be parsed. Epenthetic segments were marked with a special status in the output as well so that other constraints could differentiate them from segments faithful to the input. Epenthesis was seen as a violation of FILL, which militated against filling empty prosodic structure.

In correspondence theory, PARSE-segment is replaced by MAXIMAL(MAX) and FILL by DEPENDENCY(DEP). No special status is

[29] Output-Output (O-O) was proposed by Benua, (1995) to account for the correspondence between derivational forms. Output-Output can be used to show correspondence between the prosodic levels between different morphological forms of the same root, McCarthy (1995). O-O has also been applied to the specific rankings needed for loanwords, (Broselow, 1999).

assigned syncopated or epenthetic segments. Deleted segments are fully deleted; they can have no part in determining how output forms perform on constraints. Likewise, DEP violations are no longer conceived of as empty prosodic structure being filled. The formal definitions below are taken from McCarthy and Prince (1995).

(65) MAX:
Every element of S_1 has a correspondent element in S_2. Domain® = S_1.

(66) DEP:
Every element of S_2 has a correspondent element in S_1. Range® = S_2.

Faithfulness to the input features of each segment is then constrained by IDENT-IO(F). Thus in Atayal, when [ɣ] is realized as [w] in word final position, this is a violation of IDENT-IO(*OBS*).

(67) IDENT-IO(F):
Correspondent segments have identical values for the feature F.

If *xRy* and *x* is [γF], then *y* is [γF].

The following constraints also come under correspondence theory. LINEARITY militates against metathesis, UNIFORMITY against coalescence, and INTEGRITY against the splitting of a diphthong.

(68) LINEARITY: ("No metathesis"):
S_1 is consistent with the precedence structure of S_2, and vice versa.

Let x, y $\in$ S_1 and x', y' $\in$ S_2.

If xRx' and yRy', then $x < y$ iff $\neg$ $(x' < y')$.

(69) UNIFORMITY ("No Coalescence"):
No element of S_2 has multiple correspondents in S_1.

For $x, y \in S_1$ and $z \in S_1$, if xRz and yRz, then $x=y$.

(70) INTEGRITY ("No Breaking"):
No element of S_1 has multiple correspondents in S_2.

For $x \in S_1$ and $w,z \in S_1$, if xRw and xRz, then $w=z$.

2.3.2.2 Markedness Constraints

Markedness constraints are based on language typology. The least marked syllable is CV. Every language has it. If a language has CVC, you can guarantee it also has CV, but you cannot assume a language has CVC just because it has CV. This asymmetry needs to be reflected in constraints on wellformedness. For this reason, ONSET is framed as a 'must have' constraint, while NO CODA is framed as 'must not'.

(71) ONSET:
Every syllable must have an onset.

(72) NO CODA:
A syllable must not have a coda.

(73) PEAK:
Every syllable must have a vocalic peak.

CODA CONDITION, another markedness constraint, marks certain features or 'lack of place' as permissible codas. The following are the coda conditions of Mabalay Atayal.

(74) CODA CON(*LAT):
No lateral codas.

(75) CODA CON(*VDOBS):
No voiced obstruent codas.

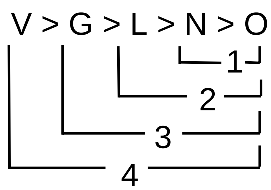
NO CC recognizes consonant clusters as more marked than a single C. NO CC militates against consonant clusters where each consonant is linked to a separate mora. It is not violated by a secondary articulation.

(76) NO CC:
No consonant clusters within the syllable.

The Sonority Principle states that syllables rise in sonority toward the peak. As a constraint, SONORITY recognizes that some clusters are more harmonic than others. An obstruent plus glide is more harmonic than an obstruent plus nasal cluster. Some languages have a more specific constraint, SONORITY DISTANCE, requiring a certain distance in the rise in sonority. Mabalay requires a distance of at least three.

(77) SONORITY:
Clusters must rise in sonority toward the syllable peak.

(78) SONORITY DISTANCE:
Clusters must rise in sonority toward the syllable peak at a distance of at least three.



Obstruent + nasal has a distance of one, obstruent + liquid a distance of two, obstruent + glide a distance of three, and obstruent + vowel a distance of four. So only obstruent + glide clusters are allowed in Mabalay Atayal.[30]

FOOT BINARITY and PARSE SYLLABLE are markedness constraints at higher levels of prosody. FTBIN militates against degenerate feet and PARSE SYLL requires every syllable be parsed into its mother node, the foot. Both degenerate feet and unparsed syllables are considered marked.

(79) FTBIN:
A foot is binary at the syllable or mora level.

(80) PARSE SYLL:
Every syllable must be parsed into a foot.

[30] This constraint is used in my initial analysis, but as the analysis develops, it will be replaced by ranking No CC higher than in the initial analysis. This is made possible with the introduction of *SecArt in §3.3.2.3.

These constraints make bold claims often contrary to one another. They could never be mutually surface true in any language. But by its ranking of these markedness constraints, a language determines what it considers to be well formed syllables and feet.

2.3.2.3 Generalized Alignment

McCarthy and Prince (1993b) have also presented Generalized Alignment (GA), a sub-theory of OT that has significance for the following analysis of footing. GA developed out of the recognition of a correspondence between prosody and morphology. Rather than stating the correspondence as templatic, MCat=PCat, as in their previous work (McCarthy and Prince, 1991), GA '... allows separate control over the fate of each edge,' (1993b:3). It defines the alignment of one edge of a grammatical category (morphological or syntactic) with one edge of a prosodic category. The original ALIGN(GCAT, EDGE1, PCAT, EDGE1) mapping is extended under GA such that opposite as well as corresponding edges can be aligned.[31] Thus, ALIGN(PCAT, GCAT), ALIGN (PCAT, PCAT), and ALIGN(GCAT, GCAT) are also proper expressions of alignment.

In regards to footing, ALIGN-FT applies to every foot. Even if one foot is aligned with a designated edge of a prosodic word, a contiguous foot could not be perfectly aligned. Even so, ALIGN-FT forces each foot to lie as close as possible to the designated PRWD edge. Violations are marked gradiently so that

[31] GCAT is a grammatical category. This includes morphology. PCAT is a prosodic category.

contiguous footing will be considered more harmonic than non-contiguous footing. When ranked higher than PARSE SYLL, ALIGN-FT has the power to make a single foot more harmonic than iterative footing. This ranking is very significant in Atayal, as it also provides motivation for limiting epenthesis – which would have created more unparsed syllables – and finding other means to meet footing and syllable wellformedness conflicts.

Alignment constraints can account for epenthetic sites. While Mester and Padgett (1994) employ syllable alignment constraints to mimic directional syllabification, this has not been necessary in my analysis of Atayal. We will see that footing constraints together with markedness constraints sufficiently account for epenthesis and metathesis in Atayal.

These are the alignment constraints employed in this analysis.

(81) ALIGN (FT R, PRWD R):
The right edge of every foot must align with the right edge of the prosodic word.

(82) FINAL-C
ALIGN(PRWD R, CONSONANT R)

Every PrWd is consonant-final.

Any constraints that have not been mentioned here will be defined as they are included in the analysis.

2.4 In Summary

This chapter has given us a background in previous analyses of epenthesis, metathesis, and vowel-glide alternations. It has also introduced us to Optimality Theory, the framework in which my research is done.

In the next chapter, we will focus on the syllable and footing constraint rankings that account for these same phenomenon in Mabalay Atayal. We will first establish the syllable markedness constraint ranking, applying it to cases of epenthesis and metathesis. We will then establish the ranking of the footing constraints. From this base, we will be ready to analyze instances of epenthesis and metathesis which will support my thesis that footing constraints are necessary both to refine the epenthetic site and to induce metathesis. We will then analyze cases of vowel-glide alternation in light of footing. In applying OT to these phenomenon in Mabalay Atayal, we will find that its parallelist approach gives it its cutting edge on other theories.

CHAPTER 3

PROSODIC REFLEXES IN MABALAY ATAYAL

3. Introduction

In Mabalay Atayal, I have noted three phonological processes – epenthesis, metathesis, and vowel-glide alternations – for which a prosodic analysis looks promising. We want our analysis to be able to account for all three of the following data sets, preferably in a unified manner.

(83) Epenthesis:

m-in-sa̳taʒiɮ^{n} PFV	pa̳ʃtaʒiɮ^{n} JUSS	‘jump’
sa̳ʔrox-an	m-a̳ʃʔa̳rox	‘stand’
ßa̳ħaʔ-an	ß-in-ħaʔ-an PFV	‘wash (clothes)’
pa̳ɤi-an	p-in-ɤi-an PFV	‘dry (clothes)’
ka̳tariʔ	k-in-tariʔ PFV	‘kneel’
sa̳puħ-i	s-in-puħ-an PFV	‘sweep’
ka̳ɮkaħ-iʔ̳ JUSS	k-am-ɮa̳kaħ	‘kick’[32]

[32] [kamɮakaħ] ‘kick INTR’ and [kaɮkahiʔ] ‘kick JUSSIVE’ may actually be better viewed as having a~ɮ metathesis. This would also work in the final grammar, but for the sake of argument at the syllable level, I posit an underlying stem form of /kɮkaħ/.

(84)

Epenthesis	Epenthesis	Metathesis	
ka$_1$y$_2$a̳ʁ^n	k-am-a$_1$y$_2$a̳ʁ^n	k^y$_2$a$_1$ʁ-ʊn	‘speak’
ħ$_1$a$_2$ʒaɣ-an	m-a̳ħ$_1$ɐ$_2$ʒaw	βa$_2$ħ$_1$yaɣ-ʊn	‘chase’
pa̳t$_1$a$_2$ʒuaw	m-a̳t$_1$a$_2$ʒuaw	pa$_2$t$_1$ʒ^{w}aɣ-ʊn	‘work’
k$_1$a$_2$niʔ	m-a$_2$niʔ	pa$_2$k$_1$niʔ-i	‘eat’[33]
ʁa̳ŋ$_1$a$_2$ʁoŋ	ʁ-am-ŋ$_1$a$_2$ʁoŋ	ʁa$_2$ŋ$_1$ʁuŋ-ʊn	‘think, remember’
ta̳ʁ$_1$a$_2$ʔiŋ	t-am-ʁ$_1$a$_2$ʔiŋ	ta$_2$ʁ$_1$iŋ-an	‘hide (person)’
βa̳ʁ$_1$a$_2$βiʁ^n	m-a̳ʁ$_1$a$_2$βiʁ^n	βa$_2$ʁ$_1$βiʁ-an	‘tremble’

(85) Vowel-Glide Alternations:

Diphthong	Secondary Articulation	
ʔaʁiap	ʔaʁ^{y}ap-ʊn	‘hunt’
samʁia͡ts	saʁ^{y}at-an	‘cut (grass)’
maʃiaʔ	paʃ^{y}aʔ-an	‘laugh / funny’
	saʃ^{y}aʔ-an	‘make laugh’
s-am-piaʁ^n	sap^{y}aʁ-an	‘dream’
β-in-ʃiak	βaʃ^{y}ak-ʊn	‘hit’
m-ataʒuaw	patʒ^{w}aɣ-ʊn	‘work’
ʔ-am-uax	ʔ-an-^{w}ax-an	‘wash (sth.)’
maʔuas	p-a̳ʔ^{w}as-an	‘study’

In this chapter we will start at the lowest level of prosody where much former linguistic analysis has focused, taking a look at the syllable structure of Mabalay. Working within an OT framework, we will determine the ranking and interaction of syllable markedness constraints with faithfulness constraints. We will find that the ranking can sometimes give correct predictions about epenthesis, but not consistently. In §3.1.3 we will apply Mester and Padgett’s suggested ALIGN-SYLLABLE constraint to mimic directionality effects. By the end

[33] This example shows no epenthesis in [ka̲niʔ] or [maniʔ], but metathesis in causative form, [pa̲kaniʔ] ‘CAUSE eat’.

of §3.1, we will know that there is more to epenthesis than syllable wellformedness.

We will look to the next higher prosodic level for an answer to this dilemma. In so doing, we will find that an analysis which goes beyond the syllable level has more insight in dealing with not only epenthesis, but also metathesis and vowel-glide alternations, as well. Once the ranking of footing constraints is established in §3.2, its interaction with epenthesis will be analyzed in §3.2.1. We will then extend the analysis to account for instances of metathesis in §3.2.2. §3.3 takes a look at VV sequences and the hierarchy that determines their output forms. We will find that their allophones occur in positions affected by footing. Finally in §3.4 we will take a look at data that remains faithful to the input even though it means settling for a less than perfect iambic foot.

3.1 Syllable Markedness Constraints

The hierarchical organization of the syllable markedness constraints, PEAK, ONSET, NO CODA, CODA CONDITION, and NO COMPLEX as defined in §2.2.2.3, determines what syllable shapes a language permits. Faithfulness constraints such as DEP, MAX, and LIN interact with the syllable markedness constraints. The ranking of the crucially interacting constraints determines the strategies the language will use to resolve poorly formed 'faithful to input' syllables. In this section, we will establish that ranking for the Mabalay dialect of Atayal.

3.1.1 Establishing the Crucial Syllable Constraint Rankings

In Mabalay Atayal, we see the following syllable shapes.

(86) CV inventory of Mabalay syllables:

CV	[pu.niʔ] 'fire', [ʔa.ɮʸa.pʊn] 'hunt PAT', [ʔa.ɮa.ʔiʔ] 'child'
	[kʸa.ɮʊn] 'speak PAT', [sʷa.yaɮⁿ] 'agree',
CVC	[ßin.kis] 'ancestors', [poŋ] 'hear',
CVVC	[ʔam.ɮiap] 'hunt INTR', [ʔuas] 'song',

We note that every syllable in the inventory has an onset. There are no V or VC syllables. Since it is unlikely that all lexical inputs are C-initial, some word initial glottals must be epenthetic.[34] This entails that ONSET is undominated, thus requires violations of DEP whenever an onset is not provided by the input. A vowel is also always present to fill the syllable peak. In some words, the position of a vowel varies from one derivation to another as in [pa̳.k_1a_2.ní ʔ] 'CAUSE eat' versus [pa$_2$k$_1$.ni.ʔí] 'eat JUSSIVE'. Other words have a vowel present in one form of the word and absent in another, as in the double-underlined /a/ in

[34] The fact that prefixation can be accompanied by word initial consonant deletion of not only glottal, but also /ß/, /ɣ/, /p/, /k/ makes it difficult to prove whether /ʔ/ was epenthetic or lost. However, the fact that there are no onsetless syllables speaks up in support of epenthetic glottal onset.

[pa̲̲.ka.ní ʔ] 'CAUSE eat' above. I posit that these are metathetic and epenthetic vowels, respectively. Epenthesis is a violation of DEP; metathesis, a violation of LINEARITY. This gives us the following ranking:

(87) Onset, Peak >> Dep(V), Lin

Quite regularly, input CC is output as CV̲C. This can be seen in data set (88).

(88)	a. /p-kaniʔ/	[pa̲̲.ka.niʔ]	'CAUSE eat'	*[pka.niʔ]
	/ʒŋaʒuŋ/	[ʒa̲̲.ŋa.ʒuŋ]	'think'	*[ʒŋa.ʒuŋ]
	b. /p- kaniʔ -i/	[pa$_2$k$_1$.ni.ʔi]	'eat JUSSIVE'	*[pk$_1$a$_2$.ni.ʔi]
	/ʒŋaʒuŋ -un/	[ʒa$_2$ŋ$_1$.ʒu.ŋun]	'remember PAT'	*[ʒŋa.ʒu.ŋun]

From this we gather that the constraint NO CC ranks higher than DEP(V) (permitting epenthetic vowels) and LIN (permitting metathesis).

(89) ONSET, PEAK, NO CC >> DEP(V), LIN

Tableau (90) shows an instance of what Broselow (1982) termed syllable level epenthesis, while tableau (91) shows metathesis. Although the tableaux prove NO CC ranks above DEP(V) and LIN, the present constraints – however ranked – could not decide between epenthesis and metathesis. The symbol, ☞, indicates Eval's choice of optimal candidate; (☞) indicates this is the attested form, but it was not chosen by Eval; ☞!! indicates Eval chose this rival, but it is not the attested form. These symbols will be used throughout the paper.

(90) Tie, but attested form is formed by epenthesis: [ɮa̳ŋaɮuŋ] ‘think’

/ɮŋaɮuŋ/	ONSET PEAK	NOCC	DEP(V) LIN
a. (☞) ☞ [ɮa̳.ŋa.ɮuŋ]			*
b. [ɮŋa.ɮuŋ]		*!	
c. ☞ [ɮa$_2$ŋ$_1$.ɮuŋ]			*

(91) Tie, but attested form undergoes metathesis: [ɮa$_2$ŋ$_1$.ɮu.ɲun] ‘remember’

/ɮŋaɮuŋ -un/	ONSET PEAK	NOCC	DEP(V) LIN
a. (☞) ☞ [ɮa$_2$ŋ$_1$.ɮu.ɲun]			*
b. [ɮŋa.ɮu.ɲun]		*!	
c. ☞ [ɮa̳ŋ.ɮuŋun]			*

Judging from the high ranking of ONSET, we would expect the grammar to aim for the same CV target structure and split V_iV_j sequences by an epenthetic consonant, but this does not occur. Neither is one or the other vowel of the sequence deleted.

(92) /ptaʒuaɣ/ [pa̳taʒuáw] ‘work INTR’ *[pa̳.ta.ʒu.ʔ̳áw]
*[pa̳.ta.ʒu.w̳áw]
*[pa̳.ta.ʒáw]
*[pa̳.ta.ʒúw]

/am- ɣnauʔ/ [ɣamnáuʔ] ‘joke INTR’ *[ɣam.na.úʔ]
*[ɣam.na.wúʔ]
*[ɣam.núʔ]

Instead, V_iV_j sequences are realized as diphthongs, as shown in (92). This implies a ranking of ONS, MAX, DEP© >> NODIPH, as shown in tableau (93).

(93) Vowel sequences remain in output: [ɣamnauʔ] 'joke INTR'

/am- ɣnauʔ/	MAX ONS	DEP©	NODIPH
a. ☞ [ɣam.náuʔ]			*
b. [ɣam.na.w̳úʔ]		*!	
c. [ɣam.na.úʔ]]	*!		
d. [ɣam.núʔ]	*!		

The collated ranking to this point is given in (94) below.

(94) Peak, Ons, Max, No CC >> Dep©, Dep(V), Lin >> NoDiph

3.1.1.1 Word Final Consonant Epenthesis

Atayal lexical words all end in a consonant.[35] If there is no word-final consonant in the input, it is supplied in the output by an epenthetic glottal. Observe the following data.

[35] The jussive form /-i/ seems to vary, sometimes being pronounced [~i] and sometimes [~i?]. It has not been resolved why this suffix behaves differently. Whether pronounced [~i] or [~i?], it carries stress. The free variation occurs in an isolated word list as well as within phrases. In an isolated wordlist, /-i/ is not only prosodic word final – where it should be stressed, but also intonational phrase final – where it should receive even more stress.

(95) Word-final ʔ-epenthesis

INPUT	OUTPUT	GLOSS	FORM WITH NO [ʔ]	GLOSS
/an- ßakħa/	ßanakħɐʔ	break PFV	ßakħɐ-un ßakħɐ-an	break TRANS.PAT break TRANS.LOC
/am- satu/	samatuʔ	send INTR	satu-un satu-an	send TRANS.PAT send TRANS.LOC
/am- si/	samiʔ	put INTR	si-an si-un	put TRANS.LOC put TRANS.PAT
/am- ħkaŋi/	ħɐmkaŋiʔ	seek INTR	ħɐkaŋi-an	seek TRANS.LOC
/sinħi/	sinħəiʔ	believe INTR	sinħə-un	believe TRANS.PAT
/am- ktri/	kamtariʔ	kneel INTR	k-in-tari-un	kneel PFV TRANS.PAT
/m- paŋa/	mapaŋaʔ	carry on back INTR	paŋa-an	carry on back TRANS.LOC
/am- sßu/	samaßuʔ	shoot INTR	ßu-an	shoot TRANS.LOC

All of these words would end in a light syllable if it were not for the glottal. If we could find an epenthetic glottal after a rising sonority diphthong, /ia/ or /ua/, then we would know that the glottal is not inserted to meet a moraic requirement. We could then be quite sure that what we need is an alignment constraint, FIN-C. If /ia/ or /ua/ were never followed by an epenthetic glottal, then we would know it is because they are already heavy syllables and don't need the extra mora.[36] Epenthetic glottal would then be added only to light syllables for reasons of syllable weight to ensure an iambic foot.[37]

I have only found one such word where the glottal seems to be epenthetic, that is in [paʔ.ʃiaʔ] 'water (vb.)'. When suffixed with [-an], it is commonly pronounced [paʔ.ʃʸaːn] or [paʔ.ʃʸa.ʔán]. Since its pronunciation varies, we do not have a strong case either way. For now, I will posit an Align constraint keeping in line with our syllable level analysis. The constraint, ALIGN(PRWD R, CONSONANT R), will ensure every prosodic word ends in a consonant. We will refer to it as FIN-C.

(96) FINAL-C (FIN-C):
A prosodic word must end in a consonant.

It is crucial that MAX ranks above FINAL-C so that an input word-final consonant is neither deleted nor syllabified as an onset through word-final vowel epenthesis. (Although vowel epenthesis entails a DEP(V) violation, DEP(V) does not need to be ranked above FIN-C to eliminate such a rival as the DEP(V) violation also causes a violation to FIN-C itself.) It is also crucial that FINAL-C rank above NO CODA and DEP© as it is only in this way that epenthesis can supply the missing consonant. This is verified in tableaux (97) and (98) below.

