Resolving Vowel Clusters:
A Comparison of Isbukun Bunun and Squliq Atayal[*]

Hui-chuan J. Huang

National Tsing Hua University

The goals of this paper are to identify, compare, and account for the ways suffixation-induced vowel clusters are handled in Isbukun Bunun and Squliq Atayal, two Formosan Austronesian languages. Despite the fact that the two languages have distinct segmental inventories and prosodic characteristics, Isbukun and Squliq are shown to be strikingly similar in adopting both glide formation and coalescence to modify vowel sequences, and they differ in terms of the conditioning environments in which the two processes occur. The paper argues that such differences are correlated with the permitted syllable types in the two languages, and points out that the correlation can be explicitly captured in the output-oriented framework of Optimality Theory but not in a rule-based analysis that states generalizations based on input configurations.

Key words: syllable nucleus, vowel hiatus, glide formation, coalescence, Optimality Theory

1. Introduction

A major issue in phonological studies is how ill-formed configurations that arise through morpheme concatenation are dealt with in a particular language and whether there exist cross-linguistic principles that determine the types of changes. Typical illegitimate sequences include vowel and consonant clusters that disobey the phonotactics. As far as vowel clusters are concerned, previous studies such as Casali (1997) and Rosenthall (1994, 1997) have shown that languages exhibit a variety of modification

processes in response to such ill-formed sequences, including vowel deletion, consonant epenthesis, glide/diphthong formation, and coalescence. Given that differences in resolving vowel clusters play a crucial role in characterizing different languages, the goals of this paper are to examine and compare the ways suffixation-induced vowel clusters in Bunun and Atayal are manifested on the surface.

The Bunun dialect investigated in the present study is the Isbukun variety spoken in Kaohsiung County (Kaohsiung Isbukun).[1] According to the classification in Li (1988), Bunun can be divided into five dialects: the northern dialects Takituduh and Takibakha, the central dialects Takbanuað and Takivatan, and the southern dialect Isbukun. There have been a number of studies on or related to Isbukun Bunun,[2] including He et al. (1986), Li (1987, 1988, 1997), L. Huang (1997), H. Lin (1995, 1996), Nojima (1996), Jeng (1999), Yeh (2000), Zeitoun (2000), T. Lin et al. (2001), and H. Huang (2005c), among others. Although the phonemics and major segmental processes in Isbukun have been outlined in these previous studies, especially Li (1997) and H. Lin (1996), how segmental rules interact with prosody in the language awaits more research.

The Atayal language can be subdivided into two major dialect groups Squliq and C'uli' (Li 1980, 1981, 1985), and the focus of the paper is the Squliq dialect spoken in Jianshi Township of Hsinchu County. Squliq is spoken in a geographically more contiguous region than C'uli', and the differences among the various dialects classified as C'uli' are more divergent than those among Squliq dialects (Li 1980, 1981). Among the works on or related to the Atayal language, such as Egerod (1965, 1966, 1980), Yamada & Liao (1974), Li (1977, 1980, 1981, 1982a, 1982b, 1985, 1995), Rau (1992, 2000), L. Huang (1993, 1994, 1995, 2000a, 2000b), Lambert (1999), and Cheng (2001), there have been relatively more descriptions on the fairly uniform Squliq dialects than on each of the C'uli' dialects. All of the works listed above, except Li (1995), L. Huang (1995, 2000a, 2000b), and Lambert (1999), deal with Squliq data either partially or exclusively. Although the phonemic inventories and the rich morphophonemics of Squliq have been presented in some detail, especially in Li (1980), the ways that segmental rules interact with prosody in the synchronic grammar of Squliq remain unclear.

A comparison between Isbukun Bunun and Squliq Atayal[3] is possible because they share the following characteristics: both languages obey the constraint that syllables must have onset consonants, and both have vowel-ending stems and vowel-beginning

---

[1] According to Li (1997:301), Isbukun is spoken in Nantou (Hsinyi Township), Pingtung (Majia Township), Taitung (Yanping and Haiduan townships), and Kaohsiung (Taoyuan and Sanmin townships) Counties.

[2] Also see Jeng (1977) on Takbanuað Bunun.

