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Syllable Structure and Hiatus Resolution in Squliq Atayal

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The present work offers an Optimality-Theoretic account of syllable structure and hiatus resolution in Squliq Atayal. I concentrate on presenting a mora-based alternative to the analysis of Huang (2006). In particular, I argue that constraints banning long vowels and codas—both ignored in Huang's study—play a crucial role in deriving the attested patterns and in providing a more insightful approach to Atayal phonotactics. On the other hand, constraints employed by Huang (2006) are shown to be statements of parochial surface-true patterns that should not figure in a principled Optimality Theory (OT) account. Other flaws in the analysis offered by Huang (2006) are identified and addressed, illustrating the power of comparative tableaux in spotting these and similar analytical mistakes.

Key words: Atayal, Austronesian, hiatus resolution, Optimality Theory, syllable structure

1. Introduction

Optimality Theory (OT) depicts the grammars of particular languages as rankings of a universal set of violable constraints (McCarthy 2002; Prince & Smolensky 2004). This set, labeled CON, includes two broad kinds of constraints. Markedness constraints evaluate candidate outputs for a given input in terms of the presence of particular structural elements. Each such constraint expresses a particular 'markedness dimension', a preference for some structures over others. The other subset of constraints, the faithfulness constraints, proscribe any difference between input and output; 'unfaithful mappings' between an input and an output are disfavored. Conflicts among such constraints are unavoidable any time enforcing a particular markedness constraint demands a change in a given input. The grammars of individual languages are alternative ways of dealing with such conflicts: in very general terms, this is done by assigning priority relations. A given constraint may be violated if, and only if, this implies complying with the demands of a higher-priority constraint. Such priority relations defined over CON are particular rankings imposed on the set CON.

A central component in the grammatical architecture under an OT conception is H-Eval: this component orders all the candidate outputs for a given input in terms of their HARMONY, meaning how well these candidate outputs fare in relation to the demands of the particular ranking of CON that characterizes the language in question. According to Prince & Smolensky (2004:6) two conditions are put on how H-Eval is defined:

> H-Eval is to be constructible in a general way if the theory is to be worth pursuing. There are really two notions of generality involved here: general with respect to UG, and therefore cross-linguistically; and general with respect to the language at hand, and therefore across constructions, categories, descriptive generalizations, etc.

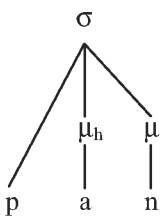
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In the present work I advance an OT treatment to hiatus resolution in Squliq Atayal—henceforth called simply Atayal—that tries to meet both of these 'generality demands'. This is done mostly in §3, along with an explicit discussion of its advantages vis-a-vis the alternative analysis presented in Huang (2006). Section 4 extends the account to encompass additional phonotactic patterns, such as those involving consonant sequences, thus generalizing the solutions in §3 to other constructions in the language and avoiding the dangers of 'toy grammars' that account only for parochial sets of data. Finally, §5 presents an overall synthesis and discussion of the work.

1.1 Assumptions on representations and syllable structure

I assume here a mora-based conception of syllable structure (Hayes 1989; Zec 1995, 2007), including the assumption of a default bimoraic maximum for syllables (Féry 2003; Sherer 1994; Steriade 1990; Zec 1995:86). Following Zec (1995, 2007), the representation below is proposed for bimoraic syllables:

(1)



Note the distinction between a head mora (μ_h) and non-head mora (μ), which impose distinct licensing conditions on the segments they dominate.

Moraic theory is usually said to provide a 'minimalist' conception of syllable structure, stripped-off of most constituents—such as nuclei and rimes—postulated in other conceptions of syllable structure (McCarthy & Prince 1986:56; Vaux & Wolfe 2009). The fundamental notions of Onset and Coda are, however, retained in moraic theory. Though the notion of Onset is uncontroversial and finds a simple translation in the mora-based representational format (an Onset is any non-moraic segment preceding the head-mora, as in (1) above; see Green 2003:239; Smith 2007:263), there is much more ambiguity concerning what is the equivalent of the Coda in a bare moraic representation of syllable structure (see e.g. Smith 2007:264).[1] The question is obviously related to the differing status of Coda segments in some languages: diagnostics for their moraic status is often sought in phenomena like compensatory lengthening, weight-sensitive stress systems, and the possibility of tonal contrasts (see e.g. Hayes 1989). In the absence of these diagnostic features, a Coda is often taken to be non-moraic.

In the case at hand, none of these standard cues to the moraic status of Coda consonants is available: there is neither tone nor a weight-sensitive stress system in Atayal, and since the language has no opposition between short and long vowels, it has no compensatory lengthening either[2]

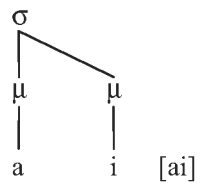
[1] See also Itô (1989), which includes a discussion of some of the issues involved in this 'translation' between moraic and non-moraic (or skeletal) theories of syllable structure.

[2] As Hubbard (1995) shows, however, while it is true that languages showing compensatory lengthening have a vowel length opposition, the reverse is not true: not all languages with a vowel length opposition show compensatory lengthening, at least not in all the expected contexts. Hubbard calls these 'pseudo-vowel-length languages'.

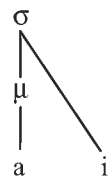
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(see De Chene & Anderson 1979 for the classical statement of the association between vowel length and the presence of compensatory lengthening). Therefore, I shall assume here that any segment following a nuclear mora—the moraic equivalent of the syllable nucleus—is a non-moraic Coda segment.

Finally, a fundamental assumption made here concerning moras relates to the status of the glides [j w]. I assume that the pairs [i j] and [u w] are featurally-identical, the difference between vowels and their corresponding glides being expressed in terms of moraic affiliations: while the former are associated to a mora, the latter are not (Hayes 1989; Rosenthall 1994, 1997). That is, glide formation is just the preferential parsing of an underlying vocoid as a non-moraic segment. The representational distinction between a diphthong [ai] and a vowel-glide sequence [aj] is thus the following:

(2) a. 

[ai]

b. 