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[36] For a discussion on the moraic weight of diphthongs, see §3.3.2.1. All Mabalay diphthongs are treated as bimoraic in this analysis.

[37] We cannot use a falling sonority diphthong because /au/ or /ai/ could be being realized as [aw] or [ay] to meet the FINAL-C alignment constraint or remaining [au] or [ai] as it already meets the moraic weight

(97) Max, Dep >> No Coda:
/CVCVC/ → [CV.CVC] as seen in [wiʒoŋ] 'chicken'

/wiʒuŋ/	MAX	DEP(V)	FIN-C	NO CODA	DEP©
a. ☞ wi.ʒoŋ				*	
b. wi.ʒu.ŋa̲		*!	*		
c. wi.ʒu_	*!		*		

(98) Max, Final-C >> No Coda, Dep©:
/CVCV/ → [CV.CVʔ] as seen in [ʔaßiʔ] 'sleep'

/ʔaßi/	MAX	DEP(V)	FIN-C	NO CODA	DEP©
a. ☞ ʔa.ßiʔ̲				*	*
b. ʔa.ßi			*!		
c. ʔaß._	*!		*		

3.1.2 The Coda Condition Family of Constraints

In Mabalay Atayal, the following phones can be found in coda positions; [p, t, k, ʔ, m, n, ŋ, ts, ʃ, x, ħ, ʒ, ʒⁿ, w, and y]. In data set (99) we see that there must be a condition on the coda. Input /ɣ/ appears as /ɣ/ in onset position, but as /w/ in the coda.

(99) Allophonic variation in coda

requirement. The problem is it is very difficult to hear any difference between these two representations. We, therefore, need to hear it on a rising sonority diphthong.

Isolated form	Suffixed form PAT	
[βaħaʒaw̲]	[βaħyaɣ̲un]	‘chase’
[na.βuw̲]	[na.βuɣ̲un]	‘drink’
[pa.ta.ʒuaw̲]	[pat.ʒua.ɣ̲un]	‘work’

/β/, /ʒ/, and /ɾ/, while having no allophonic alternation, do not occur in coda position. Historically, /p/ was an allophone of /β/ occurring in coda position, but in the present day Mabalay dialect, /β/ appears to have been reanalyzed as /p/ in the input form. For instance, in [ʔamsuyap] ‘yawn INTR’ and [suyap-an] ‘yawn LOC’, /p/ does not alternate with /β/ in the Mabalay dialect as it does in a Squliq dialect: [suːyap] ‘yawn’, [syaβ-an] ‘yawn LOC’, and [syaβ-un] ‘yawn-PAT’(Rau, 1992:29). In the same way, /ʒ/and /ɾ/ are also absent from the coda position. /ɮ/, on the other hand, can fill coda position word internally, but word finally it is conservatively /ɮ^{n}/ – now changing to /n/.

The allophonic alternation means CODA CON is ranked above the relevant IDENT-IO constraint. That coda conditions show up at all means CODA CON ranks higher than NO CODA. NO CODA is a general constraint banning all codas; CODA CON is more specific, banning only certain segments from coda position. The specific constraint must rank above the general in order to be seen at all, therefore, CODA CON >> NO CODA. Word internally, syllabification as an onset via vowel epenthesis is one way for a segment unacceptable as a coda to satisfy CODA CON, but word-final syllables do not have such an option. Due to FIN-C, they must have a coda. FIN-C forces a coda to stay, therefore, MAX, DEP(V) >> FIN-C. Neither is deletion of an offending coda an option, which means MAX ranks on par, if not above, CODA CON.

(100) CODA CON: No voiced obstruent or liquid codas.

This gives us the following ranking:

(101) MAX, CODA CON>> IDENT-IO, DEP(V) >> FINAL-C >> NO CODA

(102) A word internal voiced obstruent forms an onset via vowel epenthesis.
[sa̳.ɣa̳.ʒ̵u.tóx] • 'love'

/sɣʒ̵utux/	MAX	CODA CON	IDENT-IO DEP(V)	FIN-C	NO CODA
a. ☞ sa̳.ɣa̳.ʒ̵u.tóx			**		*
b. sa̳w.ʒ̵u.tóx			**		**!
c. sa̳ɣ.ʒ̵u.tóx		*!	*		**
d. sa̳.ʒ̵u.tóx	*!		*		*

Tableau (102) verifies that a voiced obstruent will never fill a word internal coda position, as in rival ©, as this comes at too high a price. Due to the ranking, the violation against CODA CON is more serious than the optimal candidate's two DEP(V) infractions. Deletion is just as costly a violation, as rival (d) can verify. Rival (b) is a close contender with (a), but the extra violation made against NO CODA proves fatal. Mabalay Atayal prefers epenthesis to a change in consonantal identity word internally.

(103) A word final voiced obstruent changes identity.
[pa̳.ta.ʒuaw] ‘work’

	/ptaʒuaɣ/	MAX	CODA CON	IDENT-IO DEP(V)	FIN-C	NO CODA
a. ☞	pa̳.ta.ʒuaw			**		*
b.	pa̳.ta.ʒʷa.ɣa̳			**	*!	
c.	pa̳.ta.ʒuaɣ		*!	*		*
d.	pa̳.ta.ʒua_	*!		*	*	

Tableau (103) shows that word finally, voiced obstruents take a different tact; they cannot be parsed as onsets like rival (b) due to violations this would cause against DEP(V) and FIN-C. The mark against FIN-C proves fatal because FIN-C ranks above NO CODA, which is violated by candidate (a). Although DEP(V) ranks above FIN-C, its tie at this point with the optimal candidate makes the mark against FIN-C the deciding factor. The most faithful candidate, (c), fails on the CODA CON and rival (d) incurs a fatal mark against high ranking MAX. The change in identity proves best as FINAL-C is still satisfied without incurring high ranking constraint violations.

In spite of our success in selecting the optimal candidate from inputs with voiced obstruent codas, tableau (104) reveals that this ranking is unable to select the attested candidate for [kaɮkaħiʔ] ‘kick JUSSIVE’.

(104) Current ranking fails for [kaɮkaħiʔ] ‘kick JUSSIVE’:

	/kɮk$_1$a$_2$ħ -i/	MAX	CODA CON	IDENT-IO	DEP (V)	LIN	FIN-C
a. (☞)	ka̳ɮ.ka.ħiʔ̳		*!		*		
b. ☞!!	ka̳n.ka.ħiʔ̳			*	*		
c. ☞!!	ka̳.ɮa̳.ka.ħiʔ̳				**		
d. ☞!!	ka̳.ɮa$_2$k$_1$.ħiʔ̳				*	*	

Eval is unable to decide on an optimal candidate based on the current ranking, However, it has eliminated candidate (a), which is actually the attested candidate. Because /ɮ/ behaves differently from /ß/ and /ɣ/, the coda constraint needs to be decomposed so that other constraints can intervene, interacting with one and not affecting the other. The following section takes on the discussion of breaking down CODA CON into its composite parts and ranking the subsidiary constraints among IDENT constraints such that codas are properly restricted and the correct allophone is chosen.

3.1.2.1 The CODA CON Family of Constraints and Allophone Selection

Most of the constraints have very universal definitions. The reader is referred back to §2.2.2.3 for a discussion of these constraints. CODA CON, however, is more language specific. Theoretically speaking, a language specific definition is not what is required. Rather, CODA CON is a family of markedness constraints, like – NO VOICED OBSTRUENT CODA, NO OBSTRUENT CODA, NO LIQUID CODA, NO NASAL CODA, NO GLIDE CODA, NO CODAS WITH PLACE. These are each in conflict with one or more of the feature identity faithfulness constraints, IDENT-

IO(VOI), IDENT-IO(SON), and IDENT-IO(CONT). If a markedness constraint ranks below MAX but above its relevant IDENT-IO(F) constraint, it must change its feature identity to that of a suitable coda. Deletion is not an option. The effects of those markedness constraints ranking below their relevant IDENT-IO constraint will only emerge when all rivals tie on violations of the higher identity constraints. The ranking of these constraints in the Mabalay dialect is such that the coda condition is ‘no voiced obstruent or liquid codas’. This outcome is due to ranking Max >> NO VOICED OBSTRUENT, NO LIQUID >> IDENT-IO(voi)>> IDENT-IO(son) >> IDENT-IO(cont). Then, below the IDENT-IO constraints are NO NASAL >> NO GLIDE further refining the choice of sonorants. Input voiceless obstruents nasals and glides remain faithful in output because their rivals all fail on the IDENT-IO constraints. Tableau (105) verifies this.

(105) CODA CONDITION internal hierarchy

/CVɣ/	MAX	*VD OBS]	*LAT]	IDENT-IO(VOI)	IDENT-IO(SON)	IDENT-IO(CONT)	*NAS]	*GL]
a. ☞ CVw					*			*
b. CVŋ					*	*!	*	
c. CVx				*!				
d. CVk				*!				
e. CVɣ		*!						
f. CV	*!							

We see that voiced obstruent codas are never tolerated due to the high rank of *VDOBS], but undominated MAX ensures they do not delete. The fact that /ɣ/ alternates with /w/ rather than /x/ or /k/ suggests that a change in voice identity proves more fatal than a shift in sonorancy, hence the ranking of

IDENT(voi) higher than IDENT(son). Further, because the two most serious rivals tie on IDENT-IO(son), we see the effects of lower ranked IDENT-IO(cont) and *NAS] in choosing the glide, /w/, above its nasal counterpart, /ŋ/.[38]

The segments /ɮ/ and /r/ are all but lost from coda position now, too. /r/ is absent from coda in the distribution, but no variation is found between it and another segment. Conservative speakers still pronounce /ɮ/ as /ɮ^{n}/ in word final coda position and /ɮ/ word internally. Now for younger speakers, word final /ɮ^{n}/ has lost its primary articulation and become /n/. Word internally, /ɮ/ can take coda position.

(106) Alternation between /ɮ/ and /ɮ^{n}/ ~ /n/

Medial	Final-Younger Speakers	Final-Older Speakers	
kyaɮ-un	k-am-ayan	k-am-ayaɮ^{n}	'speak INTR'
patɕisaɮ-an	matɕisan	matɕisaɮ^{n}	'chat INTR'
ɣaɮ-un	m-aɣan	m-aɣaɮ^{n}	'take INTR'
sauɣaɮ-an	s-am-auɣan	s-am-auɣaɮ^{n}	'like/want INTR'

The same ranking that chose /w/ as the allophone of /ɣ/ shows that /n/ or /ɮ^{n}/ will be chosen above /ɮ/ as a word final coda. The difference between younger and older people's grammar will lie in the ranking of *SECART[39]

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[38] The same ranking could not get the historical ß → p word finally, however Mabalay has reanalyzed the input as /p/ throughout the lexicon. /ʒ/ likewise are absent from coda position. Suffixation never causes their word internal appearance.

[39] For a definition of *SECART, refer to (143).

and *NAS]. Word internal /ɮ/ codas, although violating *LAT], are forced into coda position by higher ranking DEP(V). Tableau (107) shows /ɮ/ in the input changing its identity by taking on a secondary nasal articulation in the speech of older people.[40] Perceptually, in word final position nasality follows the fricative lateral, making the edgemost part of the coda nasal. By ranking *VDOBS] >> DEP(V) >> *LAT], the behavior of /ɮ/ can be accounted for.

(107) The grammar of older speakers chooses /ɮ^n/ over /n/ word finally because *NAS] >> *SECART. [matɕisaɮ^n] 'chat, play'

/m- tisaɮ/	MAX *VDOBS]	DEP (V)	*LAT]	IDENT (voi) IDENT (son)	IDENT (cont)	IDENT (nas)	*NAS] *GL]	*SEC ART
a. ☞ ma̳.tɕi.saɮ^n		*			*	*		*
b. ma̳.tɕi.san		*			*	*	*!	
c. ma̳.tɕi.saħ		*		**!				
d. ma̳.tɕi.sat		*		**!	*			
e. ma̳.tɕi.saɮ		*	*!					
f. ma̳.tɕi.sa.ɮa̳		**!						
g. ma̳.tɕi.saɣ	*!	*		*				
h. ma̳.tɕi.sa_	*!	*						

Tableau (108) shows that as long as a coda is not a voiced obstruent or liquid, it passes through Eval unscathed. Its rivals fail on the identity constraints.

[40] A constraint such as *SECONDARY ARTICULATION may have diachronically shifted higher in the ranking to force the loss of secondary articulation in coda position. Moving from below *NAS to just above it would be sufficient to cause this diachronic change. That it is /ɮ/ that is lost rather than /n/ follows from the ranking of CODA CON family of constraints. There is no need to specify which branch of the feature geometry tree was severed.

(108) CODA CON: Voiceless obstruents, nasals and glides are permitted.
[ʔuas] ‘song’

/ʔuas/	MAX *VDOBS]	DEP (V)	*LAT]	IDENT (voi)	IDENT (son)	IDENT (cont)	*NAS] *GL]
a. ☞ ʔuas							
b. ʔuat						*!	
c. ʔuay				*!	*		*
d. ʔuan				*!	*	*	*
e. ʔua.sa̳		*!					
f. ʔuaʒ	*!			*			
g. ʔua_	*!						

Coda condition, *LAT], is crucially interacting with DEP(V). By ranking below DEP(V), liquids can fill word internal codas since an onset parse comes at the cost of a DEP(V) violation. In tableau (109), [kaɮkaħan] ‘kick LOC’, we see that the interaction of the coda constraints with DEP(V) resolves the problem encountered in (104). Based on the posited input, epenthesis is required at least once. The choice between a second epenthetic vowel or a violation of *LAT] is determined by the ranking of DEP(V) above *LAT]. In (110), [kamɮakaħ] ‘kick INTR’, the choice concerns the position of the epenthetic site – the same problem Itô grappled with.[41] With both contestants tying on DEP(V), the attested site is chosen as optimal based on the ranking of *LAT] above *NAS]. In other

[41] [kaɮ.kaħ.an] and [kam.ɮa.kaħ] are at this point treated with an input suitable for epenthesis. Metathesis is actually the better analysis, but our analysis cannot handle the input at this point. Higher level prosodic constraints are needed.

words, the site is determined by choosing the candidate that best satisfies the coda conditions.[42]

(109) Interaction of CODA CON constraints with DEP(V):
[kaɮ.ka.ħan] 'kick TRANS-LOC'

/kɮkaħ -an/	PEAK ONSET MAX *VDOBS]	NO CC	DEP (V)	*LAT]	FIN-C	NO CODA DEP©
a. ☞ ka̲ɮ.ka.ħán			*	*		**
b. ka̲.ɮa̲.ka.ħán			**!			*

(110) The epenthetic site is determined by the rival with the best codas.
[kamɮakaħ] 'kick INTR'

/am- kɮkaħ /	PEAK ONSET MAX *VDOBS]	DEP (V)	*LAT]	FIN-C	*NAS]	NO CODA DEP©
a. ☞ kam.ɮa̲.kaħ		*			*	**
b. ka.ma̲ɮ.kaħ		*	*!			**

Now that we have seen the internal workings of the coda conditioning constraints, we will continue working with the two active constraints, *VDOBS] and *LAT]. By decomposing CODA CON, we have been able to rank *LAT] below DEP(V), leaving *VDOBS] above. Since violations of DEP(V) are more serious than violations against *LAT], /ɮ/ can be forced into coda position under duress.

[42] A much more insightful analysis can be made at a higher prosodic level. Compare this with §3.2.1. tableau (138) [kaɮħaŋan] 'take care of'. From an input of /kɮ$_1$a$_2$kaħ-an/, [kaɮ.kaħ.an] 'kick' would have an identical tableau.

3.1.2.2 Crucial Rankings

Listed below is a summary of the constraint rankings that have been discussed in this section.[43]

(89) ONSET, PEAK, NO CC >> DEP(V), LIN

(93) ONSET, MAX, DEP© >> NODIPH

(94) PEAK, ONS, MAX, NO CC >> DEP©, DEP(V), LIN >> NODIPH

(97) MAX , DEP(V) >> NO CODA

(98) MAX, FIN-C >> NO CODA, DEP©

(101) MAX , CODA CON >> IDENT-IO, DEP(V) >> FIN-C >>NO CODA

(109) *VDOBS] >> DEP(V) >> *LAT] >> FIN-C

Tableau (111) shows that our crucial rankings accurately predict epenthesis is the best syllabification strategy for [k-a.m-a.ya̳ɮʒ^{n}] 'speak INTR'. Candidates (b) and (c) fail with violations against MAX, while (d) although faithful violates *LAT] and NO CC. Rival candidate (e) undergoes metathesis to avoid rival (d)'s unacceptable coda cluster, but still fails on NO CC.[44] Rival (f) attempts to satisfy NO CODA, but fails on MAX as well as violating DEP(V) and FIN-C – all

[43] These rankings are subject to change with the introduction of higher levels of prosody. In particular, we will find that Dep(V) and LIN will demote somewhat to be on the same level as *LAT].

[44] Making a *SecArt violation instead of a No CC violation would cause a fatal violation of IDENT-σ'(SEG). For the details of this analysis, see §3.3.2.3.

higher ranking than NO CODA. The worst mark made by (a) is against low ranking DEP(V) making epenthesis the best choice.

(111) Syllable wellformedness hierarchy

/am- kayl/	MAX PEAK ONS *VDOBS]	NO CC	DEP(V) LIN	*LAT]	FIN-C	NO CODA DEP©
a. ☞ ka.ma.yan			*$_{DEP}$			*
b. ka.m_yan	*!$_{MAX}$		*$_{DEP}$			*
c. kam_.yan	*!$_{MAX}$		*$_{DEP}$			**
d. ka.mayɮ_		*!		*		*
e. ka.my$_2$a$_1$n		*!	*$_{LIN}$			*
f. ka.ma.ya_	*!$_{MAX}$		*$_{DEP}$		*	

3.1.2.3 Problems

From this we would conclude that epenthesis is the only strategy Mabalay needs to form good syllables. However, we find that the above grammar cannot handle all of the data. As we saw in (90) and (91), the grammar cannot decide when to use vowel epenthesis and when to use metathesis, yet Mabalay employs both. Furthermore, it cannot correctly determine when to accept a consonant plus glide sequence and when to split it by epenthesis.

In that it meets Sonority Distance, [swayaɮ^n] 'agree' has an acceptable cluster, yet Eval prefers the rival which forms an extra CV syllable.[45] The DEP(V) violation is less costly than a mark against NO CC. Constraints pertaining to

[45] Later analysis will find Sonority Distance unnecessary once *SecArt is introduced in §3.3.2.3.

other than syllable form are necessary to accurately select [swa.yaɮ^{n}] ‘agree’.[46] With a grammar that pays attention only to syllable wellformedness, Eval chooses an unattested rival as optimal.

(112) swa.yáɮ^{n} ‘agree’
p-a̳ʃ.wa.yaɮ^{n} (~ pa̳.sa̳.wa.yaɮ^{n})[47] ‘will agree’

Since slow speech verifies that /w/ is separable from /s/, we are working with an input of /swayaɮ/.

(113) [swa.yaɮ^{n}] ‘agree’

/sw$_{1}$a$_{2}$yaɮ/	ONSET PEAK MAX *VDOBS] SD	NOCC	DEP(V) LIN	*LAT]	FIN-C	NO CODA DEP©
a. (☞) sw$_{1}$a$_{2}$.yaɮ^{n}		*!				*
b. ☞ !! sa̳.w$_{1}$a$_{2}$.yaɮ^{n}			*			*
c. sa$_{2}$w$_{1}$.yaɮ^{n}			*			**!

3.1.3 Align Syllable: an untenable analysis

We noted that Mester and Padgett (1994) were able to mimic Itô’s directionality parameter through a syllable alignment constraint. The constraint

[46] In §3.3.2.3 we discuss *SECART, and WNB. In §3.2 we discuss the effects of PARSE σ. [s^{w}a.yaɮ^{n}] violates *SECART, not high ranking NO CC. It fits the pattern of glide formation in the penultimate syllable although it is not for purposes of mora reduction – the usual purpose of secondary articulation. However, it gives a better syllable parse than rival (b) in tableau (112). Both PARSE σ and WNB have to do with the higher prosodic level of footing.

[47] If in slow speech it is possible to put an epenthetic vowel between a consonant and glide, the glide is a consonant in the input, not the first vowel of a diphthong.

was gradiently calculated in number of mora. I now posit Align-Syll and show that it cannot solve our problems. We noted in §2.1.3. that L-R syllabification was required for Mabalay Atayal. Align(R) corresponds to Itô's L-R syllabification.

(114) Align(Syll R, PrWd R):
The right side of every syllable must be aligned with the right side of every prosodic word.

(115) Align-Syll fails to select [swa.yaɮ^{n}] 'agree' as the optimal candidate.

/swayaɮ/	Onset Peak Max *VdObs] SD	Align- Syll	No CC	Dep (V) Lin	*Lat]	Fin -C	No Coda Dep ©
a. (☞) sw$_1$a$_2$.yaɮ^{n}		μμ	*!				*
b. sa̳.w$_1$a$_2$.yaɮ^{n}		μμ μμμ !		*			*
c. ☞ !! sa$_2$w$_1$.yaɮ^{n}		μμ		*			**

Align is optimally ranked above No CC, causing it to be effective in eliminating candidate (b); breaking up an acceptable consonant-glide sequence with epenthesis is not desired. However, it still fails to eliminate rival candidate (c), which uses metathesis to break up the consonant-glide sequence. Because the word is only two syllables in length, metathesis does not increase the mora count made by Align-Syll and candidate (c) is chosen above the attested form, candidate (a).