[3] Hereafter the terms Bunun and Atayal refer to the dialects Isbukun Bunun and Squliq Atayal, respectively, unless noted otherwise.

suffixes that would potentially give rise to medial onsetless syllables.[4] As the paper will show, Bunun and Atayal are strikingly similar in adopting both gliding and coalescence to repair vowel sequences, and their differences lie in the environments where gliding and coalescence apply. The paper argues that the differences in resolving vowel clusters are correlated with the distinct syllable types allowed in the two languages and that such a correlation can be directly captured in an output-based framework such as Optimality Theory (OT) (McCarthy & Prince 1993, Prince & Smolensky 1993).

The paper is organized as follows. Section 2 shows how vowel clusters are handled in Isbukun Bunun and formalizes the account within the framework of OT. Section 3 presents the case of Squliq Atayal and demonstrates that when gliding would lead to a CVGC syllable, which is not allowed in the language, Squliq crucially differs from Isbukun in adopting coalescence rather than glide formation to avoid vowel clusters. Section 4 summarizes the patterns in Isbukun and Squliq, and offers a comparison between a rule-based analysis and the proposed OT analysis. Since syllable wellformedness plays a crucial role in the ways of resolving vowel clusters, a discussion about the constraints responsible for a legitimate syllable in the two languages is offered. Section 5 concludes the paper.

2. Isbukun Bunun

This section will show that gliding and coalescence are the two primary strategies to deal with vowel clusters in Isbukun Bunun, and they take place in complementary environments. A brief background on Isbukun is given in Section 2.1, the gliding/ coalescence data are presented in Section 2.2, and an analysis within OT is offered in Section 2.3.

2.1 Background on Isbukun Bunun

The phonemic inventory of Isbukun Bunun includes the three vowels /i u a/ and the following fourteen consonants (cf. He et al. 1986, Li 1997).[5]

---

[4] Morpheme concatenation could possibly give rise to a sequence of more than two vowels in Isbukun, such as /pia-un/ [piun] 'how many-Patient Voice marker (PV).' In the attempt to give a comparison between Isbukun and Squliq, the paper will only address the ways that two-vowel clusters are modified because sequences of more than two vowels do not arise in Squliq.

[5] Li (1997:301) places /h/ under uvular. He et al. (1986) includes the lateral fricative /ɬ/ rather than /l/. Li (1997:302) observes that while older speakers tend to devoice /l/, there is a growing tendency in younger speakers to pronounce a voiced /l/.

(1) Bunun consonant inventory[6]

	Labial	Coronal	Velar	Glottal
Stop	p b	t d	k	ʔ
Fricative	v	s ð		h
Nasal	m	n	ŋ	
Liquid		l		

Surface glides [j w] do exist, but they are derived from underlying vowels /i u/, respectively, in order to satisfy the requirement that syllables must have onset consonants (H. Lin 1995, 1996).

Li (1997:306) and H. Lin (1996:32) characterize an Isbukun syllable as CV(C). To put it another way, onsets are obligatory, codas are optional, and complex syllable margins are prohibited in the language. Isbukun allows up to two vocalic elements (GV/VG) in syllable peak positions, based on evidence from stress assignment (H. Huang 2005c). Postconsonantal onglides are in the nucleus rather than in the onset because they are moraic. Offglides are also moraic and thus better considered as part of the nucleus too.[7]

2.2 Gliding and coalescence in Isbukun Bunun

When a vowel-initial suffix attaches to a vowel-ending stem in Isbukun, gliding of one of the vowels is observed if the adjacent vowels are not alike, as illustrated by the following data.[8]

---

[6] The chart employs the active articulator 'coronal,' rather than passive articulators 'interdental' and 'alveolar,' to characterize the interdental /ð/ and other alveolar sounds. The term 'coronal' better shows the parallel between /s/ and /ð/ in the inventory: both /s/ and /ð/ are coronal fricatives, but they are realized at different places of articulation.

[7] Since coda consonants could be moraic, the moraic status of offglides does not necessarily lead to the conclusion that the offglides are in the nucleus. However, allocating Isbukun offglides to the coda would cause one to abandon the generalization that the language prohibits complex coda consonants.