[aj]

The assumption that post-vocalic glides are part of Codas will ultimately be vindicated by their role in providing a motivated account for the absence of a particular syllable configuration in Atayal. An additional motivation for this view may be presented, since the more general assumption that glides (i.e. the semiwovels [w j]) are part of syllable margins in Atayal, instead of constituting complex nuclei, has been questioned by one of the reviewers of this paper. I note, first, that Li (2004[1980]:235) argues that word-final, phonetic [i:] and [u:] are phonologically /ij/ and /uw/, respectively. One of the justifications for this analysis is that it brings these forms in line with the overarching phonotactic generalization that, with the exception of a few function words, all Atayal words end in a consonant. I take the relevant notion of 'consonant' here to be the same as, for instance, in Clements & Keyser (1983), where a C slot corresponds to a functional position within the syllable, in particular that of syllable margin.[3] In §4 we shall see that there is additional evidence—from the distribution of the surface transition vocoids [ə]—to support the generalized claim that all glides, not only post-vocalic ones, belong to syllable margins rather than as constituents of putative branching nuclei. In particular, consonant-glide sequences are undone by vowel epenthesis in the same way that sequences of 'true consonants' are.

2. Hiatus resolution in Atayal: the core patterns

According to Huang (2006:11), Atayal syllables are minimally CV and maximally CGVC. The author explicitly states that a CVGC type is not found and pays particular attention to this fact since

[3] This is also consistent with Rau (1992:25), where Li's (2004[1980]) analysis is accepted and the glides are taken to be consonants.

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this is a salient distinction between Atayal and Isbukun Bunun, the other language described in Huang (2006) and with which Atayal is explicitly compared. What seems to be at play here is a particular constraint on the way vowel sequences are dealt with: though gliding of a pre-vocalic vowel is allowed, a post-vocalic vowel cannot be subject to glide formation, thus yielding the non-existence of *VG sequences.

The author presents the following data as instances of the general process of glide formation in the language (after Huang 2006:11–12, with minor transcription adaptations):

(3)	a.	soja-i	sjaj	'to like'
	b.	mʔabi-a	mʔbja	'to sleep'
	c.	mnbu-a	mnbwa	'to be sick'
	d.	tutu-i	ttuj	'to fell trees'
	e.	hkani-an	hknjan	'to walk'
	f.	biɾu-an	bɾwan	'to write'
	g.	tbut͡si-un	tbt͡sjun	'to separate'

Vowel coalescence, on the other hand, applies, according to the author, when the two vowels in a V + V sequence are identical or when a falling sonority contour obtains between them:

(4)	a.	tbut͡si-i	tbt͡si	'to separate'
	b.	pnbu-un	pnbun	'to cause to be sick'
	c.	kita-an	ktan	'to see'
	d.	soja-un	sjon	'to like'
	e.	ɣiba-un	ɣbon	'to embrace'

After presenting these data sets, Huang (2006) works out an Optimality-Theoretic account of the attested patterns.[4] The next section is devoted to presenting an OT approach to these and other phenomena of the phonology of Atayal. At particular points it will be considered in which respects the analysis is superior to that furnished by Huang (2006). The approach developed here differs from Huang's not only in the choice of a particular set of interacting constraints—which I argue, capture in a more insightful manner the attested patterns—but also in that I assume a moraic model of syllable structure.

3. The phonology of vowel sequences in Atayal: an OT approach

Following McCarthy (2008:174–175), I define the relevant constraints for the present work in terms of explicit instructions on how violation marks are assigned to particular forms. Also, given that establishing the correct constraint hierarchy for the Atayal grammar is the main focus of

[4] The suffixes appearing in the data above are: -/un/ 'Patient voice', -/an/ 'Locative voice', -/a/ 'Subjunctive Agent voice' and -/i/ 'Imperative non-Agent voice'.

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this paper (a ranking problem, following Brasoveanu & Prince 2005:3), tableaux in comparative format will be used throughout (Prince 2002, 2007). When the analysis of particular candidates and their relevance for ranking arguments is a central concern I shall, in addition, employ the 'combination format' of McCarthy (2008), which combines the violation marks of the classic violation tableau with the labels expressing the preference each constraint has for either the attested output (W) or a sub-optimal candidate (L) in each candidate pair.

(5) *Constraints employed in the present paper:*

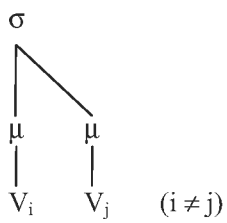
ONSET:	Assign one violation mark for every onsetless syllable.
NOCODA:	Assign one violation mark for every syllable with a coda.
$\text{COMPLEX}_{\text{ONSET}}$:	Assign one violation mark for every tautosyllabic cluster of onset consonants.
$\text{COMPLEX}_{\text{CODA}}$:	Assign one violation mark for every tautosyllabic cluster of coda consonants.
*LONGV:	Assign one violation mark for every long vowel.
NODIPH:	Assign one violation mark for every diphthong.
*CG:	Assign one violation mark for every consonant-glide sequence.
*APPENDIX:	Assign one violation mark for every consonant parsed as an extra-syllabic appendix.
MAX-μ:	Assign one violation mark for every input mora with no output correspondent.
MAX-X:	Assign one violation mark for every input element with no output correspondent. Here, X = V(owel) or C(onsonant).
DEP-X:	Assign one violation mark for every output element with no input correspondent. Here, X = V(owel) or C(onsonant).
UNIFORMITY:	Assign one violation mark for every pair of input elements with the same output correspondent.

All of the constraints above figure in well-known and widely supported accounts of syllable structure and related phenomena. Assuming with classic Optimality Theory that constraints such as these, bona fide members of the universal set CON, are present in the grammar of all languages (McCarthy 2002; Prince & Smolensky 2004), assessing their place in the constraint hierarchy defining the grammar of Atayal becomes a legitimate and important research goal. Few of the constraints above need any comment, being widely known from the standard OT literature. The constraint NOCODA is defined here in a 'top-down' fashion, assigning one violation mark to every syllable with a coda and not to every consonant in coda position (see McCarthy 2008:176–177 for this subtle but important difference in constraint definition). Faithfulness constraints are understood as in McCarthy & Prince (1995), though defined here in a less explicit manner. MAX-μ will play an important role in the analyses presented here since, as discussed in the preceding section, I assume that moras are underlyingly associated with vowels and that glide formation consists in the promotion of surface, non-moraic parsings for vowels. This implies—with much of the OT literature (Bakovic 2007; Casali 1997:499; Rosenthall 1997:153)—that glide formation implies a violation of MAX-μ, not of MAX-V.