(116) ALIGN-SYLL accurately selects [ʒa₂ŋ₁.ʒu.ŋun] as optimal.

/ʒŋaʒuŋ -un/	PEAK ONSET MAX *VDOBS]	ALIGN-SYLL®	NO CC	DEP (V) LIN	*LAT]	FIN -C	NO CODA DEP©
a. ☞ ʒa₂ŋ₁.ʒu.ŋun		μμμ μμ		*			**
b. ʒa̳.ŋa.lu.ŋun		μμμμ μμμ μμ !		*			*

Tableau (116) shows that ALIGN-SYLL improves our analysis for some words. The difference between the failure and success of tableaux (115) and (116) lies in which syllable has a coda. The attested candidates do not have a coda in the penultimate syllable, but ALIGN-SYLL fails to make this distinction.

(117) ALIGN-SYLL fails to select [ʒa.ŋa.ʒoŋ] as optimal.

/ʒŋ₁a₂ʒuŋ/	PEAK ONSET MAX *VDOBS]	ALIGN-SYLL®	NO CC	DEP (V) LIN	*LAT]	FIN -C	NO CODA DEP ©
a. (☞) ʒa̳.ŋ₁a₂.ʒoŋ		μμ μμμ!		*			*
b. ☞ !! ʒa₂ŋ₁.ʒoŋ		μμ		*			**

Again in tableau (117) ALIGN-SYLL fails to select the attested candidate, (a), as optimal, choosing rather the shortest word. Once again, the candidate Eval chooses has a heavy penult, whereas the attested candidate does not.

Even if we change the input so as to interpret all candidates as making violations against DEP(V) rather than LIN, ALIGN-SYLL cannot rescue the ranking.[48] Observe tableau (118).

(118) ALIGN-SYLL fails to select [ʒa.ŋa.ʒoŋ] as optimal. Input: /ʒŋʒuŋ/

/ʒŋʒuŋ/	PEAK ONSET MAX *VDOBS]	ALIGN-SYLL(R)	NO CC	DEP (V) LIN	*LAT]	FIN -C	NO CODA DEP (C)
a. (☞) ʒa̳.ŋa̳.ʒoŋ		μμμ μμ !		**			*
b. !! ☞ ʒa̳ŋ.ʒoŋ		μμ		*			**

ALIGN-SYLL has been ranked in the best possible position to make it succeed, yet it only has a sporadic success rate. In the tableau above, the distance of the right edge of each syllable is calculated in mora from the right edge of the word. It has the effect of maximizing on the coda of the first syllable in need of epenthesis as the moras of this syllable go uncounted, but like Itô's directional syllabification, cannot handle the whole scope of epenthetic decisions to be made in the Mabalay data.

3.1.4 Vowel-Glide Alternation

To this point, I have treated all consonant sequences as clusters, but it is possible to analyze consonant plus glide as a consonant with a secondary articulation. This is the preferred analysis for Mabalay Atayal, but syllable level

[48] Broselow (1992:34) suggests that for Itô's directional syllabification to be able to account for syncope, it requires all potentially syncopated vowels removed from input. Likewise, if potentially metathesized vowels were removed from input, they can be considered cases of epenthesis rather than metathesis. (See §0).

constraints alone cannot determine when secondary articulation should be used and when it should be pronounced as a diphthong. This can be seen in the following tableaux. Tableaux (119) and (120) show us that if *SECART ranks above NODIPH, glide formation is never induced.

(119) *SECART >> NODIPH: correctly chooses [amɮiap] 'hunt INTR'

	/am- ʔɮiap/	*SECART	NODIPH
a. ☞	ʔamɮiap		*
b.	ʔamɮʸap	*!	

(120) *SECART >> NODIPH: incorrectly chooses [ʔaɮiapʊn] instead of the attested form [ʔaɮʸapʊn] 'hunt LOC'

	/ʔɮiap -un/	*SECART	NODIPH
a. (☞)	ʔa.ɮʸa.pʊn	*!	
b. ☞ !!	ʔa.ɮia.pʊn		*

Alternatively, if NODIPH ranks above *SECART, glide formation will apply to all V_iV_j sequences of rising sonority, as seen in tableaux (121) and (122).

(121) NODIPH >> *SECART: incorrectly chooses [ʔamɮʸap] instead of the attested form, [ʔamɮiap] 'hunt INTR'

	/am- ʔɮiap/	NODIPH	*SECART
c. ☞	ʔamɮiap	*!	
d.	ʔamɮʸap		*

(122) NODIPH >> *SECART: correctly chooses [ʔaɮʸapʊn] 'hunt LOC'

	/ʔɮiap -un/	NODIPH	*SECART
c. (☞)	ʔa.ɮʸa.pʊn		*
d. ☞ !!	ʔa.ɮia.pʊn	*!	

We must conclude that there is no syllable level constraint that can determine the location of secondary articulation over a diphthong pronunciation. Vowel-Glide alternation will be taken up in §3.3.2.3 where higher prosodic levels will supply the missing constraints.

3.1.5 Conclusion

We are forced to conclude that there is more to Mabalay epenthesis, metathesis and vowel-glide alternation than syllabification alone. Rather than trying to mimic directionality which only helps some of the time, we look now to footing – the next higher level of prosodic constraints. At this higher level, we will find that not only epenthesis and metathesis, but also vowel-glide alternations are prosodic reflexes of footing constraints. Once the ranking for footing constraints is determined, these constraints need to be incorporated into the grammar of syllable wellformedness. As we see syllabification and footing conflicts resolved, a hierarchy will be established that gives only the attested output forms.

3.2 Footing Constraints

Although this part of the analysis will be very straightforward, it is necessary to establish the constraint hierarchy for footing and stress assignment since it interacts with syllable wellformedness constraints. It is at the core of all that follows.[49]

Stress is always on the ultimate syllable of lexical words. Although a (H́) moraic trochee would be a possible analysis, it does not hold for all the data. If the foot form were trochaic, stress should show up on the penult whenever the final syllable of a word is light, as in [pak.ni.ʔí] 'CAUSE-eat-Juss', but it does not. The fact that we never hear stress on the penult even when the ultima is light, yet always hear stress on the ultima, means that what we are dealing with here is an iambic foot. I have called this constraint FOOT FORM(IAMB). Being iambic, it must also be moraic as quantity insensitivity is only possible in trochaic feet (Hayes, 1995). The inventory of possible moraic iambs, (ˈH), (L.ˈH), and (L.ˈL), follows from the constraint interaction of IAMB, FOOTBINARITY, and Weak-nodes-do-Not-Branch.

(123) FOOT FORM (IAMB):
Feet are right-headed.

(124) FOOT BINARITY(FTBIN):
Feet are binary at the syllable or moraic level.

(125) WEAK-NODES-DO-NOT-BRANCH (WNB):
The weak node of a foot does not branch; it cannot be bimoraic.

[49] See the appendix for an acoustic analysis of stress in Mabalay.

I have taken Hayes' (1980:80) Weak-Nodes-Do-Not-Branch Principle as a constraint. Its validity as a constraint will be proven by the analysis to follow. It scans only parsed feet. An unparsed heavy syllable is ignored. The Weight-to-Stress Principle (WSP), on the other hand, scans the prosodic word for the heavy syllables (Prince, 1990). It would be violated by not parsing a heavy syllable and making it the head of a foot. In other words, if heavy, then stress. In Mabalay Atayal, this constraint ranks low and has no effect whatsoever.

(126) WEIGHT-TO-STRESS PRINCIPLE (WSP):
Heavy syllables are prominent in foot structure and on the grid.

An iambic foot could theoretically fall anywhere in the word. But the only way to have stress fall on the final syllable is to force the iambic foot to the right edge of the prosodic word. To this end, I posit an ALIGN(FOOT, R, PRWD, R) constraint. From this point on, it will be referred to in its abbreviated form, ALIGN-FT.

(127) ALIGN-FT:
The right edge of every foot must align with the right edge of the prosodic word.

The high ranking of this constraint will not only force the foot to the right edge of the prosodic word, it will also ensure that there is only one foot per word. This is due to the asymmetry in the definition of Generalized Alignment (GA). GA states that there is 'universal quantification over the first constituent argument, existential quantification over the second,' (McCarthy and Prince, 1993:16).

Since FOOT R is the first argument, this entails that the distance of *each* foot from the right edge of the word is calculated in terms of syllables. Therefore, even if a foot aligns right, a contiguous foot must violate ALIGN-FT by one or two syllables. A word parsed in this manner, (σ ‘σ) (σ ‘σ), would earn two violations of ALIGN-FT. A candidate with only one parsed foot can, therefore, escape violations of ALIGN-FT. This however comes at the cost of violations to PARSE SYLLABLE.

(128) PARSE SYLLABLE:
Every syllable must be parsed into a foot.

PARSE SYLLABLE prefers that every syllable in the prosodic word be parsed into a foot. ALIGN-FT effectively militates against this due to its higher rank. The ranking of ALIGN-FT >> PARSE SYLLABLE obtains the non-iterative foot parsing pattern (McCarthy and Prince, 1993). However, PARSE SYLLABLE still has the force to cause Eval to select a two syllable foot over a foot of only one syllable. Such a foot does not violate ALIGN-FT, yet reduces the number of unparsed syllables. A consequence of this ranking is a preference for (L.ˈH) and (L.ˈL) foot types over a (ˈH) foot.

Although secondary to ALIGN-FT, the effect of PARSE SYLLABLE in selecting a two syllable foot over a one syllable foot can be seen in Eval’s choice of [pat.(ʒʷa.ˈɣun)] over *[pa.ta.(ʒʷa.ˈɣun)] from input /ptaʒuaɣ -un/. This can be seen in the following tableau.

(129) [pa̳t.(ʒʷa.ˈɣun)] ‘work Trans/ Pat’

/ptaʒuaɣ -un/	WNB FtBin	Iamb	Align-Ft	Parse Syll
a. ☞ [pa̳t.(ʒʷa.ˈɣun)]				*
b. *[pa̳t.ʒua.(ˈɣun)]				**!
c. *[pa̳.(ta̳.ˈʒua).(ˈɣun)]			*!	*
d. *[(pa̳.ˈta̳).(ʒʷa.ˈɣun)]			**!	
e. *[pa̳t.(ˈʒʷa.ɣun)]	*!WNB	*!		*
f. *[pa̳t.(ʒua.ˈɣun)]	*!WNB			*
g. *[(pa̳t.ʒua.ˈɣun)]	**!WNB FTBIN			

This tableau shows that Align-Ft ranks above Parse Syll, making non-iterative footing optimal. This is clear from rival candidates © and (d). The one violation of Parse Syllable made by the optimal candidate is irrelevant due to the more severe violation of the higher ranking Align-Ft made by both rivals © and (d). The alternative ranking with both Iamb and Align-Ft falling below Parse Syllable would cause rival candidate © to fare better than the true optimal candidate. Candidate (a) fares better than (b) because although both are acceptable iambic feet, Parse Syll chooses the candidate with fewer unparsed feet. Candidate (e) fails because not only does it violate the WNB with its heavy syllable in a weak position, but it also violates Align-Ft. Candidate (f) fails on WNB – its weak node is heavy, and candidate (g) with its foot of three syllables fails on FtBin.

We can deduce from the tableau that Align-Ft >> Parse Syll and WNB >> Parse Syll. Since FtBin is a universally undominated constraint, it too ranks above PARSE SYLL. No ranking can be ascertained between FOOT FORM(IAMBIC) and PARSE SYLLABLE via this tableau.

The above tableau does not prove that IAMB ranks high. FTBIN, WNB, ALIGN-FT >> PARSE SYLL >> IAMB would give us the same winning candidate for this word. However, this is not true in every case. IAMB is an undominated constraint in Mabalay Atayal, but its position in the highest level of the hierarchy cannot be proven apart from a more complex example. An example verifying that IAMB is an undominated constraint needs to have a rival candidate that fares better than (and not merely equal to) the optimal candidate on PARSE SYLLABLE and does not violate ALIGN-FT or WNB. This requires syllable reduction in a rival candidate but not in the optimal candidate. Syllables can be reduced in Mabalay Atayal in three ways, either by deletion of a syllable peak – violating DEP(V) – forcing the onset to be parsed as the preceding syllable's coda, by consonant clustering – violations of NO CC, or by metathesis– violations of LINEARITY. I will go into this in greater detail in *§* 3.2.2.

Forming a complex cluster or a secondary articulation through metathesis, [CGV] from /CVG/, rather than using an epenthetic vowel, *[CV.G<u>V</u>] from /CVG/, causes the candidates to fare differently on PARSE SYLLABLE, but the greater violation of PARSE SYLLABLE falls on the rival candidate. Words with complex clusters, therefore, cannot verify that IAMB is an undominated constraint.

The opposite effect is seen when violations are made against LINEARITY. The definition is repeated here from §2.2.2.1:(18) for convenience of reference.

(130) LINEARITY ('No metathesis'):
S_1 is consistent with the precedence structure of S_2, and vice versa.

Let x, y $\in$ S_1 and xˈ, yˈ $\in$ S_2.

If x$\Re$xˈ and y$\Re$yˈ, then x y iff $\neg$ (xˈ < yˈ).

When this constraint is violated, PARSE SYLLABLE benefits since it adds no syllable peaks as DEP(V) does, but parses a consonant as a coda rather than as an onset. By expanding on the syllable, the number of unparsed syllables is reduced in the rival candidate. Thus, when a candidate violates both LINEARITY and IAMB, but not WNB, ALIGN-FT or PARSE SYLLABLE, we see it disqualified by Eval due to its fatal violation of IAMB. Not having completely established the ranking as of yet, we can see from (131) that it is either IAMB or LIN that must rank above PARSE SYLLABLE.

(131) [pa.(ta.ˈʃi)] 'tattoo JUSSIVE'

/pt₁a₂s -i/	WNB	IAMB	ALIGN FT	PARSE SYLL	LIN	DEP(V)
a. ☞ pa̳.(t₁a₂.ˈʃi)				*		*
b. (ˈpa₂t₁.ʃi)		* !			*	

Tableau (132), [kʸa.ɮun] 'speak PAT', establishes that PARSE SYLL outranks LINEARITY. (We have already seen that *SECART ranks very low, below *NAS]. *NAS] ranks below FIN-C, which ranks below DEP(V). It is, therefore, not affecting the establishment of the ranking between PARSE SYLL and LIN.) Since *SECART is a low ranking constraint, this tableau establishes that PARSE SYLL ranks above LIN.

(132) PARSE SYLL >> LIN: [kʸa.ɮun] 'speak PAT'

/ka₁y₂ɮ -un/	IAMB WNB ALIGN-FT FTBIN	ONS PEAK MAX *VDOBS]	PARSE σ	DEP (V) LIN	*LAT]	*SECART
a. ☞ (kʸ₂a₁.ɮún)				*LIN		*
b. ka₁y₂.(ɮún)			*!			

It follows then that it is IAMB which ranks above PARSE SYLL. In example (131) above and (133) below, a re-ranking of IAMB below PARSE SYLLABLE would cause Eval to wrongly select rival candidate (b) as optimal.

(133) [ʃin.(ˈħiʔ)] 'believe'

/sinħi/	WNB	IAMB	ALIGN FT	PARSE SYLL	FIN-C	DEP(C)
a. ☞ ʃin.(ˈħiʔ̳)				*		*
b. (ˈʃin.ħi)		*!			*	

Together, these tableaux show that FOOT FORM(IAMBIC) along with WNB, FTBIN, and ALIGN-FT rank higher than PARSE SYLLABLE. What this means is one right aligned iambic foot is more harmonic than parsing two heavy syllables into one foot. The iambic foot is sensitive to the weight of its penult. Incurring violations the result in a heavy penult is of no benefit because it restricts that syllable from being parsed into the foot. It also means that non-iterative footing is optimal. The key points of our analysis as it pertains to footing and stress can be summarized in the following table showing the constraints, their definitions and the hierarchy.

Constraint	Definition
IAMB	Every foot must be stressed on the right-hand syllable.
FTBIN	Feet are binary at the syllable or moraic level.
WNB	Weak nodes do not branch; a weak node cannot be bimoraic.
ALIGN-FT	The right edge of every foot must align with the right edge of the prosodic word.
PARSE SYLL	Every syllable must be parsed into a foot.

Figure 3: Footing and Stress Assignment in Mabalay

3.2.1 Metrical Epenthesis

We have seen that the interaction of syllable markedness constraints with faithfulness constraints alone can count on epenthesis to form wellformed syllables, but cannot determine the epenthetic site (§3.1.1). Even mimicking directionality effects with an ALIGN-SYLL constraint failed to determine the insertion site on at least part of the lexicon. I maintain that this is because some epenthesis falls under the rubric of 'metrically conditioned epenthesis', to borrow

Broselow's (1982) term. Epenthesis for purely syllabic reasons is accounted for through syllable markedness and faithfulness constraints. But metrical epenthesis can only be explained by the interaction of footing constraints with syllable wellformedness requirements.

We noted that CODA CON for Mabalay consisted of two crucial parts, CODA CON(*VDOBS) and CODA CON(*LAT). Once we split them apart by DEP(V), our analysis improved considerably, but still could not handle all of the data. Word finally we have seen that codas which violate CODA CON cannot delete or reparse as onsets via vowel epenthesis. They can only change their feature identity, which /ɮ/ does when it changes to /n/ or /ɮ^{n}/. Word internally, /ß/ induces epenthesis allowing its syllabification as ONSET. /ɮ/, however, follows a different pattern. Basing that behavioral difference on greater or fewer violations of DEP(V) means Eval will always choose the shorter word. This has the same effect as the footing constraint PARSE SYLL. PARSE SYLL wants fewer syllables left unparsed, so avoiding excessive epenthesis serves its end as well. But whenever the choice is between a two syllable candidate or a three syllable one, Mabalay surprisingly chooses the three syllable candidate as optimal. This tells us that a further footing constraint is coming into play that does not want to make a heavy syllable of the penult. Under its pressure, /ɮ/, along with any segment acceptable as a coda, will not succumb to the pressures of DEP(V) and

PARSE SYLL to keep the word short, but will avoid the coda position in order to meet footing constraints more harmonically.

A more motivated analysis than our previous syllable level analysis of epenthetic site selection can now be seen. Observe how it is really PARSE SYLL that is making the deciding vote in tableau (134).

(134) [maʒwaˈtox] 'bark INTR'

/m- aʒwtux/	IAMB WNB FTBIN ALIGN -FT	ONS PEAK MAX *VDOBS]	PARSE σ	DEP (V) LIN	*LAT]	FIN -C	DEP © NO CODA
a. ☞ maʒ.(wa̳.ˈtox)			*	*	*		
b. ma.ʒa̳.(wa̳.ˈtox)			**!	***			
c. ma.ʒa̳w.(ˈtox)			**!	*			

Whenever epenthesis is used, the output form increases by one syllable. This causes a greater violation of PARSE SYLL as well as DEP(V). For this reason, maximizing the syllable by incorporating a coda or filling onset position with a segment having secondary articulation is preferred to epenthesis. PARSE SYLL cannot force voiced obstruents into coda position as we see from words such as [ʔa̳.ßa̳.su.ˈyan] 'elder sibling'. It follows then that CODA CON(*VDOBS) ranks above PARSE SYLL. The converse is also true; we see that /ʒ/ and /w/ can be codas; depending upon which syllable they belong to in the word, PARSE SYLL may benefit from parsing them as codas. This can be seen in tableau (134) above.[50] Candidate (a) parses /ɮ/ as a coda and benefits PARSE SYLL. It follows that PARSE SYLL ranks above CODA CON(*LAT). It is, therefore, less harmonic for a word to violate PARSE SYLL than CODA CON(*LAT). With PARSE SYLL doing the work we formerly assigned to DEP(V), DEP(V) is no longer bound to this position in the grammar. Rival (c), on the other hand, parses /w/ as a coda, but with no benefit to PARSE SYLL because this forced /ɮaw/ to be excluded from the iambic foot. It, therefore, got counted as a fatal mark against PARSE SYLL.

This account of syllabification and footing is actually superior to a directionality account as such an account must ignore the duality within the coda condition, 'No Laterals'. This shows the advantage of working with violable constraints.

We have seen how epenthesis can be compelled by both syllabic wellformedness and footing. Ultimately the choice of epenthetic site is left up to footing. We have also seen that epenthesis causes a violation mark against PARSE SYLLABLE, a footing constraint. Other means of achieving a perfect iamb with a more harmonic syllable parse would, therefore, be desirable. We turn now to the strategy of metathesis.

[50] For the behavior of word final /ɮ/, refer to §3.1.

3.2.2 Metrical Metathesis

Part II of our data is a set of words that undergo CV metathesis. Why call it metathesis rather than a combination of epenthesis and syncope? Apart from word initial consonant loss, there are no words that undergo only syncope in Mabalay. If they experience syncope, it is always accompanied by epenthesis. Since the two processes are inseparable, it seems best to see it as a single function.[51]

We have already made reference to metathesis in §3.2 in order to establish the footing constraint hierarchy. The LINEARITY constraint militates against metathesis, but when faithfulness to the input form would make a poor syllable or foot, metathesis is preferred to faithfulness.