[8] The suffixes in the Isbukun data given here include /-un/ '(patient voice marker),' /-an/ '(locative voice marker),' /-a/ '(imperative agent voice marker),' and /-av/ '(imperative non-agent voice marker).' The abbreviations AV, PV, LV, NAV are used for Agent Voice, Patient Voice, Locative Voice, and Non-Agent Voice, respectively. All the suffixes included here are stress-shifting, which is in contrast with non-stress-shifting suffixes such as /in/ '(perfect marker).' The examples (2d') and (3c') contain the prefixes /pa/ '(causative)' and /pat/ 'write,' which do not appear in the corresponding non-suffixed forms (2d) and (3c).

(2) Non-identical vowel sequences: gliding

	Agent voice			*Suffixed forms*		*Gloss*
a.	/sadu/	[sádu]	a'.	/sadu-av/	[sadwáv]	'see'
b.	/silulu/	[šilúlu]	b'.	/silulu-av/	[šilulwáv]	'pull'
c.	/silili/	[šilíli]	c'.	/silili-av/	[šililjáv]	'imitate'
d.	/mavali/	[maváli]	d'.	/pavali-av/	[pavaljáv]	'shine upon'
e.	/tupa/	[túpa]	e'.	/tupa-un/	[tupáwn]	'tell'
f.	/mapasnava/	[mapasnáva]	f'.	/pasnava-un/	[pasnaváwn]	'learn'
g.	/taʔaða/	[taʔáða]	g'.	/taʔaða-un/	[taʔaðáwn]	'listen to'

Given that Isbukun does not allow onsetless syllables on the surface, the motivation for gliding here is clearly to satisfy the onset requirement.

If the stem-final vowel and the following vowel are identical, coalescence takes place instead. The data (3) below illustrate that two adjacent identical vowels merge into one at the segmental level.

(3) Identical vowel sequences: coalescence

	Agent voice		*Gloss*		*Suffixed forms*		*Gloss*
a.	/matutu/	[matútu]	'pour out'	a'.	/tutu-un/	[tutún]	'pour out'
b.	/taʔaða/	[taʔáða]	'listen to'	b'.	/taʔaða-a/	[taʔaðá]	'listen to'
c.	/muliva/	[mulíva]	'mistaken'	c'.	/patliva-an/	[patliván]	'make mistakes in writing'

Because the merged vowel is perceptually similar to a single vowel, the phonetic realization of the suffixed forms in (3) is subject to an alternative phonological interpretation that involves a rule deleting one of the identical segments, rather than coalescence.[9] Although the deletion analysis appears straightforward in this case, these suffixed forms are better viewed as involving coalescence of the adjacent vowels, rather than outright deletion of one of the elements, based on stress assignment and cross-dialectal comparison (H. Huang 2003).

In the cases where stem-final and suffix-initial vowels are identical, such as those in (3a') to (3c'), the resulting vowels pattern differently with respect to stress assignment from those which do not correspond to two underlying vowels. An examination of stress placement in the language reveals that the type of final syllables in the suffixed forms (3) almost always attracts stress, in contrast with the unmarked penultimate stress pattern in Kaohsiung Isbukun. The coalescence hypothesis renders possible a transparent account

---

[9] Please see H. Lin (1996:48) and Li (1997:305-306).

of the marked final stress pattern in (3) when it is coupled with two other assumptions: the language constructs a quantity-sensitive left-headed foot at the right word edge, and the language in general obeys the Weight-to-Stress Principle (WSP, 'heavy syllables do not stand in a prosodically weak position'). In this account, stress falls on the final syllables of the suffixed forms in (3) because the final syllables contain both the moras associated with the underlying vowels; placing stress on the penult would create a final heavy syllable standing in the nonhead position of the foot and hence leading to a violation of WSP. In non-suffixed forms, stress falls on the penultimate syllables because the final syllable contains just one mora.[10] Since both moras of the two input vowels must be retained, it is straightforward to assume that the two identical vowels simply coalesce at the segmental level without their quantity being affected. An analysis with outright deletion would have difficulties explaining why monophthongal vowels in the final syllables of non-suffixed forms are unstressed while similar-sounding vowels in the final syllables of suffixed forms attract stress when they come from two juxtaposed vowels in the input.[11]

An additional argument for the coalescence analysis is that some exceptional final-stressed words in Isbukun correspond to identical vowels flanking glottals in a related, more conservative dialect, such as Isbukun [ʔuváð] 'child' corresponding to Takituduh [ʔuvaʔáð].[12] Given the sound changes *ʔ > zero in Bunun (Li 1988), it is likely that coalescence takes place after the loss of glottals in the diachronic phonology of Bunun, which leads to some of the exceptional final-stressed words in Isbukun. A coalescence analysis of the data (3) in the synchronic phonology of Bunun is therefore highly viable as it is also operative diachronically.