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I stress here that NoDiph militates against a configuration such as (6) below (see Booij 1989 for non-moraic but close equivalents; Harris 1985; and especially Rosenthall 1994:17; Zec 2007:174):

(6)



Finally, *CG is adapted from Casali (1997) and *Appendix is defined in Sherer (1994) and Zec (2007).

3.1 Long vowels and diphthongs

In cases where two identical vowels are brought into adjacency by morphological concatenation, one has to consider the faithful parsing of these as a long, bimoraic vowel. Given that long vowels do not contrast with short ones in Atayal (Rau 1992:22), a rather high ranking for the constraint *LongV is expected, with obvious consequences for these morphologically derived contexts. Consider thus Tableau 1 (in comparative tableaux the optimal output is always the first member in each pair):

Tableau 1

1.	/kita-an/ [ktan]	*LongV	Max-μ
1a.	[ktan] ~ [ktaan]	W	L
2.	/paa/ [pa]		
2a.	[pa] ~ [paa]	W	L

The comparison in (1a) above shows that given an input presenting a (morphologically) derived sequence of two identical vowels, a candidate output in which both vowels are preserved forming a long vowel is knocked out of competition by the local ranking *LongV >> Max-μ. As the hypothetical input-output mapping in (2) shows, this particular constraint ranking is also active in underived forms, accounting for the absence of contrastive vowel length in Atayal: the 'richness of the base' input containing a long vowel maps to the shortened, monomoraic output [pa].

One could legitimately raise the question as to whether independent evidence for the loss of a mora in a mapping such as /kita-an/ → [ktan] could be provided. As noted in §1.1, it seems that, aside from the absence of a surface contrast between short and long vowels, other patterns that could work as diagnostic of moraic structure, phenomena like weight-sensitive stress or tone, are not found in Atayal. Since long, bi-moraic vowels are not allowed in optimal outputs in the language, the assumption that a mapping involving two input vowels (hence two moras) and one output vowel (i.e. one mora) consists in the loss of one mora seems fairly reasonable. One reviewer notes that 'duration' is a phonetic variable, while 'mora' is a phonological construct, so that the absence

of a duration contrast is no warrant to suppose that a mora is absent (or, positively stated, that a single mora is present in the output structure). Though the mapping between phonological constructs, especially prosodic notions such as 'accent' or 'prominence', and their phonetic implementation is complex and variable, I submit that the association between moraic structure and (phonetic) duration is much more straightforward. Studies such as Broselow and colleagues (1997) and Hubbard (1995) show that the existence of additional independent moras in phonological representations correlates with increased durations. Thus, even in the absence of precise acoustic measurements of vowel or rhyme length in Atayal, one may safely assume that the perceived short-vowel-like durations described for Atayal in the primary literature imply the presence of a single mora in outputs. We may, therefore, keep the assumption that mappings like /kita-an/ → [ktan] imply mora loss, as opposed to suboptimal mappings such as /kita-an/ → [ktaan] with complete faithfulness to input moras.

The fact that Huang (2006) does not consider that the action of *LongV makes her analysis unable to underscore two important generalizations concerning Atayal phonology: the structure-preserving character of hiatus resolution—long vowels are allowed neither underlyingly nor in morphologically-derived contexts; and the fact that an input mora may be deleted, both in the mapping of inputs containing identical vowel sequences and in cases of glide-formation (in order to avoid hiatus or a diphthong). This latter case will be discussed now.

Mora-deletion in glide formation is depicted in Tableau 2:

Tableau 2

	/mʔabi-a/ [mʔbja]	Onset	NoDiph	*LongV	Max-μ	*CG
a.	[mʔbja] ~ [mʔbi.a]	W			L	L
b.	[mʔbja] ~ [mʔbee]			W	L	L
c.	[mʔbja] ~ [mʔbia.]		W		L	L

The candidate pair in (a) above shows that heterosyllabification of the two vowels in a sequence produces a less harmonic output than glide formation. Heterosyllabification implies a violation of Onset, while glide formation, the preferred 'repair strategy', is effected via mora deletion. Candidate (b) involves coalescence of the vowel quality features with mora preservation and is ruled out by the constraint against long vowels. This candidate is important for the characterization of hiatus resolution in Atayal from a typological perspective, given that in many languages hiatus resolution strategies are characterized by compensatory lengthening: glide formation, coalescence or vowel elision may apply, with concomitant preservation of underlying moraic structure (see e.g. Clements 1986 on Luganda, and Odden 1996 on Kimatuumbi). Finally, candidate (c) provides a ranking argument for NoDiph >> Max-μ, which is again consistent with the general ban on surface diphthongs in Atayal. Note that *CG is also violated by the optimal candidate above due to the fact that glide formation targets the first vowel in a /CV + V/ structure.

We have shown in this section that the inclusion of constraints on moraic structure and long vowels greatly enhances both the typological characterization of the Atayal patterns of hiatus resolution and the system-internal generality of the account offered here. These may be seen as

advantages when compared with the OT approach given in Huang (2006), in which such constraints are not considered.

As a final yet necessary commentary, I note that all that has been said here in this section, as well as in some of the following sections of this paper, is that a consideration of moraic structure and the inclusion of the constraint *LongV, along with candidates that preserve input moras in the output, offers a better account of hiatus resolution in Atayal than that presented in Huang (2006). The stronger claim that her analysis is incompatible with an account that includes *LongV in the relevant set of constraints, with all its consequences, was neither made nor implied at any point. Clearly, Huang's (2006) proposals are, at least in principle, compatible with an amended analysis that includes this additional theoretical and conceptual machinery. Yet to downplay the proposals made here on the grounds that the referred study 'could have been done otherwise'—that is, that it could have been carried and presented with explicit consideration of such matters—comes close to what Postal (2004:292) called the 'Psychic Alternation Move': that is, the position that 'this criticism of A's is not valid, because although A admittedly made the claim, he could easily have made a different, correct claim instead'. This looks like an argument that lacks in force and, for this reason, in the remainder of this paper, I keep with the presentation of arguments and proposals that stand in frank contradiction to Huang's (2006) analysis but that, at some points, simply complement or extend her study, without being belittled by this fact.