Metathesis gives superior results to epenthesis because it avoids violations to PARSE SYLL. It is also more faithful to the input in that nothing is added, nothing is taken away. I refer to it as metrical metathesis because its motivation is always linked to footing. This is why syllable wellformedness constraints alone could not decide when to use it. The output of course must be a wellformed syllable as well as a well formed foot, but the foot is the higher goal. For example, the input of 'speak JUSSIVE' is not a well formed syllable -- /kayɮ/. The CC coda is not acceptable. Metathesis could produce [k^{y}aɮ], a

[51] Since the vowels that metathesize are always /a/, it is possible to analyze this as more examples of epenthesis instead of metathesis. This requires positing one less vowel in the input form. It actually has little effect on the overall analysis as LIN and DEP(V) are equally ranked and both would earn one violation since the two analysis' input forms differ.

perfectly acceptable syllable. However, this is not the output form. In this case, epenthesis is preferred, producing [kayá̳ɮ^{n}] ~ [kayá̳n]. It is interesting to note that the attested form is the one which makes a better iamb – a perfect iamb. So even in the choice of strategy used to reach the target form, footing makes the decision. This is because the target form is not just a perfect syllable, but a perfect iambic foot. Perfect syllables are merely subsumed in the iambic foot. It is as if footing is the supervisor overseeing the task of syllabification. The supervisor makes the decisions because he has more insight into the purpose of the task at hand. Observe from the following tableaux how the grammar chooses the strategy that attains the perfect iamb target.[52]

[52] As the analysis develops, we will better understand why [k^{y}aɮ^{n}] is prevented from being selected optimal. IDENT-σ'(SEG) prevents the formation of secondary articulation in the stressed syllable. This can be seen in the following tableau.

Eval chooses **epenthesis** inside the foot: [kayáɮ^{n}] 'speak'

/kayɮ/	IAMB WNB ALIGN-FT FTBIN	MAX ONS PEAK *VDOBS] IDENT-σ'	PARSE σ	NO CC	DEP (V) *LAT] LIN	FIN-C	DEP (C) NO CODA	*SEC ART
a. ☞ (ka.yá̳ɮ^{n})					*		*	
b. (ky$_{2}$á$_{1}$ɮ^{n})				*!	*		*	
c. (k^{y}áɮ^{n})		*!$_{\text{IDENT-σ'}}$			*$_{\text{LIN}}$		*	*

(135) Eval chooses epenthesis inside the foot: [kayáɮ^{n}] 'speak'

/kayɮ/	IAMB WNB ALIGN -FT FTBIN	MAX ONS PEAK *VDOBS]	PARSE σ	NO CC	DEP (V) *LAT] LIN	FIN-C	DEP © NO CODA
a. ☞ (ka.yá̲ɮ^{n})					*		*
b. (ky$_2$á$_1$ɮ^{n})				*!	*		*

When epenthesis is made within the foot, all footing constraints are equally satisfied in both candidates. Since epenthesis has not affected PARSE SYLL in particular, syllable wellformedness constraints choose (a) over (b).

Metathesis is influenced by other footing constraints, as well. The constraint IAMB requires that the foot be right headed; stress must fall on the right syllable or mora. For a foot to be able to parse two syllables, the penult must be light to satisfy WNB. It is, therefore, IAMB and PARSE SYLL together that choose [(ky$_2$a$_1$.ɮún)] over *[kay.(ɮún)]. For FTBIN to be calculated in syllables rather than mora is an effect of PARSE SYLL – it is better satisfied by a two syllable foot. When the penult is heavy, a moraic foot – one heavy syllable—is the only choice available. For this reason, the target of the footing constraints is to create a perfect iamb – a (L.ˈH) foot. Mabalay Atayal has several tactics by which to keep the penult light. One, of course, is to lighten the penult via metathesis. We see this demonstrated in tableau (136).

(136) Eval chooses metathesis inside the foot. [kya.ʙ̰un] 'speak PAT'

/ka₁y₂ʙ̰ -un/	IAMB WNB ALIGN-FT FTBIN	ONS PEAK MAX *VD OBS]	PARSE σ	NO CC	DEP (V) LIN	*LAT]	FIN -C	DEP © NO CODA
a. ☞(ky₂a₁.ʙ̰ún)				*	*LIN			*
b. ka₁.(y₂a̳.ʙ̰ún)			*!		*DEP			*
c. ka₁y₂.(ʙ̰ún)			*!					**
d. (ka₁y₂.ʙ̰ún)	*!WNB							**

Candidates (b), (c), and (d) make fatal violations against footing constraints. Rival candidates (b) and (c) fatally violate PARSE SYLL while (d) fatally violates WNB. These are all worse than a mere violation of lower ranked NOCC or LIN.[53] Although (a) and (b) and (c) are all iambic and satisfy the WNB, PARSE SYLL makes the perfect iamb optimal.

(137) Eval chooses epenthesis when candidates fare equally on PARSE SYLL: [ma̳.(ʙ̰a.ħáŋ)] 'take care of INTR'

/m- ʙ̰₁a₂ħaŋ/	IAMB WNB ALIGN-FT FTBIN	MAX *VD OBS]	PARSE σ	NO CC	*LAT]	DEP (V) LIN	FIN-C	DEP © NO CODA
a. ☞ ma̳.(ʙ̰₁a₂.ħáŋ)			*			*		*
b. ma₂ʙ̰₁.(ħáŋ)			*		*!	*		**
c. (ma₂ʙ̰₁.ħáŋ)	*!WNB				*	*		**

In tableau (137) candidate © is out on a WNB violation. Candidates (a) and (b) tie on PARSE SYLL, but (b) makes a violation against *LAT] which proves

53 In §3.3.2.3 we will find that all Cy, Cw clusters are actually secondary articulations. Thus, [kʸaʙ̰ʊn] is the true optimal candidate, not [kyaʙ̰ʊn]. NO CC will not be crucially ranked with PARSE SYLL. In fact, we will find that NO CC is an undominated constraint and SD (Sonority Distance) is unnecessary.

fatal. This means that if maximizing the coda makes no difference to PARSE SYLL, then it is better to have a CV syllable.

(138) Eval chooses metathesis as long as the heavy syllable it forms is outside the foot:
[ka$_2$ɮ$_1$.(ħa.ŋán)] 'take care of LOC'

/kɮaħaŋ -an/	IAMB WNB ALIGN -FT	MAX *VD OBS]	PARSE σ	NO CC	*LAT]	DEP (V) LIN	FIN -C	DEP © NO CODA
a. ☞ ka$_2$ɮ$_1$.(ħa.ŋán)			*		*	*		**
b. ka̳.ɮa.(ħa.ŋán)			**!			*		*

3.2.3 Conclusion

We've seen a tension between using metathesis or epenthesis to create a well-formed syllable. This is because most consonants could fill either onset or coda position. Epenthesis will place it in onset position, while metathesis will generally be used to place the consonant in coda position. Either way, the syllable is well-formed. The tension is resolved by footing constraints. Metathesis is better than epenthesis as long as it does not result in a heavy penult. This shows that IAMB ranks higher than PARSE SYLL (or DEP(V)) as it is guarding the penult against accepting an extra mora. IAMB could easily allow a one syllable foot as long as it were heavy, but PARSE SYLL is more satisfied with a two syllable parse as less syllables remain unparsed. The tension between IAMB and PARSE SYLL generally produces a perfect iamb.

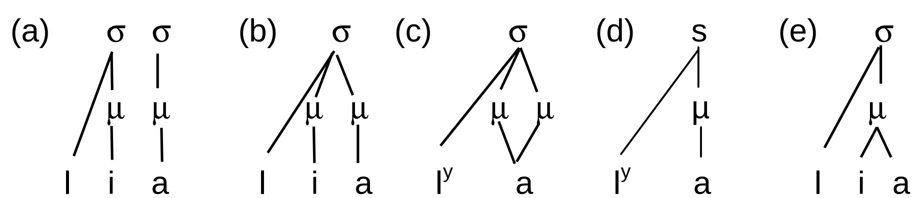
3.3 Diphthongs

A whole set of data dealing with diphthongs was unable to be handled with a syllable level analysis, so we did not even attempt it in §3.1. As we analyze it now, we will find that diphthongs too are affected by footing constraints. In this way it ties in with the epenthesis and metathesis.

3.3.1 Possible syllable structures

In his work on Rotuman, McCarthy represents vowel sequences of rising sonority in closed syllables as monomoraic and all vowel sequences in open syllables as bimoraic (1995:8-9). Rosenthall (1994, 1997), who has made a very in-depth analysis on the alternation of vowels with their glide counterparts, also describes both mono and bimoraic diphthongs. The possible representations of vowel sequences are diagrammed below.

(139) Representations of vowel sequences[54]



[54] Diagram (a), (b), (c) and (d) are from Rosenthall, 1997. Diagram (e) is based on discussion in McCarthy (1995:8,9), McCarthy refers to work by Rosenthall, 1994; Kaye and Lowenstamm, 1984, which would assign this structure only to rising sonority diphthongs.

The monomoraic representation shown in (e) has the following limitation placed on it. It can only represent vowel sequences of rising sonority (i.e., decreasing height). This is presented as a fact of Universal Grammar (Rosenthall, 1994; McCarthy, 1995). It follows that only monomoraic, 'light diphthongs' can be protected by INTEGRITY.

(140) INTEGRITY:
No element of S_1 has multiple correspondents in S_2.

The apparent integrity of falling sonority vowel sequences in Mabalay must be a result of the ranking of constraints other than INTEGRITY.

3.3.2 Constraints and ranking

Rosenthall (1997) determines the necessary constraints for an account of vowel/glide alternation. His constraints are validated in the typological test of being able to apply the same constraints cross-linguistically. A change in ranking is all that is needed to account for the diverse patterns of several languages. Rosenthall's constraints should, therefore, adequately account for the vowel/glide alternation pattern of Mabalay Atayal as well. In this section we will establish the crucial rankings, then combine these to form the grammar pertaining to vowel/glide alternation.

3.3.2.1 Final syllable diphthongs

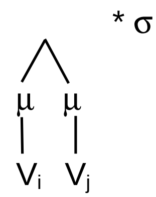
In Mabalay the peak of ultimate syllables can be filled by a single vowel or a diphthong. Diphthongs of both rising and falling sonority behave alike. I have observed that they give equal duration to each vowel and stress the most sonorant, the low vowel /a/. There is no epenthetic consonant separating the two vowels, and stress attraction to the most sonorant peak explains why the first vowel gets stressed in a /ai/ or /au/ sequence, but the second vowel in a /ia/ or /ua/ sequence. Since, according to McCarthy (1995), heavy diphthongs cannot be monomoraic and light diphthongs are not restricted from being bimoraic, we will treat them all as heavy, bimoraic diphthongs in Mabalay Atayal as in pattern (139b).

(141) a. Rising Sonority b. Falling Sonority

a. Rising Sonority		b. Falling Sonority	
ʔamʒ̢iáp	'hunt INTR'	ßaʒ̢ái?	'good'
siám	'meat, pork'	ßái?	'give'
ßuáx	'rice'	ráum	'sewing needle'
ßaʒuák	'wild pig'	samáuk	'suck'

These words all have heavy diphthongs. They are, therefore, all violating NO DIPHTHONGS. This means NODIPH must rank below whatever constraints are violated by their rivals.

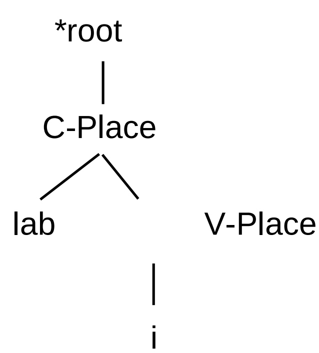
(142) NO DIPHTHONGS (NODIPH):



where V_i and V_j are vowels of differing features.

Words with rising sonority vowel sequences have rivals that violate ONSET and *SECART. Their elimination requires that ONSET, DEP©, and *SECART all rank above NODIPH.

(143) *SECONDARY ARTICULATION (*SECART):
V-place must link directly to the root node and not to C-place.



*SECART is violated by a vowel linking to the C-Place node of a consonant. Such a vowel is transcribed as a raised glide, C^y or C^w. A prevocalic vowel could become a secondary articulation, violating *SECART, or it could remain a vowel, violating NODIPH. Since both have a cost, the ranking of these constraints – as they interact with other constraints – will determine the optimal choice.

(144) Rising Sonority VV in ultima of disyllabic words:
[ʔam.(ʒ̢iáp)] 'hunt INTR'
ONSET, DEP(C), MAX-IO$_{\mu}$, SECART >> NODIPH

/am- ʔʒ̢iap/	ONS	PARSEσ	DEP(C)	MAX-IO$_{\mu}$	SECART	NODIPH
a. ☞ ʔam.(ʒ̢iáp)		*				*
b. ʔam.(ʒ̢^{y}áːp)		*			*!	
c. ʔam.(ʒ̢^{y}áp)		*		*!	*	
d. ʔam.(ʒ̢i.yáp)		*	*!			
e. ʔam.(ʒ̢i.áp)	*!	*				

(145) Rising sonority VV in monosyllabic words: [(ßuáx)] 'rice'
ONSET, DEP(C), MAX-IO$_{\mu}$, SECART >> NODIPH

/ßuax/	ONS	PARSEσ	DEP(C)	MAX-IO$_{\mu}$	*SECART	NODIPH
a. ☞ (ßuáx)						*
b. (ß^{w}áːx)					*!	
c. (ß^{w}áx)				*!	*	
d. (ßu.w̳áx)			*!			
e. (ßu.áx)	*!					

Tableaux (144) and (145) show that syllables must have onsets, just as all word-initial syllables have onsets. However, word internal epenthetic onsets are not tolerated due to violations of DEP(C). We also see that diphthongs are preferable to linking the vowel to a neighboring consonant's C-Place node as that would violate *SECART, yet gain no points with PARSE SYLL. *SECART must rank above NODIPH to achieve the attested output form.

Words with input vowel sequences of falling sonority behave similarly in that they do not alternate with glides in the ultimate syllable. A new constraint must be introduced at this point, however; one that serves to differentiate low from high vowels. High vowels are parsed as vowels when they fall under a V-Place root node, but as consonantal glides when they fall under a C-Place node. Low vowels are banned from occurring under the C-Place node due to their higher sonority. The constraint responsible for this is labeled Moraic-a.[55]

(146) MORAIC-ɑ
The low vowel /ɑ/ must be linked to a mora.

Treating /a/ as a prevocalic segment (e.g. [ßɑ.ɮ^{a}iʔ] 'good') forces it to violate *SECART as well as MORAIC-ɑ. It also goes against the sonority principle which would choose the most sonorant segment, /ɑ/, for the syllable peak. MORAIC-ɑ is a universally undominated constraint. Apart from this, words with rising-sonority vowel sequences are very similar to those with falling-sonority sequences.

(147) Falling Sonority VV sequences:
MORAIC-ɑ, ONS, MAX-IO, PARSE Σ >> NODIPH

55 Moraic-ɑ corresponds to Rosenthall's constraint,{A}=V, which he gives in Dependency Phonology notation, (Rosenthall, 1997).

/ßaʒ̢aiʔ/[56]	MORAIC-a	ONS	MAX	PARSE σ	DEP (C)	LIN	MAX-IO$_{\mu}$	*SECART	NODIPH
a. ☞ (ßa.ʒ̢áiʔ)									*
b. ßa.(ʒ̢a.yí ʔ)				*!	*				
c. ßaː.(ʒ̢í ʔ)			*!	*		*			
d. (ßa.ʒ̢í ʔ)			*!			*	*		
e. ßa.(ʒ̢a.í ʔ)		*!		*					
f. (ßa.ʒ̢ᵃíːʔ)	*!							*	
g. (ßa.ʒ̢ᵃí ʔ)	*!							*	

Tableau (147) shows that in order to have Eval select the attested candidate as optimal, MORAIC-a, ONS, MAX-IO, and PARSE σ must all rank above NODIPH. Rival candidates (c) and (d) were formed through metathesis, violating LIN. After metathesizing, both deleted /a/. Rival © kept the mora, violating MAX-IO for the vowel loss, but not violating Max-IO$_{\mu}$. Candidate (d) violated both MAX-IO and MAX-IO$_{\mu}$. In other words, this rival showed no compensatory lengthening. Rival © did not create a perfect iamb by benefiting PARSE SYLL, so the metathesis was certainly unmotivated. It is interesting to note that only the optimal candidate was able to produce an output where /a/ carries stress. This verifies the diphthong representation.

Even across morpheme boundaries, the Mabalay dialect does not insert a hiatal glide between vowels as other dialects do.[57] No heed is taken to the

[56] Here glottal is phonemic. In Squliq, it would be a /q/, [ßaʒ̢aəq] 'good'. It also remains in the word when the word is suffixed, as in [kaßaʒ̢eʔʊn] 'build, repair LOC'.

[57] For a phonological description of other dialects, see Li (1980).

morpheme boundary; a heavy diphthong forms across the morpheme boundary just as it exists in root words. Empirical proof is to be found in the fact that the stress is carried by /a/. Were this a case of vowel hiatus at a syllable boundary, Align-Ft and Iamb would form an iambic foot at the right edge of the prosodic word resulting in stress on /u/, not /a/ as is attested. This can be seen in the tableau (148) below.

(148) Heavy diphthong forms across morpheme boundary.
[ßak.(ħáun)] 'break Pat'

/ßakħa -un/	Ons Mor-a NoCC	Max	Parseσ	Lin Dep (V)	Dep (C)	*Sec Art Max_{μ}	No Diph
a. ☞ ßak.(ħáun)			*				*
b. ßak.(ha.w̲̲ún)			*		*!		
c. ßa.(ka$_2$.ħ$_1$ún)			*	*!$_{LIN}$			
d. ßa.(ka̲̲.ħáun)			*	*!$_{DEP}$			*
e. (ßa.kħáun)	*!$_{No CC}$						*
f. (ßa.kħún)	*!$_{No CC}$	*				*$_{Max\mu}$	
g. ßak.(ħa.ún)	*!$_{Ons}$		*				
h. (ßa.kħ^{a}ún)	**!$_{NoCC\ Mor\text{-}a}$					*$_{Max\mu}$	

Metathesis as is found in rival candidate (c) is not optimal, not because the two vowels link to one mora causing metathesis to violate Integrity – we know they cannot because of the falling sonority – but because Lin is ranked above NoDiph. Candidate (d) is eliminated by a Dep(V) violation, and (b) by a mark against Dep(C). Although (b) spares violations against NoDiph and Onset, it fails because DEP(C) ranks above NODIPH, which the optimal candidate violates. Rivals (e), (f), (g), and (h) are all out on undominated constraints.

3.3.2.2 Final syllable vowel length

When vowels of equal height come together at a morpheme boundary, the moraic weight is maintained. That the formation of long vowels is permitted in Mabalay ranks MAX-IO$_\mu$ above NO LONG VOWELS (NLV)[58], as can be seen in tableau (149) below.

(149) Long vowels: ONS, MAX >> PARSEσ>>NLV [(sa.túːn)] 'send PAT'

	/satu -un/	ONS	MAX	PARSE σ	LIN	DEP (C)	MAX-IO$_\mu$	NLV
a. ☞	(sa.túːn)							*
b.	sa.(tu.wún)			*!		*		
c.	sa.(tu.n$_2$ú$_1$)			*!	*			
d.	sau$_2$.(t$_1$ún)			*!	*			
e.	(sa.tún)		*!				*	
f.	sa.(tu.ún)	*!		*				

Vowel hiatus in (f) incurs a fatal mark against ONSET. Glide insertion to avoid the onset violation as seen in rival (b) also fails because it results in an unparsed syllable showing that PARSE SYLL ranks above NLV. Rivals formed by metathesis, (c) and (d), also fail, their violation to LINEARITY goes hand in hand with the fatal violation against PARSE SYLL; by metathesis, they either created a diphthong in the penult instead of in the ultima as in (d) or they created a light

58 Constraints are defined in (54) and (56), page 65.

final syllable as in (c). Either way, using metathesis to avoid diphthongs results in a less than perfect iamb. It is, therefore, avoided.

3.3.2.3 Vowel-Glide Alternations

There is also data where an underlying high vowel is realized as a glide. What was pronounced as an /i/ or an /u/ when it was in the final syllable of the prosodic word has lost its moraic weight. It is said much more quickly, lacking the mora's duration.

(150) Vowel:

/ptaʒuaɣ/	[pataʒuáw]	'work INTR'
/m- ʔuas/	[maʔuás]	'study INTR'
/am- ʔɮiap/	[ʔam.ɮiáp]	'hunt INTR'
/am- sɮiat/	[samɮiáts]	'cut (grass) INTR'
/m- siaʔ/	[maʃiáʔ]	'laugh, smile INTR'
/am- spiaɮ/	[s-am-piáɮ^{n}]	'dream INTR'

Glide:

/ptaʒuaɣ -un/	[patʒ^{w}aɣún]	'work PAT'
/p- ʔuas -an/	[pa̳ʔ^{w}asán]	'study LOC
/ʔɮiap -un/	[ʔaɮ^{y}apún]	'hunt PAT'
/sɮiat -an/	[saɮ^{y}at-an]	'the area (of grass) cut Loc'
/s- siaʔ -an/	[saʃ^{y}aʔ-an]	'make laugh Loc'
/spiaɮ -an/	[sap^{y}aɮ-an]	'dream Loc'

This type of alternation seen in data set (150) incurs a violation of *SECART. Note that these alternations only ever occur in the penult. We need to ensure that our analysis does not permit rivals with secondary articulation in the ultima to get by. Such a case would be *[ka.m^{y}al] ‘speak INTR’. *[ka.m$^{y}{}_{2}$a$_{1}$ɮ^{n}] must be eliminated in favor of the attested form, [ka.ma.ya̳ɮ^{n}], even though the attested candidate has an unparsed syllable due to its violation of DEP(V).