Notice that in the descriptions of the data (2), the term 'gliding' or 'glide formation' simply refers to the fact that the high vowels are pronounced with a transient quality and do not acoustically manifest steady state formants that are typical of a vowel. The use of the term does not imply the loss of the moraic status of the glided vowel as some scholars would use it in standard moraic theory. In fact, the stress assignment rules mentioned above indicate that non-syllable-initial glides in the language are

---

[10] The penultimate stress pattern is illustrated by the data in (2a)-(2g) and (3a)-(3c). Notice that stress location is determined by the quantity of the vocalic elements in the final syllables; whether the final syllables are closed by a consonant does not play a role. More examples can be found in H. Huang (2003). All the examples in (2a)-(2g) and (3a)-(3c) contain a final open syllable because the focus of discussion here is on the ways that vowel-ending stems combine with vowel-initial suffixes.

[11] The deletion analysis would work if we assume that the mora of the deleted vowel survives in the output. It would be, however, difficult to distinguish this approach from the coalescence analysis proposed here.

[12] Stress is in general final in Takituduh Bunun.

moraic. The moraic status of non-initial glides, as in the word [sa.dwáv], is justified by its final stress pattern; the language would not place stress on the penultimate syllable *[sá.dwav] because the final syllable is heavy.

The moraic status of non-syllable-initial glides (such as those in the suffixed forms in (2)) suggests that the glides and the adjacent vowels are in the peak position of a syllable. That is, the peak of an Isbukun syllable allows both glide-vowel and vowel-glide sequences. As will be shown in sections 3 and 4, Squliq crucially differs from Isbukun in lacking vowel-glide syllable peaks.

2.3 An Optimality-theoretic analysis of the Isbukun data

Both gliding and coalescence are strategies to avoid onsetless syllables in Isbukun, which can be embodied in the framework of OT by ranking the ONSET constraint higher than the constraints against the two types of changes. The major constraints that appear in the proposed analysis are shown below.

(4) ONSET: Syllables must have onset consonants.

(5) V-NUCLEUS (V-NUC): Every [-consonantal] segment must be linked to the nucleus without sharing it with other elements.[13] (cf. Rubach 2000:274)

(6) UNIFORMITY-IO: No element of the output has multiple correspondents in the input. (McCarthy & Prince 1995)

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

(8) MAX-IO-V: An input vowel must have a correspondent in the output. (McCarthy & Prince 1995)

(9) DEP-IO-C: An output consonant must have a correspondent in the input. (McCarthy & Prince 1995)

The constraint V-NUC penalizes a vocalic element that does not occupy the nucleus position of a syllable on its own; therefore, glided vowels such as [w j] in (2a) [sadwáv]

---

[13] The constraint V-NUC is proposed in Rubach (2000), which is the segmental counterpart of the constraint V-MORA (Rosenthall 1994). The original definition of the V-NUC constraint in Rubach is 'Every [-consonantal] segment must be linked to the nucleus.' Although the definition works in the formation of syllable-initial glides by assigning a violation mark to them, it is unclear whether non-syllable-initial glided vowels invoke a violation of this constraint as well, since they are linked to the nucleus but share it with another vowel. Therefore, the paper modifies the definition of V-NUC so that it explicitly penalizes both initial and non-initial glides that come from underlying vowels.

and (2b) [šililjáv] violate V-Nuc. The constraint Uniformity-IO prohibits coalescence in the output, so (3a) [tutún] invokes a violation of Uniformity-IO. Gliding and coalescence are, respectively, accounted for by the rankings Onset >> V-Nuc and Onset >> Uniformity-IO. Max-IO-V and Dep-IO-C are included here to illustrate that the language does not resort to the strategies of vowel deletion or consonant epenthesis to avoid onsetless syllables due to the high-ranking status of the two constraints.[14]