3.2 On the non-existence of CVGC syllables

Huang (2006) assigns special importance to the fact that CGVC syllables are allowed in Atayal while CVGC are not. While this is important in her effort to draw a comparison between hiatus resolution strategies and broad phonotactic patterns in Atayal with those in Isbukun Bunun, another Formosan language, I argue here that she fails to capture this basic asymmetry of Atayal phonotactics in an insightful manner.[5]

The fact that the author fails in her attempt to account for why CVGC vowels are unattested is obviously seen in the following quotation (p.14):

> The existence of CGVC and the gap of CVGC in Squliq are confirmed by an examination of all the native words in the dictionary of Egerod (1980). This surface generalization on possible syllable shapes will take the form of OK-σ in the tableaux of the proposed OT analysis. OK-σ is a cover term for a set of syllable structure constraints that all well-formed syllables in a language obey.

It is clear from this quote that whatever its name, the constraint 'OK-σ' employed in Huang's (2006) analysis amounts to a statement of the surface-true generalization that CVGC syllables are not allowed. It could as well be labeled *CVGC, a parochial markedness constraint banning the

[5] It must be noted that in the Mayrinax variety of Atayal CVGC syllables are allowed. Thus, to Squliq /huzin/ 'dog' corresponds Mayrinax /hujl/.

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particular unattested syllable shape. I propose instead to derive this pattern from the consideration of the interaction between general and independently motivated constraints.

Before proceeding I shall comment on an observation made by a reviewer, who raised the possibility that the constraint *CG, employed here, might be as parochial as the constraint OK-σ, used by Huang (2006). There is, however, a large difference between these constraints. Note that *CG, whether it turns out to be a legitimate or useful constraint in a 'final theory' of the set CON or not, works as a regular, ordinary markedness constraint: it may, for instance, interact in a predictable manner with faithfulness constraints. Sequences of a consonant followed by a glide (or, alternatively, a consonant with a vocalic offglide) will surface just in case this constraint is dominated by the relevant faithfulness constraints; if the ranking is reversed to *CG >> FAITH, no such structures will appear. This leads to the prediction—likely borne out by empirical evidence—that there are both languages that allow for consonant-glide sequences and languages that do not (see Casali 1997). OK-σ is a whole different kind of animal: according to Huang's (2006) own description, given verbatim in the quote earlier, this is a constraint that encapsulates all the constraints that a given language's well-formed syllables obey.[6] Note that while *CG may be a plausible candidate for membership in the universal set CON, OK-σ is not. We note first that every language would need its own OK-σ so that what Huang (2006) proposes is actually closer to 'OK-σ-Atayal', given that it refers to the set of syllable structure constraints obeyed by well-formed syllables in Atayal. From an OT perspective, it is hard to get more parochial than this. More to the point, it is even hard to think what 'FAITH >> OK-σ' would amount to: a language whose syllables do not obey all the constraints that the same language's syllables do obey? In sum, it seems that, contrary to *CG, OK-σ does not even qualify as a legitimate OT constraint.

As a first step in providing an alternative, motivated account for the absence of surface CVGC syllables I note that while CVGC syllables are unattested in Atayal, VG sequences are well-formed, as shown by mappings such as /soja-i/ → [sjaj] 'to like'. Optimal candidates containing such sequences are selected under this approach in the following manner:

Tableau 3

	/soja-i/ [sjaj]	ONSET	NODIPH	UNIFORMITY	MAX-μ	NOCODA
a.	[sjaj] ~ [sja.i]	W			L	L
b.	[sjaj] ~ [sjai]		W		L	L
c.	[sjaj] ~ [sje]			W		L

The crucial feature of Tableau 3 is the inclusion of NOCODA. As implied by the labels above, I take glide formation in a VG to result in a high vowel linked directly to the syllable node. This segment is now interpreted as a post-nuclear margin, a coda, as shown next:

[6] A related problem with this constraint, and its definition, is that it seems to assume a particular instance of the 'fallacy of perfection', the statement that the set of constraints 'obeyed' by a language's attested outputs has any sort of theoretical significance in itself. Note that defined in this way this set of 'syllable structure constraints' would, in the case of Atayal, exclude the constraint NOCODA, which is 'not obeyed' in a number of attested forms in the language.

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(7) 

Given these assumptions, the ban on unattested CVGC syllables is derived as a simple effect of a non-dominated constraint banning complex codas:

Tableau 4

	/soja-un/ [sjon]	*Complex$_{coda}$	Onset	NoDiph	Uniformity	NoCoda
a.	[sjon] ~ [sja.un]		W		L	
b.	[sjon] ~ [sjaun]			W	L	
c.	[sjon] ~ [sjawn]	W			L	

In Tableau 4, the constraint NoCoda is included to show that both candidates in each row violate it equally. Candidate pair (c) is the crucial comparison, showing that an output [sjawn], the candidate with a VGC 'rhyme', is sub-optimal due to its violation of *Complex$_{coda}$.

The postulation of higher-ranked constraint banning complex codas, in addition to the assumption that a glide in a VG sequence occupies a syllable coda position, is instrumental in accounting for the presence of CVG syllables and the absence of CVGC syllables in Atayal. Huang's (2006) analysis finds no place for Coda constraints in her account, even though this constraint has widespread acceptance in the literature as a member of CON, therefore present in the grammar of every language. This is all the more surprising since, in consonance with other descriptive accounts of the language (Rau 1992:25), the author herself recognizes that the language 'does not tolerate complex syllable margins' (Huang 2006:11). This is thus a basic fact about the language's phonotactics and, as I have shown, one that plays a crucial role in accounting for the 'gap' characterized by the absence of CVGC syllables.

Now that an alternative to Huang's (2006) analysis of hiatus resolution in Atayal has been presented, we proceed to consider syllable structure in this language in greater depth.