The general thrust of the argument is that secondary articulation is a way to reduce the quantity of moraic duration in a syllable and still remain faithful to feature quality. A perfect iamb wants to have weight contrast. To achieve this, many iambic languages have iambic lengthening in the head of the foot. Less commonly, an iambic language may have iambic shortening, reducing the duration of the unstressed syllable in the foot. Atayal vowel/glide alternation is a form of iambic shortening. As such, it occurs only in the unstressed syllable. Since footing is non-iterative and right aligned, it follows that iambic shortening only occurs in Mabalay Atayal penultimate syllables. We can predict that it will never occur in the final syllable. To this end I posit a constraint called IDENT-s’(SEGMENTISM). This constraint is based on Beckman’s (1998) research on positional faithfulness constraints. Positional faithfulness can cause the type of asymmetry we see in Mabalay iambic shortening. IDENT-s’(SEG) watches over the ultimate syllable ensuring faithfulness due to its stress.

(151) IDENT-s’(SEG)
Segments in the stressed syllable must have a one-to-one correspondence with their input segments.

(a) /am- ʔɮiap/ → ʔam.ɮiap

(b) /am-ʔɮiap/ → * ʔam.ɮ^{y}ap

IDENT-s'(SEG) would prevent (b) from occurring. It follows that IDENT-s'(SEG) ranks above PARSE SYLL and DEP(V), as can be seen in (152).

(152) IDENT-σ'(SEG) >> PARSE SYLL: [kamayáɮ^n] 'speak INTR'

/am- kayl/	IDENT-σ' NO CC	PARSE σ	DEP(V) LIN	*SEC ART	NO DIPH
a. ☞ ka.(ma.yaɮ^n)		*	*		
b. (ka.my$_2$a$_1$ɮ^n)	**!		*		
c. (ka.m$^y{}_2$a$_1$ɮ^n)	*!		*	*	

In tableau (152), the optimal candidate made the worst score among its rivals on PARSE SYLL. It was still chosen as optimal because its rivals (b) and (c) made fatal infractions against IDENT-σ'(SEG). Although would be acceptable had it occurred in the penult, it is not acceptable in the ultima.

This explains why violations of *SECART are never seen in the final syllable of the word, but it does not explain why violations of *SECART are ever optimal. Which constraint is triggering the vowel to link to C-Place? To answer that, let us see what has been gained. The vowel keeps its feature identity, but loses its link to a mora. That mora is then free to delete at the low cost of a violation to Max-IO$_\mu$. This only ever occurs in the penult. Its occurrence causes what otherwise would have been a heavy penult to become light. This allows FTBIN to be measured in syllables rather than mora, which in turn satisfies PARSE SYLL to a greater degree. One more syllable has been parsed while no new syllables have been created as a DEP(V) violation would have caused. So it is that the combined effect of IDENT-σ'(SEG), PARSE SYLL, IAMB, WNB, ALIGN-FT and perhaps FINAL-C that results in a perfect iambic foot. This gives us the following crucial ranking.

(153) IAMB, WNB, ALIGN-FT, IDENT-σ'(SEG)
>> PARSE SYLL
>> *SECART, MAXμ

These rankings are verified by the following two tableaux; undominated constraints are all satisfied and omitted from tableaux. In tableau (154), vowels are not blocked from linking to C-Place although this violates *SECART. In tableau (155), the secondary articulation surfaces because the rivals fail on higher ranking PARSE SYLL and IDENT-s'(SEG).

(154) PARSE SYLL, NOCC >> *SECART, MAX_{μ}

/ʔʒiap -un/	NO CC	PARSE σ	DEP(V)	*SECART	MAX_{μ}	NODIPH
a. ☞ ʔa̳.(ʒʸa.pún)		*	*	*	*	
b. ʔa̳.(ʒya.pún)	*!	*	*		*	
c. ʔa̳.ʒia.(pún)		**!	*			*

Candidate (b) of tableau (154) above lost the mora without linking /i/ to /ʒ/. It is, therefore, interpreted as a glide in a consonant cluster. As such, it violates NoCC. Candidate (a) also lost a mora. In linking to C-Place, /i/ violated *SECART and MAX_{μ}, but benefited by making one less mark against PARSE SYLL. Candidate (c) remained faithful in these areas, but in order to also meet WNB and IAMB, had to accept a one syllable parse. This left two syllables unparsed, hence, two violations of PARSE SYLL. The extra violation proved fatal.

(155) PARSE σ , NO CC >> *SECART, MAX_{μ} : [kyaʒun] 'speak PAT'

/kayʒ -un/	NO CC	PARSE σ	LIN	DEP(V)	*SEC ART	MAX_{μ}	NO DIPH
a. ☞ ($k^y{}_2a_1$.ʒún)			*		*	*	
b. (ky_2a_1.ʒún)	*!		*			*	
c. kay.(ʒún)		*!					
d. ka.(ya̲.ʒún)		*!		*			

Because it occurs in the penult, the secondary articulation is encouraged by the grammar. Candidate (a) passes on IDENT-σ'(SEG) (not shown in tableau). Its mark against LINEARITY is minimal when compared with its rivals violations of higher ranking PARSE SYLL and NO CC. Rival (b) fails on No CC meaning the ranking prefers to interpret consonant plus glide as secondary articulation on the consonant. Rival (c) could not parse its heavy penult and still satisfy WNB. Rival (d) kept its penult light by epenthesis allowing a two syllable foot parse, but in the process it created an extra syllable which went unparsed. The optimal candidate had both the most harmonic syllable structure and the best parse.

Vowel-glide alternation is a strategy instigated by footing constraints. It successfully creates a perfect iambic foot in words with a rising sonority vowel sequence in the penult. At a syllable level analysis, it would be entirely unmotivated.

The syllabification of vowel sequences in Mabalay Atayal follows from the constraint rankings summarized in (156).

(156) Summary of Rankings:

PARSE SYLL >> LIN	(132)
WNB, PARSE SYLL >> NO CC	(136)[59]
WNB >> *LAT], DEP(V)	(137)
ONS, DEP©, MAX-IO$_{\mu}$, *SECART >> NODIPH	(144)
MORAIC-a, ONS, MAX, PARSE σ, >> NODIPH	(147)
MORAIC-a, ONS, NO CC, MAX, LIN, DEP(V), DEP©>> NODIPH	(148)
ONS, MAX, PARSE σ >> NLV	(149)
IDENT-s'(SEG) >> PARSE SYLL, DEP(V)	(152)
PARSE SYLL, NO CC >> *SECART, MAXμ	(154)

(157) Composite Ranking for Chapter 3

MORAIC-a, IDENT-σ'(SEG), IAMB, WNB, ALIGN-FT, FTBIN,
ONS, PEAK, MAX, NO CC, *VDOBS]

[59] In §3.3.2.3 the candidate with a *SECART violation is deemed better than the candidate with a No CC violation. Consequentially, No CC moves up to the level of PARSE SYLL. The constraint ranking in (132) should therefore, read WNB >> PARSE SYLL, *SECART.

>> PARSE SYLL , IDENT

>> *LAT], DEP(V), LIN

>> FIN-C

>> NO CODA, DEP(C), *NAS], *GL]

>> *SECART, MAX-IO$_{\mu}$,

>> NODIPH, NLV

3.3.3 Conclusion

An asymmetry often exists in how a language handles prevocalic vowels (Rosenthall, 1997). In Mabalay Atayal, high vowels become glides when compelled by PARSE SYLL and IAMB to create a light penult. In any other syllable, high prevocalic vowels pattern with low prevocalic vowels; their moraic weight is maintained in the output as they are realized as heavy diphthongs. When vowels having the same feature geometry meet at morpheme boundaries, they too maintain the moraic weight of their input form and MAX-IO$_{\mu}$ goes unviolated. Apart from keeping the penult light and the ultima heavy in order to output a perfect iambic foot, Mabalay Atayal's non-iterative footing puts no other restriction on syllable weight in the remainder of the word.

To form a perfect iamb is the goal throughout the language. It is the predominent outcome of the interaction of FIN-C ensuring a heavy final syllable and the three footing constraints. The other constraints in the language are ranked so as to cooperate in meeting this target structure. A non-moraic parse of prevocalic high vowels via secondary articulation can be added to the list of strategies used to meet that goal:

(158) Strategies used to form a perfect iamb

a. Epenthesis
b. Metathesis
c. Secondary Articulation

3.4 Faithful forms

Occasionally we come across a word that is completely faithful to the input, such a s [ra.ʔiás] 'face'. Since the input could be perfectly syllabified and perfectly parsed, it could not be improved upon.

(159) Faithful and Perfect:

ra.ʔias	'face'
ka.niʔ	'eat INTR'
wi.ʒoŋ	'chicken'

However, there are other words faithful to input that are not perfect in that they do not form perfect iambs.

(160) Faithful but not perfect:

Words of two or more syllables		One syllable words	
ßin.kis	‘ancestors’	ßuax	‘rice’
ʔam.ɮiap	‘hunt INTR’	ʒuaw	‘thing, situation’
ɮin.tox	‘electric light’	ʔuas	‘song’
		ßuay	‘fruit’
ħa.mau.ßin	‘cut (meat) INTR’	ŋiaw	‘cat’
ka.ħau.niʔ	‘tree’	rauɮ^{n}	‘rake’

The words of two or more syllables surprise us because the penult is heavy. For those that end in a nasal, a simple DEP(V) violation would have created a perfect iamb at no greater cost to PARSE SYLL. Words with a diphthong in the penult also surface as such when it seems a violation of LIN would have given a better parse. In one syllable words containing a heavy diphthong, we might expect a consonant insertion between the two vowels. Again, the result would be a perfect iamb. We will put three representatives through our present ranking of Eval and see why they are optimal ‘as is’.

3.4.1.1 Penultimate syllable vowel sequences

Some words have a heavy diphthong in the penultimate syllable. This results in a heavy syllable and the failure to form a perfect iamb. Although this does not seem optimal, it is obviously the most harmonic output available due to the ranking. This means that DEP(C) ranks above NODIPH, as is verified in tableau (161).

(161) VV Lin, Max, WNB, Moraic-a, Dep(c) >> NoDiph:

[ħa.mau.(ˈβin)] ‘cut (meat) INTR’

	/am- ħauβin/	WNB MAX V V LIN	MORAIC- a	PARSEσ	LIN	DEP (C)	NO DIPH
a. ☞	ħa.mau.(ˈβin)			**			*
b.	ħa.ma.(w̳u.ˈβin)			**		*!	
c.	ħa.(m^{a}u.ˈβin)		*!	*			
d.	ħa.(m^{w}a.βin)	*!$_{\text{V V LIN}}$		*	*		
e.	ħa.(mu.ˈβin)	*!$_{\text{MAX}}$		*			
f.	ħa.(mau.ˈβin)	*!$_{\text{WNB}}$					

Although PARSE SYLL would prefer to parse /mau/ into its foot, as in rival (f), this is prevented by undominated WNB. A strategy to lighten the penult without causing an increase in unparsed syllable count is what is needed. Deleting a vowel, as rival (e) does, is successfully militated against by MAX. Deleting a mora and keeping the vowel quality is Mabalay’s strategy, as we saw in §3.3.2.3, but with a falling sonority diphthong this is ruled out by the violation it would make against MORAIC-a. This is seen in rival (c). Rival (b) inserts a consonant between the two vowels, but this results in a fatal mark against PARSE SYLL. Rival (d) chose metathesis. As a violation against LIN, this would have proved successful. You will note that this metathesis differs from what we have seen in the past, however, in that it is V-V metathesis. According to McCarthy (1995), a constraint militating against it is universally undominated. I have, therefore, posited V-V LIN and ranked it in the highest level of the hierarchy. It seems Mabalay's strategies have been exhausted. Since the targeted perfect iamb cannot be attained, the single heavy syllable iambic foot parse will suffice.

3.4.1.2 Penults with nasal codas

Nasal codas are formed in penultimate syllables when the input segments are able to form good syllables. When syllabification can be faithful to the input – needing no epenthesis or metathesis to form a syllable peak – the grammar is satisfied with a one syllable parse.

(162) DEP(V) >> NO CODA, *NAS]:
ßinkis 'old people, ancestors': not perfect, but optimal.

/ßinkis/	IAMB, ALIGN-FT, WNB FTBIN NOCC	ONS PEAK MAX *VDOBS] MORAIC-a	PARSE σ	DEP(V) LIN *LAT]	NO CODA *NAS]	*SEC ART MAX-IO$_{\mu}$	NO DIPH NLV
a. ☞ ßin.(kí s)			*		** *		
b. ßi.(na̳.kí s)			*	*! DEP(V)	*		
c. (ßn$_2$i$_1$.kí s)	*! NO CC			* LIN	*		
d. (ßi_.kí s)		*! MAX			*	* MAXμ	
e. (ßin.kí s)	*! WNB				** *		

Tableau (162) shows us that [ßin.kí s] is truly the optimal form. Violations to the WNB and MAX are always fatal, as seen in (e) and (d), respectively, while violating No CC proved fatal for (c). This shows that metathesis is not used when it results in unacceptable syllable form. For candidates (a) and (b), since they both have one unparsed syllable, the additional violation of Dep(V) on the part of (b) proved fatal. Although not a perfect iamb, candidate (a) is optimal.

3.4.1.3 One syllable words

One syllable words make few violation marks. Although not perfect iambs, their rivals that try various ways to attain a two syllable parse are ousted by higher ranking constraints. Parse Syll and Align Ft are more concerned about unparsed syllables; they serve to compress the word rather than draw a short word out. This is verified in tableau (163) below.

(163)Optimal one syllable words: [ŋiáw] ‘cat’

/ŋiaw/	Iamb Align-Ft wnb Ident-σ’ Ons Peak *VdObs] Max Moraic-a	Parse σ	Lin Dep(V)	Dep(c) No Coda	*SecArt Max-IO$_{\mu}$	NoDiph Nlv
a.☞ (ŋiáw)				*		*$_{\text{NoDiph}}$
b. (ŋi.y̠áw)				**!		
c. (ʔ̠i$_2$.ŋ$_1$áw)			*!$_{\text{LIN}}$	**		
d. (i$_2$.ŋ$_1$áw)	*!$_{\text{ONS}}$		*$_{\text{LIN}}$	*		
e. (ŋ^{y}áw)	*!$_{\text{IDENT-s'}}$			*	* *	

From [ŋiáw] ‘cat’ we see that one syllable words, although not perfect iambs, can be optimal. Candidates (c) and (d) both violate Lin. Metathesis caused a fault against onset for (d) which proved fatal. Candidate (c) was rescued from this fate by glottal insertion, but its mark against Lin proved fatal in spite of this extra effort to survive. Candidate (b) fails due to a mark against DEP(C). These violations all proved more fatal than not attaining a perfect iamb. Candidate (e) incurs its fatal mark against IDENT-σ'(SEG) as it formed a secondary articulation in the final syllable.

Why is Mabalay Atayal satisfied with a less than perfect iamb in CVC.(CVC) words when simple epenthesis would give a perfect iamb, CV.(CV.CVC) – the target in other cases. We note that the input /CVCCVC/ can be syllabified into wellformed syllables without violating any faithfulness constraints. If the syllable is fine, syllable wellformedness constraints will not instigate any change. It seems that syllabification is the instigator of epenthesis. PARSE SYLL would never call on epenthesis as it is always to its disadvantage, but WNB, and IAMB together with and ALIGN-FT will choose the optimal epenthetic site. PARSE SYLL, ALIGN-FT, WNB, and IAMB pull together in an attempt to redeem a heavy penult through metathesis or secondary articulation. When dealing with rising sonority diphthongs, they meet with success, but otherwise all such attempts will cause higher ranking constraint violations. Since violations must be minimal, these words pass through Eval as optimal. The effects of the footing constraints as they negotiate harmony is pervasive throughout the language.

3.5 Conclusion

In this chapter we have seen that syllable wellformedness constraints must always be met. Their satisfaction often demands a violation of DEP(V). Thus epenthesis is the chief means of achieving a well-formed syllable. However, a syllable level analysis cannot explain all instances of epenthesis. Neither can it explain other phenomenon such as metathesis and vowel-glide alternation. Indeed, an analysis at this level would never see a connection between these phonological operations.

Once we moved up to include footing constraints in our analysis, the picture became clear and everything fell into place. Epenthesis, metathesis, and vowel-glide alternation all have the same target structure as their goal. They are all strategies to aide the grammar to form perfect iambic feet. Keeping the word as short as possible satisfies PARSE SYLL and maximizes the syllable. Although input codas cannot be helped, IAMB watches over the penult making sure it does not create a coda that need not be there. The tension between IAMB, ALIGN-FT and PARSE SYLL usually results in a perfect iambic foot.

The following diagram depicts the collated constraint rankings for Mabalay Atayal. There are seven levels in the hierarchy. The undominated constraints are at the top of the diagram. Those constraints connected by lines are crucially ranked.

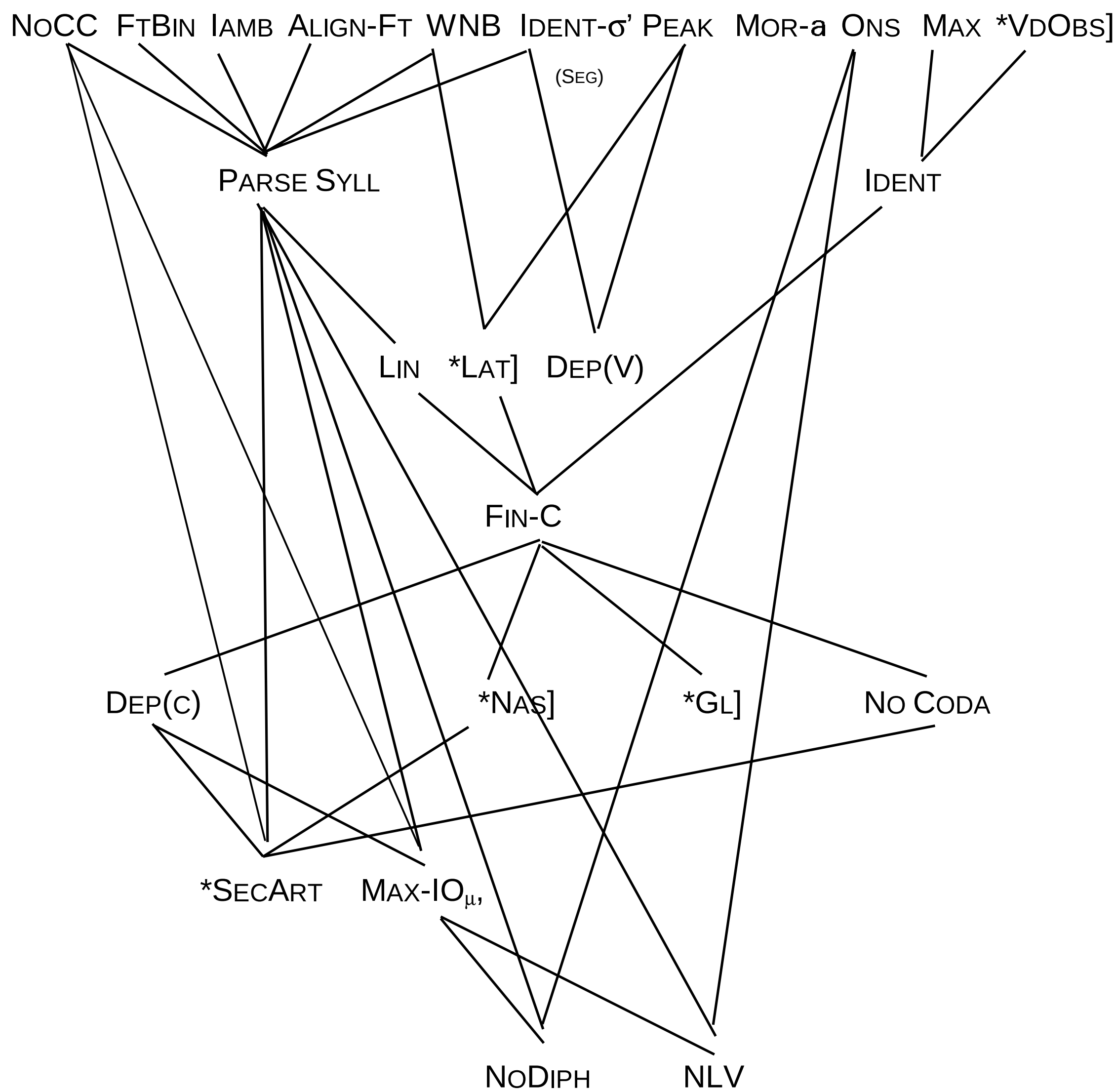


Figure 4: Final Collated Constraint Ranking

CHAPTER 4

DIALECTAL COMPARISON

4. Introduction

In this chapter we will compare two Squliq dialects with the C'uli' dialect of Mabalay as not all dialects show the same syllable structure or stress pattern as we have seen thus far. Most Atayal dialects have only CV syllables apart from the heavy ultimate syllable, but in Mabalay, diphthongs could occupy the peak of any but the penultimate syllable. Likewise, in the area of stress, Mabalay stress regularly fell on the final syllable, but this statement cannot cover all dialects of Atayal. With the majority of the lexicon made up of cognate words, we recognize these as dialectal differences, not distant enough to result in separate languages. Just as sound changes between phonemes have been shown to have regular patterns (Li, 1980), we now want to find patterns in the prosodic differences of syllable structure and stress assignment. Since I am working only from secondary sources, this chapter presents but a preliminary study of the differences between these dialects and Mabalay.