The constraint OCP-Place is employed here to ensure the occurrence of gliding and coalescence in correct environments because the pairs of ranking Onset >> V-Nuc and Onset >> Uniformity-IO alone cannot derive the pattern that gliding takes place in non-identical vowel clusters and coalescence in identical ones. Given that the correct output in an OT grammar is the one that minimally violates constraints, there cannot be two different ways to repair an onset violation because among the constraints against various types of changes, there could only be one lowest-ranking constraint.[15] Ranking Uniformity-IO above V-Nuc would lead to the gliding pattern in both identical and non-identical vowel sequences, and the opposite ranking would give rise to coalescence, neither of which is correct because gliding and coalescence occur in complementary environments in Isbukun. If the ranking between V-Nuc and Uniformity-IO is instead left undetermined and thus equally low-ranked, the analysis would also be incorrect by predicting that gliding and coalescence are in free variation. It is argued here that the occurrence of gliding and coalescence in distinct environments is due to the high-ranked OCP-Place interacting with the rankings of Onset, V-Nuc, and Uniformity-IO. Uniformity-IO ranks above V-Nuc and leads to the gliding pattern in the case of

---

[14] Isbukun has some other rules that appear to be related to constraints on syllables, such as vowel deletion. One of the deletion rules affects words that contain three vowels in the input, such as /pia-un/ [pjun] 'how many-PV.' Given that the goal of this paper is to contrast the subtle differences between Isbukun and Squliq while showing their similarities, the data are not discussed here because these types of input combinations simply do not exist in Squliq. Another deletion rule a → ø / __- i as in /minsuma-in/ [minsumin] '(negative-perfect marker)' is observed in Li (1997:306) and H. Lin (1996:49-50). This vowel deletion rule is not included here because it is very different in nature from the gliding and coalescence rules presented in the paper. First, while all the suffixes given in the paper are stress-shifting and potentially form an integrated domain with the stem, the /-in/ suffix in [minsumin] is non-stress-shifting. Morphological factors might play a role in the choice of ways to resolve vowel clusters. Second, the deletion rule seems to be optional and is more commonly found in casual or fast speech, but the gliding and coalescence phenomena examined in the paper do not exhibit such a property.

[15] This issue has already been addressed in Kager (1999:84), citing Pater's (1999) work on nasal substitution. Kager mentions that there could not be two lowest-ranking correspondence constraints in the same hierarchy; the discussion on V-Nuc and Uniformity-IO here is phrased slightly differently because V-Nuc is not a correspondence constraint.

non-identical vowel sequences, but the grammar would choose the coalescence candidate in cases where gliding in addition invokes an OCP-PLACE violation. In this way, coalescence is observed in the case of identical vowel sequences because the gliding candidate is ruled out by OCP-PLACE.

The occurrence of glide formation in Isbukun is illustrated by the following tableau:

(10)   Gliding: ONSET >> V-NUC

$/tupa_1\text{-}u_2n/$	ONSET	OCP-PLACE	DEP-IO-C	MAX-IO-V	UNIFORMITY-IO	V-NUC
a. tu.pa.un	*!					
☞ b. tu.pawn						*
c. $tu.po_{1,2}n$					*!	
d. $tu.pu_2n$				*!		
e. tu.pa.ʔun			*!			

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.

In the case of identical vowels, the same set of constraints would lead to coalescence, as illustrated by (11) below.

(11)   Coalescence:

$/tutu_1\text{-}u_2n/$	ONSET	OCP-PLACE	DEP-IO-C	MAX-IO-V	UNIFORMITY-IO	V-NUC
a. tu.tu.un	*!					
b. tu.tuwn		*!				*
☞ c. $tu.tu_{1,2}n$					*	
d. $tu.tu_2n$				*!		
e. tu.tu.ʔun			*!			

Given adjacent identical vowels in the input, glide formation necessarily invokes a violation of the high-ranked OCP-PLACE in addition to V-NUC. As a result, the grammar winnows out the coalescence candidate (c), which violates the second lowest constraint in the tableau.