4. Syllable structure in Squliq Atayal

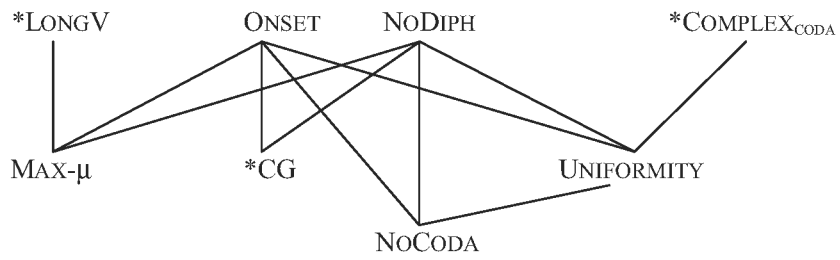
The following rankings of syllable structure constraints were justified in the previous section, given in (8a) as local rankings and in (8b) in a Hasse diagram:

(8) a. *LongV >> Max-μ
Onset >> Max-μ, *CG, NoCoda
NoDiph >> Max-μ, *CG, NoCoda
Onset >> Uniformity
NoDiph >> Uniformity

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*COMPLEX$_{CODA}$ >> UNIFORMITY
UNIFORMITY >> NOCODA

b.



The relatively high-ranking of ONSET was justified in the previous section due to its role in proscribing candidates with heterosyllabification of adjacent vowels (i.e. hiatus). One might ask whether a more general role for a higher-ranked ONSET constraint may be justified for the phonological grammar of Atayal on the basis of other patterns. According to Rau (1992:21, 26), all vowel-initial items actually begin with a (phonetic) glottal stop. This may be interpreted as an effect enforced by ONSET:

Tableau 5

	/aɾiŋ/ [ʔaɾiŋ] 'begin, from'	ONSET	MAX-V	DEP-C
a.	[ʔaɾiŋ] ~ [aɾiŋ]	W		L
b.	[ʔaɾiŋ] ~ [ɾiŋ]		W	L

Candidate pair (a) in Tableau 5 shows that the faithful mapping of a vowel initial word is less harmonic than the attested form which violates DEP-C by [ʔ] epenthesis but avoids in this way a violation of ONSET. Candidate pair (b) shows in turn that deleting the offending onsetless syllable does not improve the situation.

In arguing for her position, Rau (1992) places special emphasis on the absence of an opposition between word-initial glottal stops and zero, that is, the absence of vowel-initial words. With this 'static' phonotactic generalization as our sole data it is hard to tell for sure what the relevant underlying representations are. Lack of alternation may be problematical for OT, given the assumption that for every conceivable input, any grammar yields some output. When alternations do not exist it is hard to tell how a particular grammar deals with some inputs. This is called by McCarthy (2008:113) the 'Rich-Base Problem'. As McCarthy (2002:70) puts it, 'If a language's constraint hierarchy has been correctly analyzed, then applying GEN and EVAL to any input chosen from the universal base will yield some surface structure in that language's inventory'. So, given the existence of this universal base of inputs, there are for every language infinitely many inputs that cannot be faithfully mapped to some optimal output (attested or potential surface forms). Thus,

> Since every input must map to some output, the grammar has to map these inputs to unfaithful candidates that are well-formed: phonotactically possible words or grammatical sentences. The rich-base problem is this: sometimes there is no evidence to tell us exactly which unfaithful candidate is optimal for a given input drawn from the rich base. (McCarthy 2008:113)

McCarthy's (2008) own example involves the recurrent pattern of a language such as Yawelmani (and, supposedly, Atayal as well), which does not allow onsetless syllables. Forms that could be analyzed as vowel initial (say [apak]) actually surface with an epenthetic glottal stop providing an onset (thus: [ʔapak]). A potential source of trouble lies in the fact that no alternations provide us with unambiguous information concerning what an input such as /apak/—which, given Richness of the Base (ROTB) is an input not only to Yawelmani grammar but to every grammar allowed by UG—maps to. Does it map to [ʔapak] as a result of consonant epenthesis or to [pak] by vowel deletion? The same question can be raised concerning the grammar of Atayal.

The fact that OT grammars are global constraint rankings, not separate rankings dealing with particular constructions, allows one to circumvent many of these Rich-Base problems whenever independent evidence for particular rankings are available. Thus, in the Yawelmani case discussed, independent evidence for the ranking DEP >> MAX shows that [pak], violating MAX, rather than [ʔapak], which violates the higher-ranked constraint DEP, is the optimal output for /apak/ (McCarthy 2008:113–115). What is crucial to note here is that this independent evidence comes in the form of an alternation attested elsewhere in the language (see the mapping /taxa:kʔa/ → [taxakʔ]; McCarthy 2008:110).

In the Atayal case, there is, apparently, no evidence from alternations to support the claim that such word-initial glottal stops are epenthetic segments triggered by the need to provide an onset to a syllable. As already seen, coalescence and glide formation, rather than epenthesis, are the usual strategies employed in the language to do away with potential hiatus (i.e. onsetless syllables). There are, however, alternations that do support such an analysis for (at least part of the) word-initial glottal stops. In the derivation of the active and passive forms of verbs, in which these cease to be vowel-initial, the glottal stops found in non-derived stems are predictably absent from the derived, consonant-initial forms. This is perfectly consistent with the hypothesis that the presence of such glottal stops in stems is triggered by the need to provide an onset for word-initial onsetless syllables. A plethora of forms instantiating such alternations are found in the appendix to Li's (2004[1980]) study on the comparative phonology of Atayal varieties (see Li 2004[1980]:272–280):

(9)		*stem*	*active*	*passive*	
	a.	ʔatuk	matuk	tukan	'peck, hoe'
	b.	ʔalax	malax	laxan	'remove, give up'
	c.	ʔagal	magal	galan	'take'
	d.	ʔutsi	mutsi	-------	'do thus, say thus'
	e.	ʔumuk	mumuk	mukan	'cover'
	f.	ʔubuj	mubuj	buzan	'continue, connect'

Word-finally, however, a glottal stop is contrastive as shown by pairs such as /mu/ 'my' – /muʔ/ 'to shoot' and /nbuw/ 'to drink' – /nbuʔ/ 'illness' (Rau 1992:21).[7] This in turn shows that

[7] Word-initial glottal stops are underlyingly present when preceding a consonant, as in /ʔnux/ 'tooth' and /ʔtuŋ/ 'short'. As pointed out by Li (2004[1980]:248), comparative evidence shows that these result from word-initial vowel/syllable loss in the Squliq variety of Atayal. Thus, the Mayrinax cognates of the two forms given are /giʔnux/ and /ɾaʔatuŋ/, respectively (see Li 2004[1980]:247–248).