OT is ideal for dialectal comparison. The constraints that make up the grammar of each dialect are universal; thus, each dialect has a phonologically natural grammar. Although natural, dialects will differ in the degree of markedness. It is expected that innovations will be less marked (Zubritskaya, 1994). Since the Squliq dialects are considered more innovative than the conservative C'uli' dialects, we can expect to find the re-ranking of constraints will lower some of the more specific marked constraints of Mabalay. According to Zubritskaya, whole families of constraints rerank in the course of sound change (1994:335). This can also apply to dialectal differences as it was historical sound change which brought the dialects about. For this reason we find that Taoyuan Atayal, while similar to Mabalay in stress assignment, differs in the coda condition family of constraints. The Wulai dialect shares a similar ranking with Taoyuan in the coda conditions, but differs from both Mabalay and Taoyuan in the ranking of its footing constraints. So it is that whole families of constraints are either affected or left relatively untouched. OT is based on conflicting but violable constraints. This explains why whole constraint families are affected. As a dialect shifts one constraint in order to meet another more satisfactorily, it will entail demoting or raising a third constraint. Because they are conflicting constraints, they are forced to be ranked. One shift can, therefore, easily affect the whole family of constraints. We will now look at the details of each dialect in turn, focusing on the family of constraints which ranks most differently from Mabalay.

4.1 Taoyuan

The first dialect we will look at is Taoyuan Squliq. The Taoyuan data was collected by Li Jen-Kuei from Ciru' (Tao-nan Yu) (Li, 1980). Ciru' was 36 years of age in 1980 when the data was collected. He is from Tsejen village, Fushing county, Taoyuan prefecture, Taiwan. Our main focus will be on how the coda conditioning constraints of Taoyuan affect syllabification. We will find that a different order in constraint ranking accounts for the difference between Taoyuan and Mabalay.

4.1.1 The facts

4.1.1.1 Syllable Structure

Taoyuan syllables are CV or CVN throughout the word and CVC in the final syllable. CCVC is also a possible word final syllable provided that the second consonant of the cluster is a glide. The stem has either the final or two final syllables with underlying vowel nuclei. The peak of other syllables is supplied by an epenthetic schwa.[60] The penultimate vowel is phonetically long. Diphthongs appear only in the final syllable. By diphthongs, Li means /ay, aw, uy, iw, iy/, and /uw/ (Li, 1980:356). For the most part, his data verifies that none of these 'diphthongs' are followed by another consonant, as they could be in Mabalay.[61]

[60] I hold to my epenthetic analysis. It is also in agreement with Li's description of the data in 1980.

[61] However, see (167) (e), [məqəʒuyʔ].

Word internal codas are restricted to nasals.[62] Word final codas have the following restrictions. In Taoyuan, /ß/, /ɣ/, and /r/ change their feature identity in word-final coda position; /ß/ to /p/, /ɣ/ to /w/, and /r/ to /y/. This can be seen in the following data (Li, 1980: 357-363). I have added the epenthetic coda to Li's transcription as best I could from his description to give the surface forms.

(164) ß → p /__#

	Stem	Passive	
a.	qatap	qətaß-an	'cut with scissors'
b.	səhop	səhoß-an	'suck'
c.	suyap	syaß-an	'yawn'

(165) Word internally, *ß]

	Input	Output	
a.	/kßʒiħ -an/	kəßəʒiħan	'repeat'
b.	/m- kßka/	məkəßəkaʔ	'split'

(166) ɣ → w /__#

	Stem	Passive	
a.	kəsəyuw	kəsyuɣ-an	'borrow'
b.	pəsəyuw	p-in-syuɣ-an	'compensate'
c.	təɮamaw	təɮəmaɣ-an	'cut (grass)'
d.	səkəɮuw	səkəɮuɣ-an	'pull'

(167) Word Internally, *ɣ]

	Input	Output	
a.	m- ɣɮeŋ	məɣəɮeŋ	'lead'
b.	m- ɣɮuw	məɣəɮuw	'follow'

[62] Li (1980:357) refers only to disyllabic words when making stipulations about consonant clusters and nasal codas. However, because he omits transcribing the schwa and refers to the strings of Cə syllables as consonant clusters, this actually refers to more than disyllabic words. The implication is consonant-glide clusters and nasal codas do not appear in words with only one underlying vowel nucleus.

(168) r → y / __#

	Stem	Passive	
a.	ßaʒiy	bə/n/ir-an	‘buy’
b.	kəɣiy	k/in/ɣir-an	‘prepare hemp’
c.	pəɣyay	pəɣyar-an	‘run away’[63]

(169) Word internally, *r]

	Input	Output	
a.	/mrkyas/	mərəkyas	‘grow’
b.	/ɣrɣ -an/	ɣərəɣan	‘rub’

(170) ɮ → ɮ^{n} /__ #

	Stem	Passive	
a.	quɮ^{n}	qoɮun	‘snatch’
b.	ßərəßiɮ^{n}	ßərəßiɮan	‘tremble’

(171) Word internally, *ɮ]

	Input	Output	
a.	/tɮqiŋ/	təɮəqiŋ	‘hide (person)’
b.	sɮħaw	səɮəħaw	‘console’

[63] According to Li’s description, these words could be pronounced [pəɣyay] ~ [pəɣəyay] and [pəɣyar-an] ~ [pəɣəyar-an] ‘run away’ since he did not specify the conditions under which CC occurs. The same is true of [kəsəyuw]~[kəsyuw]and [kəsyuɣ-an] ~ [kəsəyuɣ-an] ‘borrow’ and of [pəsəyuw] ~ [pəsyuw] and [p-in-syuɣ-an] ~ [p-in-səyuɣ-an] ‘compensate’, and [syaß-an] ~ [səyaß-an] ‘yawn’.

(172) Word internally, * p] *t] *ts] *k] *q] *ʔ] *s] *x] *ħ]

	Input	Output	
a.	/spqaya/	səpəqayaʔ	‘hang up’
b.	/m- tŋi/	mətəŋiʔ	‘full’
c.	/m- tsßaq/	mətsəbaq	‘teach’
d.	/m- kɮwa/	məkəɮəwaʔ	‘float’
e.	/m-qɮuyʔ/	məqəɮuyʔ	‘flow’
f.	/m- sʔrux/	məsəʔərux	‘stand’
g.	/m- squtsi/	məsəqutsiʔ	‘defecate’
h.	/sħŋa/	səħəŋaʔ	‘catch up’

(173) Word internally, *y] *w]
(no clear examples)

(174) Word final possible codas: / • p, t, ts, k, q, ʔ, s, x, ħ, m, n, ŋ, w, y, ɮ^{n}• /

	Input	Output	
a.	/m- tuɮiq/	mətuɮiq	‘wake up’
b.	/qwax/	qəwax	‘wash (utensils)’
c.	/ħwaħ/	ħəwaħ	‘collapse’
d.	/m- ɮaħiŋ/	məħiŋ	‘weed (rice paddy)’
e.	/piray/	piray	‘turn’
f.	/m- aɣaɮ/	maɣaɮ^{n}	‘take’

(175) Word internal m], n], ŋ]

	Input	Output	
a.	tmɮamaw	təmɮamaw	‘cut (grass)’
b.	/k-in- raɣ -an/	kinraɣan	‘climb (a tree) Loc’
c.	/ɮiŋɮuŋ -an/	ɮiŋɮuŋan	‘think Loc’

4.1.1.2 Stress

The Taoyuan dialect as recorded by Li (1980) is very similar to Mabalay in its stress assignment.[64] Li simply states that stress normally falls on the final syllable (1980:356). This implies that there are words where stress falls on other than the final syllable. Because he has not been more explicit in describing the conditions under which stress falls on a non-final syllable, we will not address the issue of stress in the Taoyuan dialect.

4.1.2 Analysis of Taoyuan: Syllable Constraints and Ranking

Taoyuan has a much more restricted coda condition than has Mabalay. An Optimality Theoretic account of this dialectal difference requires a reordering of the constraints. We saw from Mabalay that if a coda condition, such as *VDOBS], were ranked above DEP(V) or PARSE SYLL, that it would always ban such phonemes from coda position, both word internally and word finally; and if a coda condition, such as *LAT] in Mabalay, were ranked below DEP(V) or PARSE SYLL, that constraint would block the specified phoneme from occurring word finally, but permit it to form a coda word internally. In the Taoyuan dialect, we want our constraints to block all but nasals from forming codas word internally and permit all but voiced obstruents and liquids to occur word finally.

Since nasals – unlike any other phoneme – can form coda's anywhere, *NAS] will rank below all other CODA CONDITION constraints. As in Mabalay,

[64] Li (1980) referred to this dialect as Pyasan. His language assistant was from Taoyuan.

*VDOBS] will rank above PARSE SYLL and DEP(V). Since liquids pattern with voiced obstruents in Taoyuan, *LAT] will be equally ranked with *VDOBS]. Voiceless obstruents and glides can occur as word final codas, but not as word internal codas. Constraints barring them from coda position, * OBS] and *GLIDES], must also rank above DEP(V) and PARSE SYLL in order to ban them from word-internal coda position.[65] *OBS] and *GLIDES] must rank below FIN-C in order to be accepted in word-final coda position. IDENT(F) has to rank between FIN-C and *OBS] and *GLIDES] so a change in feature is not acceptable for word-final voiceless obstruents and glides. Unacceptable codas are never deleted, which means MAX ranks high. This argument results in the following ranking:

(176) MAX, *VDOBS], *LAT]

>> FIN-C

>> IDENT(F)

>> *OBS], *GLIDE]

>> PARSE SYLL, DEP(V)

>> *NAS]

The ranking can be verified in the following tableaux. Tableaux (177) and (178) show that voiced obstruents and liquids change their features word-finally to form acceptable codas.

[65] *OBS] need not be specified as voiceless since voiced obstruents have already been eliminated by higher ranking *VDOBS]. *OBS] is more general than *VDOBS].

(177) [səkəʒuw] 'pull'

/skʒuɣ/	MAX *VDOBS] *LAT]	FIN-C	IDENT(F)	*OB] *GL]	PARSE σ	DEP(V)	*NAS]
a. ☞ sə̲.(kə̲.ʒuw)			*	*	*	**	
b. sə̲k.(ʒuw)			*	**!	*	*	
c. sə̲.kə̲.(ʒu.ɣə̲)		*!			**	***	
d. sə̲.(kə̲.ʒuɣ)	*!				*	**	
e. sə̲.(kə̲.ʒu_)	*!	*			*	**	

Candidate (a) is better than (d) because it does not have a voiced obstruent coda. Unlike (e), the optimal candidate (a) has kept its word final coda, satisfying MAX and FIN-C. Candidate (a) is also superior to (c) which added a vowel to make /ɣ/ an onset instead of a coda. The strategy failed because it came at the price of a mark against high ranking FIN-C. Candidate (b) reduced the number of syllables in the word, but did not succeed in reducing the number of unparsed syllables, which is really what matters. The heavy penult restricted it from being parsed into the foot and in so doing incurred a fatal mark against *OBS].

(178) [ßaʒiy] 'buy'

/ßʒir/	MAX *VDOBS] *LAT]	FIN-C	IDENT(F)	*OB] *GL]	PARSE σ	DEP(V)	*NAS]
a. ☞ (ßə̲.ʒiy)			*	*		*	
b. ßə̲.(ʒi.ra̲)		*!			*	**	
c. (ßə̲.ʒir)	*!					*	
d. (ßə̲.ʒi_)	*!	*				*	

Like tableau (177) above, tableau (178) verifies that concealing ones' true identity is the best strategy for an unacceptable coda to take in order to find acceptance, though it incurs a minimal violation of IDENT(F). Rival (b) is rejected because it fails on FIN-C. Rival (c) remained faithful but failed on *VDOBS]. Rival (d) got rid of the offending coda, but in so doing made an infraction against equally high ranking MAX.

Tableaux (179) and (180) show that voiced obstruents and liquids are barred from forming word-internal codas. A DEP(V) violation allows them to fill an onset position instead.

(179) [kəßəʒiħan] 'repeat'

	/kßʒiħan/	MAX *VDOB] *LAT]	FIN -C	IDENT(F)	*OB] *GL]	PARSE σ	DEP (V)	*NAS]
a. ☞	kə̳.ßə̳.(ʒi.ħan)					**	**	*
b.	kə̳p.(ʒi.ħan)			*!	*	*	*	*
c.	kə̳ß.(ʒi.ħan)	*!			*	*	*	*

Word-internally, FIN-C has no say over the outcome of Eval's choice. When rivals do not fail on FIN-C, going incognito, as rival (b) tried to do, is no longer the best strategy. With only one offense made against PARSE SYLL instead of the two made by candidate (a), candidate (c) may have thought it was ahead of the game, but it came at the cost of a violation against *VDOBS]. Because of the ranking *VDOBS] >> PARSE SYLL, candidate (a) won.

(180) [kəɮəkaħiʔ] ‘kick-JUSS’

/kɮkaħ-i/	MAX *VDOBS] *LAT] NOCC	FIN-C	IDENT(F)	*OB] *GL]	PARSE σ	DEP (V)	*NAS]
a. ☞ kə.ɮə.(ka.ħiʔ)				*	**	**	
b. kən.ə.(ka.ħiʔ)			*!		**	**	
c. kɮə.(ka.ħiʔ)	*!$_{\text{NO CC}}$			*	*	*	
d. kəɮ.(ka.ħiʔ)	*!$_{\text{LIQ}}$			*	*	*	

Unlike Mabalay, Taoyuan cannot accept /ɮ/ as a coda, even word internally. Candidate (d) would have been selected as optimal under Mabalay’s constraint ranking, but loses in Taoyuan because *LAT] ranks above PARSE SYLL and DEP(V). This ranking makes violations of candidate (a) inconsequential. Candidate (b) finds out that a change in identity is of no use because higher ranking FIN-C cannot eliminate any rivals word internally. Candidate (c) is out on account of its violation against No CC, which militates against consonant clusters; No CC ranks as it does in Mabalay.

Tableaux (181) and (182) show that voiceless obstruents and glides can occur word finally without any change in feature identity, but unlike Mabalay, they cannot occur as codas word internally because *OBS] and *GLIDE] rank above PARSE SYLL and DEP(V).

(181) [kuɣus] ‘scrape, shave’

/kuɣus/	MAX *VDOBS] *LAT]	FIN-C	IDENT(F)	*OB] *GL]	PARSE σ	DEP(V)	*NAS]
a. ☞ (ku.ɣus)				*			
b. (ku.ɣun)			*!				*
c. ku.(ɣu.sa̳)		*!			*	*	
d. (ku.ɣu_)	*!	*					

Final voiceless obstruents have no need to change either their identity like rival (b) did, or their position in the syllable as candidate (c) did, as constraints barring such changes rank above the only offending mark they score against *OBS]. Candidate (b) finds out that even changing to a nasal which can form a coda anywhere in the word is worse than remaining faithful. This is because IDENT(F) ranks above *OBS] even though *NAS] ranks far below. Rival (d) is out on a violation against high ranking MAX.

(182) [naβuw] ‘drink’

/naβuw/	MAX *VDOBS] *LAT]	FIN-C	IDENT(F)	*OB] *GL]	PARSE σ	DEP(V)	*NAS]
a. ☞ (na.βuw)				*			
b. (na.βum)			*!				*
c. na.(βu.wa̳)		*!			*	*	
d. (na.βuɣ)	*!		*	*			
e. (na.βu_)	*!	*					

In tableau (182) above, an input glide is better off remaining faithful than deleting, as in (e), as MAX violations are never tolerated. Changing to onset position, as rival © did, entails a mark against DEP(V) which would be inconsequential except that it is accompanied by a fatal strike against FIN-C. Changing identity to /ɣ/, as rival (d) did, is definitely a serious offense, but even in trying to pass itself off as an inoffensive nasal, rival (b) incurs a fatal mark against IDENT(F).

Tableau (183) shows that although voiceless obstruents (and by extension, glides) can fill word final coda, the ranking effectively bans them from forming word internal codas.

(183) [məsəʒuħiy] 'landslide'

/msʒuhiy/	MAX *VDOBS] *LAT]	FIN-C	IDENT(F)	*OB] *GL]	PARSE σ	DEP (V)	*NAS]
a. ☞ mə.sə.(ʒu.ħiy)				*	**	**	
b. məʃ.(ʒu.ħiy)				**!	*	*	
c. mə.sə.(ʒu.ħi_)	*!	*			**	**	

Because *OBS] and *GLIDE] rank above PARSE SYLL and DEP(V) in Taoyuan, /s/ cannot fill a word internal coda position in tableau (183) above. In Mabalay it could have because *OB] and *GL] rank below PARSE SYLL and DEP(V). Since the Taoyuan ranking places more restrictions on the coda, Taoyuan must give ground on violations against PARSE SYLL and not complain when words get a little long.

Tableaux (184) and (185) below show that nasals can be codas anywhere. This is because the constraint on nasal codas ranks below PARSE SYLL, DEP(V), and FIN-C.

(184) [həmkaŋiʔ] 'walk'

/ħmkaŋi/	MAX *VDOBS] *LAT]	FIN-C	IDENT(F)	*OB] *GL]	PARSE σ	DEP (V)	*NAS]
a. ☞ həm.(ka.ŋiʔ)				*	*	*	*
b. ħə.mə.(ka.ŋiʔ)				*	**!	**	
c. həp.(ka.ŋiʔ)			*!				
d. hə_.(ka.ŋiʔ)	*!				*	*	*

Ranking so low, nasals have no reason to change their identity, as did rival (c), to offend DEP(V) and PARSE SYLL in order to syllabify as an onset, as did rival (b), or to delete, as did rival (d). All such strategies would cause violations to higher ranking constraints.

(185) [ßoqun] 'squeeze PAT'

/ßoq -un/	MAX *VDOBS] *LAT]	FIN-C	IDENT(F)	*OB] *GL]	PARSE σ	DEP (V)	*NAS]
a. ☞ (ßo.qun)							*
b. (ßo.quʔ)			*!	*			
c. (ßo.quy)			*!	*			
d. ßo.(qu.na)		*!			*	*	
e. (ßo.qu_)	*!	*					

Neither are nasals ousted by any better rivals in word final coda position; even in changing a word final nasal to glottal – a segment unmarked enough to be the choice for an epenthetic consonant – rival (b) incurs a fatal blow against IDENT. Any change in identity is equally bad, as can be verified by rival (c) which changed /n/ to a fairly inoffensive glide. Candidate (d) loses out because a mark against FIN-C is far worse than keeping a nasal coda. Rival (e) is also out because it not only violated FIN-C, but had to first violate MAX to do so.

4.1.3 Comparison of Taoyuan and Mabalay

The differences between Taoyuan and Mabalay syllabification have been successfully accounted for by a reordering of the coda condition family of constraints within the overall hierarchy. Taoyuan ranks the constraints MAX, *VDOBS], *LAT] >> FIN-C >> $\text{IDENT}_{(F)}$ >> *OBS], *GL] >> PARSE SYLL , DEP(V) >> *NAS], whereas Mabalay ranks them MAX, *VDOBS] >> PARSE SYLL, IDENT-IO >> DEP(V), *LAT] >> FIN-C >> *NAS], *GLIDE], *OBS].

Basically this means coda conditions that rank above PARSE SYLL and DEP(V) and FIN-C bar the phonemes they militate against from all coda positions, while coda conditions ranking below PARSE SYLL and DEP(V) and FIN-C are ineffective in banning the phonemes they militate against from any coda position throughout the word. Those coda conditions ranking above FIN-C but below PARSE SYLL and DEP(V) – this refers only to Mabalay *LAT] – allow the phonemes they militate against to fill word-internal codas, but not word final codas. Conversely, those coda conditions ranking above PARSE SYLL and DEP(V) but below FIN-C – this refers only to Taoyuan *OBS] and *GLIDE] – allow the phonemes they militate against to fill coda position only word finally. Thus, we see that besides the difference in rank among the coda condition constraints themselves, the reordering of FIN-C above PARSE SYLL and DEP(V) in Taoyuan is also affecting the ranking. An overall effect is that PARSE SYLL does not have the effect of reducing the number of unparsed syllables in the word as it did in Mabalay.

4.2 Wulai[66]

Wulai is another Squliq dialect spoken in Wulai, south of Taipei. The data was collected by Victoria Rau (nee Ho Der-Hwa) in 1989-90 from eight informants in Wulai county, Taipei Prefecture, Taiwan (Rau, 1992).

4.2.1 The facts

4.2.1.1 Syllable Structure

Syllables are limited to CV, and CVC; the final syllable may be closed, but non-final syllables must be open. All syllables have onsets. If there is no onset in the input, epenthetic glottal is supplied.

(186) Syllable structure of Wulai dialect:

CV	na ‘final particle, not yet’ mu ‘1SG, my’
CVC	mit ‘goat’, baq ‘can’, muʔ ‘to shoot’, ʒik ‘deep’, ßiŋ ‘carry, bring’

[66] Rau now prefers to call this dialect Wulai. In her dissertation it was referred to as Gogan and was described as covering a much wider area, from Wulai to Ilan.