To summarize, Isbukun Bunun resolves non-identical and identical vowel clusters by gliding and coalescence, respectively. In the proposed OT analysis, the ranking of

ONSET above UNIFORMITY-IO and V-NUC means that gliding and coalescence, rather than other strategies such as consonant epenthesis and vowel deletion, will take place in response to the onset requirement. The occurrence of gliding and coalescence in complementary phonological environments is accounted for by the subset of the rankings OCP-PLACE >> UNIFORMITY-IO >> V-NUC. Ranking UNIFORMITY-IO above V-NUC implies that gliding is the preferred way to modify a vowel cluster; coalescence is adopted only when employing glide formation invokes an additional higher-ranked constraint other than ONSET. The paper proposes that this higher-ranked constraint responsible for coalescence is OCP-PLACE, which disfavors homorganic glide-vowel/ vowel-glide sequences.

3. Squliq Atayal

In this section, modification processes associated with vowel clusters in Squliq Atayal are discussed. Section 3.1 gives a brief background on Squliq Atayal. Section 3.2 presents the data involving vowel clusters and points out that the crucial difference between Isbukun and Squliq arises from interactions with syllables. The proposed OT analysis in Section 3.3 shows how syllable wellformedness constraints lead to the described patterns.

3.1 Background on Squliq Atayal

Squliq Atayal has the vowels /i e a o u/ and the nineteen consonants shown below (cf. Li 1980:352):

(12) Squliq Atayal consonant inventory

	Labial	Alveolar	Palatal	Velar		Uvular	Pharyngeal	Glottal
Stop	p	t		k		q		ʔ
Affricate		c						
Fricative	b[β]	s z		x	g[ɣ]		h	
Nasal	m	n		ŋ				
Liquid		r l						
Glide			j	w				

Since there is no phonemic contrast between voiced stops and voiced fricatives, I will follow conventional transcriptions in using the symbols /b g/ to represent the sounds that are commonly realized as the voiced fricatives [β ɣ] on the surface (or as [v ɣ], especially by younger speakers). The labiovelar glide /w/ is placed under velar in the

chart because the glide-fricative alternations j~z and w~g (Li 1980) suggest that /w/ patterns phonologically with velars (and /j/ with coronals).

A phonetically weak vowel predictably appears between consonants clusters, and its quality varies between a schwa and an apical vowel homorganic to the preceding sibilant, e.g. /blaq/ [bəlaq] 'good' and /slaq/ [sɨlaq][16] 'farmland.' In addition, Squliq Atayal has a rule of vowel reduction that affects pre-penultimate (and sometimes even penultimate) vowels: vowels are reduced to either a schwa or an apical vowel homorganic to the preceding sibilant when they are shifted to pre-penultimate positions upon suffixation, e.g. /qumah/ [qumah] 'cultivate', /qumah-un/ [qəmahun] 'cultivate-PV'. Since the qualities of such weak vowels are predictable from the preceding consonants, they will be mostly omitted in the transcription, following the conventions in previous studies on Squliq Atayal.

Similar to Isbukun Bunun, Squliq Atayal does not tolerate complex syllable margins.[17] Syllables are maximally CGVC and minimally CV. Unlike Isbukun that allows both CGVC and CVGC syllables on the surface, CVGC syllables are absent from Squliq. As will be shown in the following sections, the differences between the two languages in the ways of modifying vowel clusters arise from the gap of *CVGC syllables in Squliq.

3.2 Gliding and coalescence in Squliq Atayal: the asymmetrical pattern

Across the stem-suffix boundaries, glide formation in Squliq Atayal takes place under two circumstances: when a –V suffix follows a non-identical vowel (13a)-(13d), and when the stem-final vowel and the initial vowel of a –VC suffix are non-identical and form a sequence that is not falling in sonority (13e)-(13g).[18]

---

[16] The symbol [ɨ] here represents an alveolar apical vowel after the coronal sibilants /c s z/.

[17] An alternative view is that the pronunciation of words such as /squliq/ does not involve a vowel between the initial two consonants, which presumably poses a problem to the claim of simple syllable margins. The paper follows the assumption that there is a vowel present in the output of phonology between voiceless consonants as in the example /squliq/, but the vowel is devoiced due to the neighboring consonants (H. Huang 2005b).