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codas are allowed in Atayal and preference is given to the non-violation of segmental faithfulness constraints:

Tableau 6

	/qes/ [qes] 'happy'	MAX-C	DEP-V	NOCODA
a.	[qes] ~ [qesə]		W	L
b.	[qes] ~ [qe]	W		L

Tableau 6 shows that unfaithful mappings characterized by the presence of output vowels lacking input correspondents (a) or the absence of output correspondents for input consonants (b) are not allowed as ways to enforce the demands of the markedness constraint NOCODA.

In sum, this section established the following basic syllabification rankings for Atayal:

(10) ONSET >> DEP-C
MAX-V >> DEP-C
DEP-V >> NOCODA
MAX-C >> NOCODA

The next section offers an account of the way consonant sequences are dealt with in the phonology of Atayal.

4.1 Consonant clusters and surface schwa

A number of forms such as [mʔbja] and [ktan] with (apparently) striking consonant clusters were presented in §2 and §3 but were not discussed in any explicit manner. Such clusters are particularly common in the left edge of words. Following Rau (1992:22–23) and Huang (2006:11), I take these clusters to be uniformly undone by the insertion of an epenthetic schwa [ə].[8] Tableau 7 illustrates the selection of a candidate with such epenthetic vowel (note that <C> indicates that the consonant in question is parsed as an appendix):

Tableau 7

	/mtalah/ [mə.ta.lah] 'red'	*Appendix	MAX-C	DEP-V
a.	[mə.ta.lah] ~ [<m>ta.lah]	W		L
b.	[mə.ta.lah] ~ [ta.lah]		W	L

In Tableau 7, candidate pair (a) shows a competition between the optimal candidate with epenthetic [ə] and a candidate which parses the first consonant as an extra-syllabic appendix. I included this pair for two reasons. The first reason is that a constraint *APPENDIX has been assumed by a

[8] This schwa is taken to be epenthetic—that is, absent from input/underlying forms—due to its predictable distribution: it occurs only between the members of consonant clusters and never bears stress (see Rau 1992:22–23).

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number of researchers to be part of CON (e.g. Sherer 1994; Zec 2007; also in McCarthy 2008 as *C_{unsyll}). The second reason is that if this constraint is assumed to be present in every grammar, we expect it to be active in cases such as this, in which parsing the sequence [mt] as a complex onset would lead to a violation of the Sonority Sequencing Generalization (SSG). As noted by Vaux & Wolfe (2009:103), similar violations of the expected sonority profiles are the usual motivation for positing extra-syllabic appendixes. As seen above, Atayal does not tolerate such structures and opts for an unfaithful mapping instead: candidate pair (b) shows that inserting an epenthetic vowel has preference over the deletion of the consonant, thus MAX-C >> DEP-V.

As shown in Tableau 8, it may be argued that some instances of epenthetic [ə] are motivated by the higher-ranking constraint *$\text{COMPLEX}_{\text{ONSET}}$, since such output segments undo sequences that, given their sonority profile alone, could be parsed as SSG-complying complex onsets:

Tableau 8

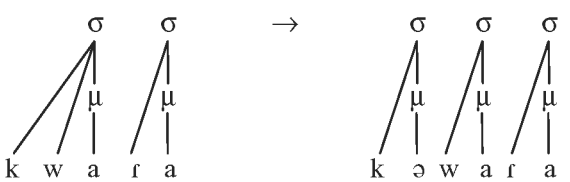
	/blaq/ [bəlaq] 'good'	*$\text{COMPLEX}_{\text{ONSET}}$	MAX-C	DEP-V
a.	[bə.laq] ~ [.blaq.]	W		L
b.	[bə.laq] ~ [baq]		W	L

Additional examples show that the distribution of these predictable schwa vowels leads to the production of the ideal CV syllable shapes (data from Rau 1992:25–26):

(11) a. /kwaɾa/ → [kəwaɾa] 'all'
b. /ɾwa/ → [ɾəwa] 'you know'
c. /spliq/ → [səpəliq] 'diarrhea'

An important implication of the data above, in particular the occurrence of [ə] breaking consonant-glide sequences (11a–b), is that it fits nicely in the analysis I proposed earlier of glide-formation in pre-vocalic vocoids through mora deletion and the consequent creation of complex onsets (as noted in §1.1, I follow Green 2003:239 in assuming that in a moraic framework the 'onset' corresponds to the string of segments between $_{\sigma}$[and the syllable nucleus):

(12)



If the glides in (11a–b) were taken instead to be part of a nucleus constituent there would be no way to account for the insertion of [ə]. The sole context in which a transition vocoid is inserted between an onset consonant and a nucleus is in the case of /q/ and /i/, no doubt related to the opposite articulatory demands of these two segments—more retracted and more advanced, respectively—rather than to any syllabification constraint (see Li 2004[1980]:234 for examples such

as /qiɾaŋ/ → [qəiɾaŋ] 'green beans'). Thus, we have additional evidence that glides are not part of the nucleus, but are instead consonants (meaning, syllable margins) that must, in accordance with the restrictions of tautosyllabic consonant clusters, be separated from adjacent consonants by vowel epenthesis.

Tableau 9 synthesizes what seems to be a relevant generalization on Atayal phonology: while epenthesis may be seen as a strategy to avoid complex onsets or extra-syllabic appendices, it is never forced as a way to comply with the demands of NoCoda (in combination tableaux the optimal output will be indicated here by shading in the leftmost column):

Tableau 9

	/spliq/ [səpəliq] 'diarrhei a'	*Appendix	*Complex$_{onset}$	Dep-V	NoCoda
a.	[sə.pə.li.qə]			W***	L
b.	[sə.pliq]		W*	L*	*
c.	[<s>pliq]	W*	W*	L	*
d.	[sə.pə.liq]			**	*

The disjunction in (c) above is not problematic since there is independent evidence that both *Appendix and *Complex$_{onset}$ dominate Dep-V from row (b) (also see Tableaux 6 and 7).