Although consonant clusters are permissible as long as the second consonant is a glide – CGV and CGVC (Rau, 1992:26) – when Rau gives examples of the predictability of schwa epenthesis, she shows even a consonant plus glide sequence is separated by schwa; for example, kwara ‘all’ is /kə̳wara/ and rgyax ‘mountain’ is /rə̳ɣə̳yax/ (Rau, 1992:25). As in Li’s data, the conditions under which Cy, Cw are clusters or separated by schwa needs to be stated more precisely.

Codas appear only word finally. There is one exception to this rule; the perfective marker is an infix, -in-. The nasal assimilates to the place of the following syllable’s onset.

(187) Place assimilation

Stem	Affixed form	
kut	p-iŋ-kut-an	‘cut LOC PFV’
ßaħuw	p-im-ßaħuw	‘harvest’

This means word internal codas cannot have place. Word finally, /ß/, /ɣ/, and /r/ change their identities to /p/, /w/, and /y/, respectively. As in other dialects, /ʒ/ appears to be banned from coda position, and /ɮ/ is realized as /ɮ^{n}/ or /n/.

4.2.1.2 Stress

A most interesting difference between Wulai and Mabalay is in the assignment of stress. Rau describes stress assignment in the Wulai dialect and provides the following list of data (Rau, 1992:26-27). She left out the schwa vowel by convention, but I have supplied it according to Rau's description of its epenthetic site[67] since these are the surface forms (Rau, 1992:25). I have also marked the stress on the data according to Rau's description (Rau,1992:27).

(188) Wulai Penultimate Stress

	Long Vowel Stem	Affixed form	
a	páːqut	pəqúːt-un	'ask PAT'
b	káːyaɮ^{n}	kəyáːɮ-an	'talk LOC'
c	ʔáːras	ráːs-un	'take along PAT'
d	táːpiħ	təpíːħ-un	'to call PAT'
e	ßíːħiy	bəħíːy-un	'to beat PAT'
f	tsíːriq	təríːq-an	'to fight LOC'
g	ħúːqiɮ^{n}	ħəqíːɮ-an	'die Loc'

(189) Wulai Final Stress

	Short Vowel Stem	Affixed Form	
a	teħúk	təħək-án	'arrive'
b	laqúx	ləqəx-án or ßəqəx-án	'win'
c	səpúŋ	səpəŋ-án	'measure'
d	qəyanúx	qənəx-án	'to live'

[67] Rau sees these as phonemic vowels that have been reduced to [ə], not as epenthetic vowels that are absent from the input.

Rau explains the correspondence in stress assignment between the stem and the affixed form in this manner.

> The affixed form has the same stress pattern as the root, that is, the accent remains on the penult in affixed form of roots with penultimate stress, and accent remains on the final syllable in affixed form of roots with final stress. ... Roots which have a penultimate stress are analyzed here to contain a long vowel, whereas roots which have a final stress are analyzed to contain a short vowel (Rau, 1992:26).

4.2.2 Analysis and Comparison with Mabalay

4.2.2.1 Syllable Constraints and Ranking

In order to account for the Wulai syllable structure allowing word internal placeless nasals, one more constraint needs to be added, that is, *NAS/PL].

(190) NO NASAL CODAS WITH PLACE (*NAS/PL])
Nasals with place cannot fill coda position.

For a nasal to fill coda position, it must share the place of articulation with the following onset. Apart from this adjustment, the Wulai constraints are identical to the Taoyuan. They are also identically ranked. *NAS/PL], being more specific than *NAS], must rank above *NAS] for its effects to be seen.

(191) CODA CON (*NAS])
Coda position cannot be filled by a nasal.

It needs to be ranked below MAX, FIN-C, and IDENT-IO(F) because nasals with place are permitted word finally. Because perfective /-in-/ ends in a placeless nasal, N, output forms /m/ and /ŋ/ do not violate IDENT-IO(F), whereas changing N to a obstruent would violate IDENT-IO(F). In rivals where /n/ behaves as if it has place – where it does not change to the place of the following consonant or is followed by an epenthetic schwa – that /n/ is considered to have place and its violations are marked accordingly.

The following tableau verifies that the Taoyuan ranking with the addition of *NAS/PLACE accounts for the Wulai data.

(192) [pimpiraʔ] 'how many PFV'

/p- in- pira/	MAX *VDOBS] *LAT]	FIN-C	IDENT	*NAS/PL] *OBS] *GL]	PARSE σ DEP(V)	*NAS] NO CODA DEP(C)
a. ☞ pim.(pi.raʔ̳)					*	**
b. pin.(pi.raʔ̳)				*!	*	**
c. pi.nə̳.(pi.raʔ̳)				*!	** *	**
d. pim.(pi.ra)		*!			*	

In tableau (192) rival candidate (d) is disqualified because it does not end in a consonant. Rivals (b) and (c) behave like nasals with place; they did not assimilate to the labial place of /p/. They, therefore, violate *NAS/PL], which proves fatal. Candidate (a) is selected by Eval as optimal.

The following tableau shows that nasals with place cannot be word internal codas.

(193) [pənəßuwan] 'CAUSE drink LOC'

	/p- nßuw -an/	MAX *VDOBS] *LAT]	FIN-C	IDENT	*NAS/PL] *OBS] *GL]	PARSE σ DEP(V)	*NAS] NO CODA DEP(C)
a. ☞	pə̳.nə̳.(ßu.wan)					** **	* *
b.	pə̳n.(ßu.wan)				*!	* *	** **
c.	pə̳m.(ßu.wan)			*!	*	* *	** **

Tableau (193) shows that the nasal with place, /n/ of [nəßuw] 'drink', cannot form a word internal coda. Candidate (c) is out on an IDENT-IO(F) violation. Since /n/ has place, changing to /m/ is a change in identity. Both (b) and (c) violate *NAS/PL]. The ranking established for the grammar effectively blocks this from occurring. Greater DEP(V) and PARSE SYLL violations are preferred to word internal nasal codas with place.

Apart from the difference in nasals with and without place, the tableaux for Taoyuan coda conditions apply to Wulai. The reader is referred back to them.

4.2.2.2 Stress

In Wulai, long vowel stems are stressed on the penultimate syllable and short vowel stems are stressed on the ultima. Apart from stress assignment, the only difference between the two sets of data is the vowel length. This means that if an analysis is to get beyond a lexical class assignment, the vowel length distinction must be present in the input and is not a result of stress.[68] This means the phoneme inventory should have a set of long and a set of short vowels. Words with long vowels are stressed on the long vowel. Otherwise, stress falls on the final syllable. This looks like a case of weight-to-stress attraction, but it is complicated in the affixed forms. We note that in affixed forms of long vowel stems, in spite of suffixation, it is the penult that has the long vowel. The long vowel of the stem's penult has reduced to schwa in the affixed form, while the short vowel of the stem's final syllable, now a penult in the suffixed form, has taken on the vowel length. This shift in vowel length is evident when the stem, [ßíːħiy] 'to beat', and the affixed form, [ßəħíːy-un] 'to beat PAT', are compared. Moraic weight has remained on the penult even though the actual vowel that was once associated with it is now in the antepenult. This contrast in the two derivational forms makes it appear to be not stress attraction, but lengthening due to stress. This tension in the assignment of stress is due to constraint interaction.

If all feet were iambic, the Wulai dialect would have many words with a poor parse. Most unaffixed forms with long vowels would have a heavy one-syllable foot. I maintain that this is not the case at all, but that universally available constraints that did not surface in our analysis of Mabalay rank higher in Wulai.

[68] However, it seems there must be some interaction with stress as long vowels only show up in the penultimate syllable.

Since stress is always on one of the last two syllables, I have parsed all the optimal candidates as right aligned. In other words, ALIGN(FT R, PRWD R) – which we have been calling ALIGN-FT – is an undominated constraint in Wulai, just as it is in Mabalay.

We have also noted that if there is a long vowel, it is stressed. This reveals a high ranking Weight-to-Stress Principle (WSP) in Wulai that we did not see operating in Mabalay.

(194) WEIGHT-TO-STRESS PRINCIPLE(WSP):
Heavy syllables are prominent in foot structure and on the grid.

The WSP of Prince (1990) scans the prosodic word for heavy syllables. If it is heavy, the WSP wants it stressed.

The combination of a high ranking ALIGN-FT and WSP entails that not all feet can be iambic. FOOT FORM(TROCHEE) ranks high enough to surface in Wulai, even though it ranked so low as to be ignored in Mabalay. IAMB and TROCHEE are actually competing constraints in Wulai. Satisfying WEAK-NODES-DO-NOT-BRANCH (WNB) is an absolute necessity for an iamb, but a (H́H) trochaic foot can get by with violations to the WNB. In fact, (H́L) is a poor trochee, violating RHYTHMIC HARMONY. Although (H́L) feet satisfy both TROCH and WNB and perhaps even WSP, they are known to be marked or even absent in trochaic systems (Prince and Smolensky, 1993; Mester, 1992; Prince, 1990; Hayes, 1987).[69]

(195) RHYTHMIC HARMONY (RHHRM)
No (H́L) feet: *(HL)

In Wulai, as in Mabalay, CVV and CVC are both heavy. In other words, the coda is moraic.[70] A CVV.CVC foot is, therefore, (H.H), satisfying RHHRM. This appearance of quantity insensitivity on the part of trochaic feet, but not on the part of iambic feet, is due in part to RHHRM, but also to the ranking of TROCH >> IAMB and to serious candidates being found in a tie on the WNB.

Constraints posited to account for the shift in vowel length are MAX_{μ}, DEP_{μ} and ASSOC_{μ}. MAX_{μ} incurs a mark when a mora is deleted; DEP_{μ} when a mora is inserted. MAX_{μ} and DEP_{μ} say nothing about the segment to which the input and output moras are linked. An alternative to both MAX_{μ} and DEP_{μ} incurring violations in the same candidate is to interpret the moraic shift as a reassociation of a mora with a segment in the next syllable. This would incur only one violation of ASSOC_{μ} as opposed to two against both MAX_{μ} and DEP_{μ}.

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[69] Since there are languages with moraic trochees having H́L) and (H) feet, (i.e. Cairene Arabic, Hayes 1995) RHHRM is not a universally undominated constraint.

[70] Mabalay codas have to be moraic. Consider [ha.mau.ˈ(ßiŋ)] 'cut (meat)'. If the coda were not moraic, the final syllable could not be the stress bearing syllable as it would only be one mora in weight. Such a parse would violate FTBIN. Parsing the final two syllables would result in (HL). This would violate undominated WNB.

(196) MAX$_\mu$
Every mora of the Input has a correspondent in the Output (i.e., don't delete moras).[71]

(197) DEP$_\mu$
Every mora of the Output has a correspondent in the Input, (i.e., don't insert moras).

(198) ASSOC$_\mu$
The segment to which a mora is associated in input must correspond to the segment that mora is associated with in output.[72]

In spite of the long vowels, one thing we do not see in Wulai is trimoraic syllables. The long vowel is never in a closed syllable. A constraint is needed to bar CV:C syllables from surfacing. To this end, I posit SYLL $\leq \mu\mu$. This constraint ranks so low as to be out of the picture in Mabalay as that dialect's tolerance for diphthongs and long vowels in the final syllable entails.

(199) SYLL $\leq \mu\mu$
A syllable is less than or equal to two moras. (No trimoraic syllables.)

Observe the interplay between the constraints in the two tableaux below.

[71] Constraint definitions for MAX$_\mu$ and DEP$_\mu$ are taken from Bakovi• , (ROA-168), posted 1996, and Rosenthall, (1997). These are the correspondence theory replacements for Prince and Smolensky's PARSE$_\mu$ and FILL$_\mu$, (Prince and Smolensky, 1993).

[72] McCarthy (1995:43) posits a input-output correspondence constraint, WT-INDEN, banning lengthening and shortening. For Rosenthall, (1997: 146) that same concept is embodied in IDEN-IO$_\mu$. I have labeled it ASSOC$_\mu$.

(200) Unaffixed form of short vowel stem: [teħók] 'arrive INTR'

/teħok/	MAX$_\mu$ ALIGN-FT SYLL ≤ μμ RHHRM	WSP	DEP$_\mu$ ASSOC$_\mu$	PARSE σ	TROCH	WNB	IAMB
a☞ (te.ħók)					*		
b. te.(ħók)				*!			
c. (téː.ħok)		*!	*			*	*
d. (té.ħok)		*!				*	*

Wulai ranks TROCH above IAMB, but both are dominated constraints subject to the undominated constraints, ALIGN-FT, MAX$_\mu$, and SYLL ≤ μμ as well as to the other violable constraints, WSP, DEP$_\mu$, ASSOC$_\mu$, and PARSE SYLL. In tableau (200), we see that Eval chooses an iambic parse when trochaic rivals (c) and (d) fail on WSP and DEP$_\mu$. In other words, a vowel is not lengthened in order to parse the syllables trochaically. Candidate (b) is iambic, like (a), but fails on PARSE SYLL. All candidates pass on ALIGN-FT.

(201) Unaffixed form of a long vowel stem: [(páː.qut)] 'ask'

/paːqut/	MAX$_\mu$ ALIGN-FT SYLL ≤ μμ RHHRM	WSP	DEP$_\mu$ ASSOC$_\mu$	PARSE σ	TROCH	WNB	IAMB
a. ☞ (páː.qut)		*				*	*
b. (paː.qút)		*			*!	*	
c. paː.(qút)		*		*!			
d. (pa.qúːt)	*!$_{SYLL\leq\mu\mu}$		*$_{ASSOC\mu}$		*		
e. (pa.qút)	*!$_{MAX\mu}$				*		
f. (páː).qut	*!$_{ALIGN\text{-}FT}$	*		*			

In tableau (201) [pá:qut] 'ask', we see that the only way to meet the WSP and WNB is by forming a right aligned iambic foot and either shifting the moraic weight to the ultima as rival (d) does, or deleting one of the two mora that are linked to the penultimate vowel, as in (e). However, these strategies cause higher ranking violations to SYLL ≤ μμ or MAX$_{\mu}$, respectively. Rival (f) is also eliminated on a high ranking violation to ALIGN-FT. It is, therefore, unavoidable for the optimal candidate to violate the WSP. The next fatal violation is made by rival candidate © on PARSE SYLL. The most serious rivals then are equal in all respects except that candidate (a) is trochaic and (b) is iambic. Since TROCH ranks above IAMB, the optimal candidate is (a) because it passed on TROCH.

It does not matter to the trochaic foot that its weak node branches. In fact, due to high ranking RHHRM, it is preferred. With equal violations of the WSP and WNB, the deciding factor between the two most serious rivals comes down to the ranking of TROCH above IAMB. The fact that TROCH is preferred to IAMB in these kinds of ties is significant because a reordering of IAMB over TROCH would result in unacceptable iambic feet. The heavy syllable in the weak node should never pass. The trochaic foot, on the other hand, although calculated with quantity sensitivity constraints in mind, can get by as being quantity insensitive. According to the Iambic/Trochaic Law, this option is only open to trochaic feet.

(202) IAMBIC/TROCHAIC LAW (Hayes, 1995:80)
a. Elements contrasting in intensity naturally form groupings with initial prominence.

b. Elements contrasting in duration naturally form groupings with final prominence.

4.2.2.3 Moraic Shift:

The moraic shift in the affixed form is due to the undominated ranking of ALIGN-FT and the high rank of the WSP. Because the optimal candidate must satisfy ALIGN-FT at all costs and at least equal its rivals on the WSP, the moraic weight of the antepenultimate syllable is compelled to shift to the penult. To maintain the satisfaction of ALIGN-FT, the foot form must be trochaic.

If, on the other hand, ALIGN-FT actually aligns the right edge of the foot with the right edge of the stem rather than with the right edge of the prosodic word, either an iambic foot entailing stress shift or a trochaic foot with no stress shift would be possible. Changing our alignment arguments is ruled out, however, when we consider the affixed form of short vowel stems. That the suffix is stressed in the affixed form of short vowel stems tells us that the suffix is within the alignment domain, the prosodic word. Its right edge is aligned with the right edge of the prosodic word. Formally, this constraint would be written as in (203) below.

(203) ALIGN(SUFFIX R, PRWD R): $\text{ALIGN}_{(\text{SFX})}$
The right edge of a suffix is aligned with the right edge of a prosodic word.

We must conclude that the arguments of ALIGN-FT are as we stated for Mabalay, ALIGN (FT R, PRWD R), and not ALIGN (FT R, STEM R).

The foot wants to align at the right edge of the Prosodic Word, (that is to say, at the right edge of the suffix), but the underlying long vowel attracting stress is in the antepenultimate syllable. Not even a three syllable foot could satisfy both the WSP and ALIGN-FT, and in attempting to do so, it would fatally violate undominated FOOT BINARITY (FTBIN).[73] This brings us to the bargaining table once again. Once again, a negotiation has to be made between the two foot form constraints, IAMB and TROCH. The demands of ALIGN-FT, SYLL $\leq \mu\mu$, and MAX_{μ} are heard due to their superior rank. In tableau (204), this eliminates (e), (f), and (g) on ALIGN-FT violations, rival © on a MAX_{μ} violation and (b) on a strike against SYLL $\leq \mu\mu$. Candidates (a) and (d) remain as the two most serious rivals. Both violate the WSP, but rival (d) makes the greater violation; two of its heavy syllables went unstressed as opposed to only one syllable in candidate (a). The additional violation proved fatal, showing that violations must be minimal. Observe this interaction in tableaux (204) below.

[73] FTBIN at a mora or syllable level has been assumed in all candidates on all tableaux.

(204) Affixed form of long vowel stem: [pəqúːtun] ‘ask PAT’

/paːqut-un/	MAX$_{\mu}$ ALIGN-FT SYLL ≤ μμ RHHRM	WSP	DEP$_{\mu}$ ASSOC$_{\mu}$	PARSE σ	TROCH	WNB	IAMB
a. ☞ pə.(qúː.tun)		*	*	*		*	*
b. pə.(qu.túːn)	*!$_{SYLL \leq \mu\mu}$		**	*	*		
c. pa.(qu.tún)	*!$_{MAX\mu}$			*	*		
d. paː.(qú.tun)		**!		*		*	*
e. (pə.qúː).tun	*!$_{ALIGN\text{-}FT}$		*$_{ASSOC\mu}$	*	*		
f. (páː.qu).tun	*!$_{ALIGN\text{-}FT}$			*			*
g. (pa.qú).tun	**!$_{ALIGN\text{-}FT}$	*		*	*		

When the two most serious competitors are both iambic, the one parsed with a two syllable foot, the other parsed with a one heavy syllable foot, PARSE SYLL determines the winning candidate. This can be seen in (205) below.

(205) Affixed form of short vowel stem: [tə.(ħo.kán)] ‘arrive LOC’

/teħok -an/	MAX$_{\mu}$ ALIGN-FT SYLL ≤ μμ RHHRM	WSP	DEP$_{\mu}$	ASSOC$_{\mu}$	PARSE σ	TROCH	WNB	IAMB
a.☞ tə.(ħə.kán)					*	*		
b. tə.ħə.(kán)					**!			
c. tə.(ħóː.kan)		*!	*		*		*	*
d. tə.(ħó.kan)		*!			*		*	*
e. (tə.ħó).kan	*!	*			*	*		
f. (tə́.ħo).kan	*!	*			*			*

In tableau (205) above, we see that short vowel stems are parsed with a right aligned iambic foot. This is due to a tie of the optimal candidate (a) with its most serious rival (b) on all undominated constraints. The tie is broken by an extra violation of PARSE SYLL on the part of candidate (b). Right aligned trochaic footing in rivals (c) and (d) fail on the WSP and DEP$_{\mu}$. Iambic footing in rivals (e) and (f) fares even worse with violations to ALIGN-FT. That their violations prove fatal shows that ALIGN-FT, the WSP and DEP$_{\mu}$ must rank above PARSE SYLL. As was true in Mabalay, the fact that PARSE SYLL ranks below ALIGN-FT is what achieves non-iterative footing. The tableau under discussion also shows that PARSE SYLL is crucially ranked above TROCH.

4.2.2.4 Comparison

ALIGN-FT is an undominated constraint in both Wulai and Mabalay. The fact that the WSP also ranks high – crucially dominated only by MAX$_{\mu}$ – forces the Wulai dialect to give way in the area of foot form. Once IAMB is lowered to a violable position, it must compete with TROCH. The Mabalay dialect, on the other hand, in order to place such value on IAMB as it does had to give way in the area of weight-to-stress. Even so, because Mabalay is concerned with keeping the penult light for the mutual satisfaction of WNB, IAMB, ALIGN-FT and PARSE SYLL, we know it is quantity sensitive, as all iambic languages are.

4.3 Conclusion

Dialectal comparison is a testing ground for the validity of the constraints used in the analysis. The idea is that the same constraints ranked in a different order should be able to account for dialectal differences. I have introduced constraints in the analysis of Wulai that were not mentioned in my analysis of

Mabalay footing; TROCH, the WSP, and SYLL $\leq \mu\mu$. These are, however, not new dialect-specific constraints, but universals. As such, they exist in the grammar every language – including that of Mabalay, as well. The fact that they do not surface shows that they rank very low in Mabalay.