[18] The suffixes in the Squliq data given here include /-un/ '(patient voice marker),' /-an/ '(locative voice marker),' /-a/ '(subjunctive agent voice marker),' and /-i/ '(imperative non-agent voice marker).'

(13) Gliding:

	Agent voice	*Suffixed forms*		*Gloss*
a.	smoja	soja-i	sjai	'to like'
b.	mʔabi	mʔabi-a	mʔbja	'to sleep'
c.	mnbu	mnbu-a	mnbwa	'to be sick'
d.	tmutu	tutu-i	ttui	'to fell trees'
e.	hmkani	hkani-an	hknjan	'to walk'
f.	miru	biru-an	brwan	'to write'
g.	tbuci	tbuci-un	tbcjun[19]	'to separate'

Coalescence takes place when the stem-final vowel is identical to the following vowel (14a)-(14c), and when the stem-final vowel and the following –VC suffix create a falling-sonority sequence (14d)-(14e).

(14) Coalescence:[20]

	Agent voice		*Suffixed forms*		*Gloss*
a.	tbuci	a'.	tbuci-i	tbci	'to separate'
b.	pnbu	b'.	pnbu-un	pnbun	'to cause to be sick'
c.	mita	c'.	kita-an	ktan	'to see'
d.	smoja	d'.	soja-un	sjon	'to like'
e.	miba	e'.	giba-un	gbon	'to embrace'

Similar to the data of adjacent identical vowels in Isbukun, an alternative interpretation of the suffixed forms in (14) is that they involve vowel deletion. Unlike the coalescence analysis in Isbukun that finds support in cross-dialectal comparison, such evidence seems to be lacking for Squliq. However, similar to the reasoning that a coalescence account renders the stress assignment rule transparent in Isbukun, an advantage of the coalescence analysis in Squliq is that it grants a less abstract account of the pre-penultimate vowel reduction phenomenon in Squliq. Under the assumption that the reduction rule affects all vowels except the last two vocalic elements, which escape being reduced because they are grouped into a foot, the reduction generalization

---

[19] The word *tbcjun* is optionally pronounced as *tbcyn* (in which *y* stands for a front rounded vowel) especially in connected speech.

[20] This type of phenomenon is described in Li (1980:372-373) and Rau (1992:32) under the subheading 'Contractions.' The descriptions in Li (1980) and Rau (1992:31) imply that the stems end with a glottal stop, which is dropped upon suffixation. The analysis here assumes that the stems are underlyingly vowel-final and that a final glottal stop could be added in non-suffixed forms.

remains transparent in a coalescence account of the data (14) but would be opaque in a deletion analysis. In a rule-based analysis that adopts the deletion approach, the reduction rule must precede the deletion rule in order to account for /kita$_1$-a$_2$n/ [kəta$_2$n], for example. The reduction rule is opaque in the sense that the second-to-the-last vowel on the surface is unexpectedly reduced, contrary to the prediction of the rule that the last two vocalic elements should remain unaffected. If the same phonetic signal is instead interpreted as coalescence /kita$_1$-a$_2$n/ [kəta$_{1,2}$n], the reduction of /i/ to [ə] is natural since the vowel is followed by two other vocalic elements in the word. The coalescence rule would not obscure the generalization put forth in the reduction generalization, since the two rules are not crucially ordered in a derivational account. The two different analyses are illustrated below:

(15)　a.　A deletion account:

	/kita$_1$-a$_2$n/		/kita$_1$-a$_2$n/
Reduction	kəta$_1$a$_2$n	Deletion	kita$_2$n
Deletion	kəta$_2$n	Reduction	kita$_2$n
	[kəta$_2$n]		*[kita$_2$n]

　　b.　A coalescence account:

	/kita$_1$-a$_2$n/	or	/kita$_1$-a$_2$n/
Reduction	kəta$_1$a$_2$n	Coalescence	kita$_{1,2}$n
Coalescence	kəta$_{1,2}$n	Reduction	kəta$_{1,2}$n
	[kəta$_{1,2}$n]		[kəta$_{1,2}$n]

The discussion here shows that if the overall transparency of rules in grammar is used as a criterion to choose between alternative phonological interpretations of a given phonetic signal, a coalescence account of the Squliq data (14) fares better than a deletion analysis.