A point of contention in recent phonological theory concerns the nature of such 'intrusive' vowels (see e.g. Hall 2006; Levin 1987; Warner et al. 2001). One of the alternatives consists in treating these vowels as the result of changes in 'articulatory timing' or accommodation, rather than as effects of markedness constraints on preferred syllable shapes. Though a careful and in-depth analysis of these intrusive vowels in Atayal demands a paper of its own, I note here that at least two reasons seem to motivate the analysis of these surface occurrences of schwa as phonological epenthetic vowels rather than simple phonetic 'transition vocoids':

(13) a. Neither Rau (1992) nor Huang (2006) state that these vowels can be optionally absent as a function of speech rate.
b. The absence of these vowels would produce marked structures, such as complex onsets or extra-syllabic appendices, so that their distribution may be likely seen as a way to avoid such configurations.

These two points are presented in Hall (2006:391) as two 'symptoms' of phonological epenthetic vowels: epenthetic vowels, as opposed to simple phonetic transitions, present in interconsonantal transitions, often work—or appear to work—as repair strategies to avoid marked structures. As argued in the present section, unfaithful input–output mappings in which these predictable vowels appear in what would be violation loci for markedness constraints are preferred to the markedness-violating faithful parsings. Also, as noted in (13a) above, the presence of these vowels does not seem to vary in any sensible manner as a function of speech rate, thus showing, according to Hall (2006), yet another trait of 'true', phonological epenthetic vowels. This is, however, a point that merits deeper consideration and will not be discussed any further here.

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4.2 On the absence of [wu] and the usefulness of comparative tableaux

This last section deals with two residual problems in Huang's (2006) analysis of Atayal phonotactics and syllable structure: her postulation of an apparent ad hoc constraint banning adjacent identical feature specifications—an OCP constraint—and her interpretation of the role of the ONSET constraint in the grammar of Atayal. One of the main objectives of the present section is to present a particular instance in which the use of comparative evaluation of candidates allows one to assess the precise explanatory contribution of particular constraints, as argued on more general grounds by Prince (2002:25–30).

Prince (2002), and to a lesser extent Prince (2007), provides extensive discussions showing how the use of comparative tableaux exposes the basic logic of constraint interaction and candidate selection in OT in a more explicit way than is made possible by the use of the traditional 'violation mark' tableaux of Prince & Smolensky (2004). Their use as analytical tools also offers additional advantages: they furnish a formidable instrument for constructing and evaluating ranking arguments. In particular, it becomes easier for the analyst to uncover the precise role played by particular constraints in accounting for particular patterns.

The first problem discussed in this section may become apparent once we consider the formulation and the intended role played by a constraint defined as 'OCP-PLACE' by Huang and presented as in (14) (Huang 2006:7):

(14) OCP-PLACE: Glide-vowel or vowel-glide sequences of identical place features such as [wu], [uw], [ji] and [ij] are disallowed.

As is made quite clear by the definition above, this constraint expressly and parochially targets sequences of vowels and glides. In its extremely particular character lies the first problem with this constraint. Note that the constraint simply bans whatever place features happen to be identical or shared in vowel-glide or glide-vowel sequences. The definition of the constraint does not mention one particular place feature (or a natural class thereof) whose adjacent occurrence is proscribed, as is the case with OCP-like constraints enforcing well-known patterns such as Lyman's Law in Japanese (for [voice]; Mester & Itô 1989:277–278) or Meussen's rule in Bantu (for H tones; Myers 1997). All of this points to the fact that rather than being part of the well-motivated OCP constraint family, the constraint above may be translated with no loss of content into a markedness constraint banning sequences of glides and vowels specifically (say, *[VG], *[GV]).

If the OCP-based approach to the absence of homorganic glide-vowel and vowel-glide sequences is pushed further and a general redefinition of the constraint in (11) above is offered, such as OCP-[CORONAL], OCP-[DORSAL] or OCP-[LABIAL], other problems arise. Note that the existence of forms such as [bali] 'not' and [mu?] 'to shoot' (Rau 1992:25) makes it unlikely that any such constraints are enforced in the language, assuming that in sequences like [li] and [mu] both the consonant and the vowel are specified as [Coronal] and as [Labial], respectively. And the plot thickens: it is in effect impossible to evaluate the action of OCP constraints constructed in the terms of Huang's (2006) definition in (14) above, since no domain within which the constraint is active is mentioned. As noted in fundamental works on the action of OCP constraints in OT (Alderete 1997; Myers 1997), a particular domain must be specified for the activity of

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these constraints, a domain in which loci of violation for the OCP constraint in question are to be evaluated by the attribution of violation marks.

It may be the case that parochial constraints banning such homorganic sequences turn out in the end to be necessary (see e.g. Booij 1989:322; Maddieson & Precoda 1992), but the above considerations make it quite unlikely that these may be construed in terms of the general OCP format. And in effect, all the cases presented by Huang (2006) as instances of the crucial activity of her OCP-PLACE constraint can be dealt with in the analysis proposed here without recourse to any similar constraint. Thus, the mapping /pnbu-un/ → [pənəbun] (Huang 2006:15) is accounted for here as follows:

Tableau 10

	/pnbu$_1$-u$_2$n/ [pənəbun]	*LONG V	ONSET	*COMPLEX$_{ONSET}$	MAX-V	DEP-C	DEP-V	UNIFORMITY	MAX-μ
a.	[pə.nə.bə.wun]						W ***	L	*
b.	[pə.nə.bwun]			W *			**	L	*
c.	[pə.nə.buun]	W *					**	L	L
d.	[pə.nə.bu$_{1,2}$n]						**	*	*
e.	[pə.nə.bu.ʔun]					W *	**	L	L
f.	[pə.nə.bu$_1$n]				W *		**	L	L

The optimal form is selected in Tableau 10 if the following assumptions are upheld: (1) that the attested output is derived via coalescence, as assumed by Huang (2006) and (2) that an output with coalescence does not violate MAX-V, since no input vowel lacks an output correspondent (see definitions in (3)).