It is somewhat disturbing to see vowel length marked in the input in Wulai when it was not marked for Mabalay. However, holding to the constraint ranking as I have analyzed it for Mabalay – IAMB, WNB, ALIGN-FT >> PARSE SYLL – the length of input vowels really makes no difference. With the addition of DEP_μ and ASSOC_μ ranked above PARSE SYLL and MAX_μ, the WSP and TROCH below, the existing constraint ranking will keep them from surfacing. This can be verified in tableau (206) below.[74]

(206) In Mabalay, long input vowels never surface.
/paːqut/ → [pa.ʔútš̃] 'ask'

	/paːqut/	IAMB WNB	ALIGN FT	DEP_μ ASSOC_μ	PARSE σ	WSP	MAX_μ	TROCH
a. ☞	(pa.ʔúts)						*	*
b.	paː.(ʔúts)				*!	*		
c.	(pa.ʔúːts)			*!$_{\text{DEP}\mu}$			*	*
d.	(pa.ʔúːts)			*!$_{\text{ASSOC}\mu}$				*
e.	(páː).ʔuts		*!		*	*		
f.	(paː.ʔúts)	*!$_{\text{WNB}}$				*		*
g.	(páː.ʔuts)	* *!$_{\text{IAMB}}$ $_{\text{WNB}}$				*		

[74] Since mora are never added to lengthen output vowels nor moved from one syllable to the next, we do need to add DEP_μ and ASSOC_μ to our grammar. This has no negative effect on the analysis to date.

The long input vowels can never surface because MAX_{μ} ranks below PARSE SYLL.[75] Once we consider that the input might have long vowels, DEP_{μ} and ASSOC_{μ} are necessary. They must at least rank above the WSP, MAX_{μ} and TROCH, but because they never occur, I have ranked them as undominated.

In both dialects we see some similarities and some differences in the ranking. Both dialects maintain ALIGN-FT as an undominated constraint keeping the foot aligned at the right edge of the prosodic word. Furthermore, the constraint arguments have not changed; they have not become ALIGN(FT L, PRWD L). The dialects share another feature in that both have non-iterative footing. This is because ALIGN-FT ranks above PARSE SYLL.

The main differences come in the ranking of MAX_{μ}, the WSP, IAMB and TROCH. In Mabalay, IAMB was an undominated constraint. The WSP ranked low and went unmentioned. Mabalay's predominant concern was for a right aligned iamb. The only attention it paid to the rest of the word was to the number of syllables that went unparsed. Satisfying PARSE SYLL even led to forming heavy syllables outside the foot. Since IAMB is undominated in Mabalay, the effects of its competitor TROCH were never seen. In Wulai, on the other hand, the WSP does rank high, crucially dominated only by MAX_{μ}.[76] Because the WSP and ALIGN-FT rank so high, FTFORM could not be an undominated constraint. The

[75] Li (1980) noted that in Pyasan Squliq the penultimate vowel was often long. It appears that this dialect is very similar to Mabalay in most aspects of footing, but obviously Maxμ ranks higher in Pyasan than in Mabalay.

[76] Compare (201) (c) with (a) and (e) to see that the other undominated constraints ALIGN-FT and SYLL $\leq \mu\mu$ are not crucially ranked above WSP.

three constraints would often be incompatible. FTFORM took the lower position in Wulai. The two foot form constraints, IAMB and TROCH, compete because neither is undominated. Because TROCH ranks above IAMB, it usually wins out over iambic foot parsing. For an iambic rival to be optimal, it must satisfy WNB. TROCH, ranking above WNB, can get away with being quantity insensitive. The main dialectal difference then is in the reverse ranking of FTFORM and the WSP. By virtue of its ranking, Wulai places its value on correlating weight with stress just as Mabalay places its value on forming the perfect iamb.

We were also able to account for a major difference between the Taoyuan and Mabalay dialects, that of syllabification differences due to a reordering of coda condition constraints, FIN-C and PARSE SYLL. Another dialectal difference seems to lie in the area of diphthongs.[77] This would be a very interesting area to investigate as the Taoyuan dialect avoids diphthongs in all but the final syllable (Li, 1980:356). It would be interesting to see if this is due to a different ranking of footing constraints in the two dialects. Judging from Mabalay's attempts to keep the penult light by changing the first vowel of a rising sonority diphthong to a secondary articulation on the onset, yet failing to find a strategy for reducing the moraic weight of falling sonority diphthongs, it seems likely that Taoyuan has come up with a strategy for doing so. Based on comparative data, Li has found vowel coalescence in the Squliq dialects (Li, 1980:373). This entails that Squliq

[77] Unfortunately, Li's description of where consonant clusters can and cannot appear is not exact enough to analyze this aspect.

has a lower ranking UNIFORMITY constraint than does Mabalay.[78] UNIFORMITY is the constraint which bans coalescence. Strangely enough, Li only mentions coalescence occurring in the final syllable, whereas one would expect it to occur in the penult for the purpose of keeping it light. Further investigation into these areas should certainly prove fruitful.

[78] UNIFORMITY and the possibility of coalescence was not considered in Chapter 3 as there was limited evidence of it in the Mabalay data. Violations of UNIFORMITY would have resulted in a better parse of syllables into feet. Since Mabalay does not take advantage of this in a predictable manner, UNIFORMITY must rank above PARSE SYLL in Mabalay. This could make it an undominated constraint, but because there are some instances of vowel coalescence, the constraint appears to be changing to a lower position in the hierarchy.

CHAPTER 5

IMPLICATIONS OF THIS STUDY

5. Implications

5.1 Syllabification

In this study, we have found a tremendous advantage in OT's parallelist approach over the serial approach to prosody adhered to by former theories. In analyzing epenthesis, we found that syllabification is watched over by footing. The syllable markedness constraints have an important role to play, but would not always predict the correct epenthetic site without the supervision of footing constraints. Mabalay goes to great efforts to maintain weight contrast in a two syllable iambic foot. With footing constraints always there to oversee syllabification, there is no repair involved. OT is indebted to Itô's (1986) work on the syllable which developed a theory of syllable constraints. Together the constraints formed a template to apply in a process of syllabification, but when applied across the board it had to be followed by repair processes. Because OT's constraints are violable, the repair stage has been done away with. Epenthesis and metathesis are not repairing degenerate syllables; since syllabification is not cyclic or continuous, there is no prior stage of poorly formed syllables to be repaired.

Vowel-glide alternation also relies on syllable markedness constraints, such as NO CC, and NODIPH, but without footing constraints – ALIGN-FT, WEAK-NODES-DO-NOT-BRANCH (WNB), IAMB, IDENT-s'(SEG) and PARSE SYLL – there is no way to predict that it will only occur in the penultimate syllable. This is where OT superseded Hayes' moraic account of vowel/glide alternation and compensatory lengthening. Hayes' (1989) insight and theoretical approach to the problem of compensatory lengthening has proven itself, but still could not predict under what circumstances glide formation would occur or why it is not necessarily accompanied by compensatory lengthening. In Mabalay we find it is not accompanied by CL because its very purpose was to reduce moraic weight in the weak node of the foot.

5.2 Footing

5.2.1 The foot as a valid prosodic constituent

The fact that these phonological phenomena are the product of footing and syllable level constraint interaction gives validity to the concept of the foot. They could not be explained by a simple statement on stress assignment, such as 'Stress the final syllable'. Although all that we perceive is stress on the final syllable, the penultimate is protected from coda formation (in epenthesis and metathesis) and is reduced when possible (through glide formation in rising sonority vowel sequences). If there were no foot, there would be no concern for the weight of the penultimate syllable. If the foot were unbounded rather than binary, there would be concern to keep all non-final syllables light. Keeping the penult light is evidence for the metrical constituency of a binary foot. The head is governing the unstressed syllable of the foot.

5.3 Iambic Contrast

5.3.1 Iambic lengthening

An Iambic foot is sensitive to syllable weight and wants to enhance the contrast in the moraic duration of its syllables. Trochaic feet, on the other hand, contrast in intensity rather than in duration. For this reason, Iambic Lengthening is common, while Trochaic Lengthening is rare. In an iambic language, (L.Ĺ) feet violate the Iambic /Trochaic Law. Iambic lengthening can convert a (L.Ĺ) foot to a (L.H́) perfect iamb either by forming long vowels or geminating consonants. Although neither of these methods is used in Mabalay, it is possible that Atayal's word final glottal epenthesis also has to do with adding moraic weight to the head of the foot. The issue of how to formulate the constraint – as one of Alignment (FIN-C) or as a constraint that would serve to ensure a heavy syllable in the head of the foot (PERFECT IAMB) – is still unresolved. More data is needed to determine whether a word final epenthetic glottal ever appears after a diphthong. Since a CVV syllable is already heavy, an epenthetic glottal would be evidence for FIN-C. Lacking clear evidence, we now have negative support for calling the constraint PERFECT IAMB. Some refinement on the definition of PERFECT IAMB would be necessary, however, if it were to replace FIN-C SO that it would invoke word final glottal insertion rather than vocalic lengthening. The advantage of keeping FIN-C is seen in the comparison of the two tableaux below.

(207) PERFECT IAMB results in vocalic lengthening:
[sa̳(pa.ŋáʔ̳)] 'BF-carry on back'

/spaŋa/	WNB IAMB ALIGN -FT	PARSE σ	DEP(V)	PERFECT IAMB	DEP µ	DEP(C)
a. (☞) sa̳.(pa.ŋáʔ̳)		*			*	*!
b. ☞ !! sa̳.(pa.ŋáː)		*			*	

(208) FIN-C results in epenthetic glottal: [sa̳(pa.ŋáʔ̳)] 'BF-carry on back'

/spaŋa/	WNB IAMB ALIGN-FT	PARSE σ	DEP(V)	FIN-C	DEPµ	DEP©
a. ☞ sa̳(paŋáʔ̳)		*			*	*
b. sa̳(paŋáː)		*		*!	*	

5.3.2 Iambic shortening

Mabalay Atayal has iambic shortening in that glide formation is not accompanied by compensatory lengthening but occurs in the weak node of the foot. This is much less common than Iambic lengthening, but still serves to enhance the weight contrast between the two syllables. Hayes (1995:301) discusses a case of iambic shortening in Cayuga. Laryngeal consonants,

/ʔ/ and /h/, metathesize with the preceding vowel in the weak position of a metrical foot. In so doing, they convert a heavy syllable into a light syllable.

(209) Laryngeal Metathesis in Cayuga (Foster, 1982:69-71)

CVʔ. → CʔV

CVh. → CV̥ / __ . C

CVh. → ChV / __ . V

In a similar manner, Mabalay Atayal glide formation shortens the syllable in the weak node of the foot, enhancing the iambic weight contrast.

5.3.3 Constraints on Quantity Sensitivity proposed

I have proposed two new constraints in this analysis, WNB and IDENT-σ'(SEG).[79] The ideas themselves are not new, but they have not been established as constraints within OT. Weak-nodes-do-not-branch was first presented as a principle of constraint on the rules of tree construction (Hayes, 1980:80). It was later interpreted as a parameter of Quantity Sensitivity (see Halle and Vergnaud, 1987:22). That iambic feet enhance the contrast in their syllable weight by lengthening the head or shortening the weak node is also well documented (Hayes, 1995). Rival candidates that would actually go against these principles need to be ruled out. Others have proposed similar constraints that would have the effect of preferring a (L.H́) foot over any other acceptable

[79] The IDENT-σ' family of constraints was proposed by Becker, 1998. Chen Su-I suggested the specific member (SEGMENTISM) to me in personal conversation.

(Ḣ) or (L.Ĺ) iamb. One such constraint – PERFECT IAMB: 'Form a perfect iamb' was proposed by Chen (p.c.), and Baković (online, 1996) proposed FTHARM to account for quantitative adjustments in Yupik languages. Baković's FTHARM was presented as a correspondence constraint that assumed the input was already syllabified. WNB and IDENT-σ'(SEG) are in effect a redefinition of Chen's PERFECT IAMB. Both PERFECT IAMB and WNB work toward a two syllable foot with a light syllable in the weak node. Both PERFECT IAMB and IDENT-σ'(SEG) prevent the reduction of moraic weight in the head of the foot from a heavy syllable down to a light syllable. The difference in these constraints is seen when a rival candidate reduces a trimoraic syllable in the head of the foot down to a bimoraic syllable. This would violate IDENT-σ'(SEG), but would not violate PERFECT IAMB as the end product would still be a perfect iamb. A further difference is that neither IDENT-σ'(SEG) nor WNB would be violated by a (Ḧ) foot, but PERFECT IAMB would be. It is these differences that have made IDENT-σ'(SEG) and WNB able to account for the Mabalay Atayal data. Although I have not used PERFECT IAMB as a constraint per se, we have seen that all in all, Mabalay is striving to reduce the number of unfooted syllables and form a perfect iamb.

5.4 Dialect comparison

In comparing the coda conditions of Mabalay and Taoyuan, we saw the whole family of constraints had to be decomposed in order to allow reordering.

This fits with Zubritskaya's (1994) findings that '...whole families of constraints may become reranked in the course of a sound change,' (Zubritskaya, 1994:335).

When comparing the stress assignment of Mabalay with that of Wulai, we found the two systems had reranked the whole family of footing constraints. As a result, the two have very different stress patterns. According to Wolff's (1993) proposals concerning Proto-Austronesian (PAN) stress, it is the Wulai dialect that is the more conservative of the two, holding very close to the Proto-Austronesian stress pattern.[80] He states,

> ... in PAN the stress 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). Further, if there was suffixation, the accent remained on the penult of the suffixed form if the penult of the root was accented and on the final syllable of the suffixed form if the final syllable of the root was accented (Wolff:1993:1,2).

This sounds identical to the Wulai dialect. However, Wolff also comments that certain affixes caused the opposite pattern to the root word. But overall, the Wulai dialect appears very conservative in maintaining the original stress assignment. This means it is the Mabalay dialect that has made innovative prosodic changes, even though C'uli' dialects are considered the more conservative in segmental sound change.

[80] At this point, Wolff's analysis of PAN is mostly based on Formosan and Philippine languages, so it may turn out to be a subgroup of PAN (Wolff, 1993:3)

We observed a drastic difference in the ranking of the footing constraints between Mabalay and Wulai, but an alternative analysis minimizes the differences. Alternatively, had the coda been considered moraic in Mabalay but non-moraic in Wulai, an identical ranking would work for both dialects. Observe this in tableaux (210) and (211).

(210) Wulai (with weightless coda) [pə.(qúː.tun)] 'ask PAT'

	paːqut -un	ALIGN FT	WNB	WSP	DEPμ MAXμ	ASSOC μ	PARSE σ	IAMB	TROCH
a. ☞	pə.(qúː.tun)					*	*	*	
b.	paː.(qu.tún)			*!			*		*
c.	pa.(qú.tun)				$*!_{\text{MAX}\mu}$		*	*	
d.	(páː.qu).tun	*!					*	*	

(211) Mabalay (coda has weight) [pa.(ʔu.tún)] 'ask PAT'

	paːqut	ALIGN	WNB	WSP	DEPμ MAXμ	ASSOC μ	PARSE σ	IAMB	TROCH
a. ☞	pa.(ʔu.tún)				$*_{\text{MAX}\mu}$		*		*
b.	paː.(ʔu.tún)			*!			*		*
c.	pa.(ʔú.tun)				$*_{\text{MAX}\mu}$		*	*!	
d.	(pa.ʔúː).tun	*!		*		*	*		*

This analysis is but preliminary. It calls for a radical readjustment of the footing constraint rankings in Mabalay indicating that there are likely many aspects that have not been considered. However, there is something attractive in having just one variable – the weight or weightlessness of the coda – be the only difference between the two dialects.

This is, however, unnatural. Generally, dialects of the same language treat coda weight the same (Chen, p.c).[81] The analysis presented in chapter 4 is the better choice. It shows that Mabalay has made some radical adjustments in its family of footing constraints, but according to Zubritskaya (1994), this is to be expected. Mabalay has also moved in the expected direction of change – away from markedness and toward simplification, (Zubritskaya, 1994; Baily, 1972).

5.5 Recommendations

The preliminary analysis of dialectal comparison made here indicates the need for more research in this area. Many dialects are said to be similar with the placement of stress the most prominent difference. This is a native speakers' impression that was expressed to me. I expect that such research into the prosody of the other dialects will bring coalescence in under the umbrella of prosodic reflexes along with epenthesis, metathesis, and vowel-glide alternations.

[81] Some Eastern Algonquian languages treat coda weight differently from one another. Goddard (p.c. with Hayes, 1995:222) links this to the rise of iambic stress in some branches of Algonquian, which was not likely passed on from Proto-Algonquian. This implies that treating coda weight differently is possible cross-dialectically and in diachronic change.

Appendix

APPENDIX

ACOUSTIC PHONETIC ANALYSIS

The spectrogram, pitch contour, and intensity graphs show that stress is always on the final syllable in Mabalay Atayal.[82] The perception of stress is created by the combined efforts of a heightened pitch contour and intensity. When the pitch difference is not distinct enough, intensity is heightened. Otherwise, pitch seems to be the most significant factor.

Vowel length is not an indicator of stress in Mabalay as it is in the Wulai dialect. Vowel length may be longer in the penult than in the ultimate syllable due to the fact that the ultimate is usually an open syllable. Vowel length is shortest when a syllable coda is filled by a stop. When comparing the length of the rhyme and not just the peak of a word's two final syllables, either syllable could be the longer of the two depending upon the sonorancy of the coda. Regardless of the duration of the rhyme, pitch contour and intensity place stress on the final syllable. We conclude that duration is not a significant cue of stress in Mabalay Atayal. In its stress assignment, Mabalay Atayal stands in sharp contrast to the Wulai dialect.

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[82] I am grateful to Professor Chang Yueh-Chin for producing and interpreting these spectrograms, pitch contour and intensity graphs. All were done on CSL. The speaker was Boku Numin, a female speaker of Mabalay Atayal, age 67.

According to Rau's (1992) data of the Wulai dialect, [ʔáː.ras] 'take along' and [ráː.sun] 'take along PAT' both have long vowels in the penult and the penult is stressed. However, in Mabalay, rhyme duration is insignificant and the pitch contour stresses the ultimate syllable. (1) [ʔa.rás] 'take along' has a rhyme duration of 103 ms and 109 ms in the penult and ultima, respectively, but pitch is 181 Hz on the penult and 217 Hz on the final syllable. Intensity is actually lower in the ultima (64 dB) than in the penult (67.5 dB), but the pitch contour difference has made up for it. In (2) [ra.sʊ́n] 'take along PAT', rhyme duration is significantly different between the two syllables; the penult is 130 ms long, while the ultima is 148 ms long. Looking at vowel length alone, the ratio is 130: 65. However, stress is on the ultimate syllable, not on the penult. This is evident in the increased pitch contour (142 Hz in the penult to 178 Hz in the ultima) and in the higher intensity of the ultima (71 dB to 76 dB) as well.

In Rau's (1992) Wulai data, [táː.piħ] 'beckon' and [tə.pʲíː.ħun] 'beckon PAT' both have a long vowel in the penult with stress on the penult. In Mabalay, the rhyme of the ultima is actually the longer of the two in both words. In (3) [ta.pʲíħ] 'beckon', the rhyme duration is 96 ms in the penult and 116 ms in the final syllable. The intensity difference is insignificant (66 dB: 65 dB), but stress is based on the significant difference in the pitch contour; the penult is 169 Hz while the ultima is 263 Hz. The results for (4) [ta.pi.ħʊ́n] 'beckon PAT' are not as clear, but show that in the absence of a pitch differential, stress is expressed as a difference in intensity. The rhyme length may also be playing a part. The rhyme durations for the three syllables from antepenult to ultima are 53 ms, 144 ms and 208 ms. The pitch is actually slightly higher in the penult than in the final syllable. Pitch contours are 217 Hz in the antepenult, 232 Hz in the penult, and 222 Hz in the final syllable. However, intensity is greater in the final syllable than in the penult. Intensity was 94 dB in the antepenult, 64 dB in the penult, and 71 dB in the ultima.[83]

(5) [ka.ya.nóx] 'live' has short vowels according to Rau's Wulai data, 1992. In this Mabalay sample, the duration of the rhymes are 112 ms, 115 ms, and 105 ms for the antepenult, penult, and ultima, respectively. The difference is insignificant. Both the pitch contour and intensity are heightened on the final syllable. (6) [kaiʔ.na.xʊ́n] 'live PAT' likewise shows little difference in rhyme length (138 ms, 130 ms, and 138 ms), but heightened pitch contour (175 Hz, 181 Hz, and 222Hz), and intensity (69 dB, 67.5 dB, and 73 dB).

The acoustic analysis shows that stress is clearly marked on the final syllable in Mabalay Atayal by either a higher pitch contour and increased

[83] The antepenult has a high level of intensity due to the more sonorous quality of its vocalic peak /a/ over /i/ or /ʊ/.

intensity. Vowel length is intrinsic to the syllable shape and is not an indicator of stress in this dialect.

(1) [ʔa.ɾás] 'take along JUSSIVE'

Rhyme duration:

Penult	Ultima
103 ms	109 ms

(2) [ɾa.sʊ́n] 'take along PAT'

Rhyme duration:

Penult	Ultima
130 ms	148 ms

(3) [tɑ.pí̆ħ] ‘beckon JUSSIVE’

Rhyme duration:

Penult	Ultima
96 ms	116 ms

(4) [ta.pi.ħɯ́n] 'beckon PAT'

Rhyme duration:

Antepenult	Penult	Ultima
53 ms	144 ms	208 ms

(5) [ka.ya.nóx] ’live’

Rhyme duration:

Antepenult	Penult	Ultima
112 ms	115 ms	105 ms

(6) [kɛiʔ.na.xʊ́n] 'live PAT'

Rhyme duration:

Antepenult:	Penult:	Ultima:
138 ms	130 ms	138 ms

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