The last issue to be discussed concerning Huang (2006) refers to the proper role of the ONSET constraint in driving hiatus resolution. After presenting her violation tableaux with the rankings that motivate glide formation as a strategy of hiatus resolution, the author comments that:

> (. . .) because V-Nuc is the lowest ranked constraint (. . .) it is more optimal to employ gliding, rather than other strategies, to avoid violations of the high-ranked Onset constraint. (Huang 2006:15)

Also, when discussing glide formation in Isbukun Bunun, whose pattern, at least as far as the interaction with ONSET is concerned, is identical to that found in Atayal, the author states that:

> The high-ranked Onset constraint rules out any candidate that contains an onsetless syllable, such as the candidate (10a). Candidates (b–e) satisfy the Onset requirement by forming a glide, merging the adjacent vowels, deleting one of the vowels and epenthesizing a consonant, respectively. Because the constraint against gliding is ranked lower than the constraints against other types of changes, the grammar chooses (b) as the optimal output. (Huang 2006:8)

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From both quotes above one gets the idea that the constraint ONSET seems to be the 'driving' force behind the alternations such as coalescence and glide formation in Atayal. As Prince (2002:26) observes, however, undominated or high-ranking marked constraints such as ONSET at best establish 'post-conditions' in the form of a target structure that should be met in optimal outputs. Though Huang (2006) is, of course, correct in claiming that the low ranking of the constraint violated by the optimal output (her V-NUC, but MORA-μ in our analysis) is a necessary condition, otherwise the violation could not be tolerated, her description of what is going on in the evaluation process misses the point that what is at stake is a conjunctive evaluation regime (Prince 2002:26–27), in which the activity of each W-assessing constraint, and not only ONSET, is required if the optimal form is going to win the competition with the other candidates. An inspection of Tableaux 2–4 presented in this paper, in comparative format, makes it conspicuously clear: given the way candidate evaluation works, it is not precisely true that the demands of ONSET drive hiatus resolution. Every W-assessing constraint does the crucial job of expressing the preference for the optimal output over one particular suboptimal candidate.

5. Summary discussion and conclusions

The purpose of this paper has centered on presenting an alternative Optimality-Theoretic treatment to particular aspects of the syllable structure and phonotactics of the Squliq variety of Atayal. Arguments have been offered to the effect that the account presented here is superior to the OT treatment of hiatus resolution in Atayal given in Huang (2006) in that it complies with the two 'generality conditions' on the construction of H-Eval put forth in Prince & Smolensky (2004:6). We have, in this way, characterized both the ways in which hiatus resolution in Atayal differs from alternative patterns observed elsewhere and have also extended the basic account into a broader approach to phonotactics and syllable structure in this language.

Briefly, the following constraint rankings have been justified in the present work (with an indication of the tableau in which the relevant ranking argument is found):

(15) *Basic syllable structure constraint rankings in Atayal:*

a. ONSET >> DEP-C (Tableau 5)
b. MAX-V >> DEP-C (Tableau 5)
c. DEP-V >> NOCODA (Tableau 6)
d. MAX-C >> NOCODA (Tableau 6)

Ranking (15a) shows that an epenthetic consonant is allowed in optimal outputs if it avoids a violation of the constraint ONSET, hence the predictable appearance of glottal stops in words that could be otherwise described as being vowel-initial. Ranking (15b), on the other hand, underscores the fact that in a vowel-commencing input, vowel deletion is not allowed to satisfy ONSET. Codas are allowed and neither vowel epenthesis nor consonant deletion may take place in optimal input–output mappings (15c–d).

Whenever inputs contain consonant sequences, the following rankings come to play a role in the selection of the optimal outputs:

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(16) *Local constraint rankings driving vowel epenthesis in input consonant clusters:*
a. *APPENDIX, *COMPLEX$_{ONSET}$ >> DEP-V (Tableaux 7 and 8)
b. MAX-C >> DEP-V (Tableaux 7 and 8)

The joint effect of the rankings in (16) above is that surface violations of *COMPLEX$_{ONSET}$ or the presence of extra-syllabic appendices are 'repaired' by means of vowel epenthesis. This accounts for the widespread presence of epenthetic vowels in Atayal and has preference over the deletion of the input consonants in the offending structures (16b).

Bimoraic syllables seem to be banned in Atayal optimal outputs. This pattern is brought about by the following constraints on input vowel sequences:

(17) *Local constraint rankings crucially active in inputs containing vowel sequences:*
a. *LONGV >> MAX-μ (Tableaux 1 and 2)
b. ONSET, NODIPH >> MAX-μ, *CG (Tableaux 2 and 3)
c. ONSET, NODIPH, *COMPLEX$_{CODA}$ >> UNIFORMITY (Tableau 4)
d. UNIFORMITY >> NOCODA (Tableau 3)

Atayal has no length contrast in vowels, and the ranking in (17a) above assures that long vowels are also banned from the output of hiatus resolution. The demands of high-ranking constraint ONSET and NODIPH are enforced by glide formation, which occurs at the expense of the faithfulness to input moras and by creating a locus of violation for *CG any time the first vowel in a sequence is the one subject to glide formation.

The rather low ranking of the correspondence constraint banning vowel coalescence (UNIFORMITY) accounts for the occurrence of this pattern as a way to avoid onsetless syllables, diphthongs and complex codas (17c). The latter is particularly important since it accounts for the absence of CVGC syllables in a motivated manner. Note, however, that a violation of NOCODA is tolerated if repairing it would lead to a violation of UNIFORMITY (17d).

It remains to be seen how other patterns and phenomena of Atayal phonology—such as accounting for the particular content of epenthetic segments or the production of reduced vowels as a result of stress shifts in environments derived by suffixation—can be integrated into an even more general OT approach to the language. We hope, however, that the present paper has contributed to an understanding of the basic constraint interactions active in the phonology of Squliq Atayal.

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賽考利克泰雅語的音節結構與元音串修補策略

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本文透過優選理論來解釋賽考利克泰雅語的音節結構與元音串修補策略，並針對 Huang (2006) 的論文，提出以音拍為主的另類分析。我們尤其認為在 Huang (2006) 中所忽略的制約，即禁止長元音及音節尾等制約，其實扮演了重要的角色，除了能衍生所測試到的模式之外，也對泰雅語的音序提供了具洞見性的看法。另一方面，本文顯示 Huang (2006) 所運用的制約乃屬於狹隘表層–真實模式的陳述，不應以具原則性的優選理論釋之。本文也指出及處理 Huang (2006) 在分析上的缺失，並由此闡明比較表足以點出這些缺失以及類似的錯誤分析。

關鍵詞：音節結構，元音串修補策略，優選理論，泰雅語，南島語

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