The above generalizations regarding the conditioning environments of gliding and coalescence are disadvantageous in that both involve discrete statements. Another way to formulate the triggering environments of gliding and coalescence is to state the generalization negatively: coalescence takes place in identical vowel clusters, and gliding occurs in non-identical vowel sequences unless the non-identical sequences are falling in sonority and followed by a consonant, in which case coalescence occurs. The negatively-phrased generalization allows the similarity between Squliq Atayal and Isbukun Bunun to be directly captured: in both languages, gliding occurs in non-identical vowel clusters and coalescence in identical ones. The crucial difference is that while Isbukun is 'symmetrical' in allowing gliding to occur in any unlike vowel combinations, Squliq prohibits gliding in such configurations when a falling-sonority sequence is created through a –VC suffix. Gliding does not uniformly occur in all unlike vowel

sequences or in all falling-sonority sequences in Squliq; coalescence is instead observed when a falling-sonority sequence is followed by an additional consonant. The crucial reference to a consonant after a falling-sonority sequence in the conditioning environment of coalesce suggests that not only the segmental similarities of adjacent vowels, but also the types of syllables permitted in the language, play a role in determining whether the language would adopt gliding or coalescence to avoid vowel clusters.

3.3 An Optimality-theoretic analysis of the Squliq data

Given the similarities in the ways of modifying vowel clusters between Isbukun Bunun and Squliq Atayal, the same set of constraints ONSET, V-NUC, UNIFORMITY-IO, OCP-PLACE, MAX-IO-V, and DEP-IO-C for Isbukun are sufficient to account for the Squliq data. Squliq is different from Isbukun by employing coalescence when suffixation introduces a falling-sonority sequence followed by a consonant. It is proposed in the paper that coalescence in these cases, such as /$soja_1$-u_2n/ [sjon], is due to constraints on syllable shapes: while syllables in Isbukun are maximally CGVC/CVGC (which corresponds to underlying CVVC), Squliq permits CGVC but disallows CVGC syllables. The existence of CGVC syllables and the gap of CVGC in Squliq are confirmed by an examination of all the native words in the dictionary by 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 (Yip 1993). The constraints collectively referred to as OK-σ vary across languages since languages differ in the types of syllables that are tolerated. What is particularly relevant for the data of Squliq Atayal and Isbukun Bunun here is that candidates with CVGC syllables are ruled out by OK-σ in the Squliq grammar but such candidates satisfy OK-σ in Isbukun.

In the proposed OT analysis of the Squliq data, UNIFORMITY-IO ranks above V-NUC and the ranking leads to the choice of glide formation when a −V suffix follows an unlike vowel, similar to the case of Isbukun:

(16)   Gliding in −V suffixed forms

/soja-i/	OK-σ	ONSET	OCP-PLACE	DEP-IO-C	MAX-IO-V	UNIFORMITY-IO	V-NUC
a. sɨ.ja.i		*!					
☞ b. sɨ.jaj							*
c. sɨ.je						*!	
d. sɨ.ji					*!		
e. sɨ.ja.ʔi				*!			

When a –VC suffix creates a sequence that is not falling in sonority, the candidate with gliding is chosen as the optimal output form due to the low ranking status of V-NUC. This is illustrated in (17) below:

(17) Gliding in –VC suffixed forms

/hkani-an/	OK-σ	ONSET	OCP-PLACE	DEP-IO-C	MAX-IO-V	UNIFORMITY-IO	V-NUC
a. hə.kə.ni.an		*!					
☞ b. hə.kə.njan							*
c. hə.kə.nen						*!	
d. hə.kə.nan					*!		
e. hə.kə.ni.ʔan				*!			

Notice that the interactions of the constraints in (16), (17) are exactly identical to the analysis of Isbukun glide formation that takes place in adjacent non-identical vowels. The gliding candidates (16b) and (17b) win in these cases simply because V-NUC is the lowest ranked constraint, so it is more optimal to employ gliding, rather than other strategies, to avoid violations of the high-ranked ONSET constraint. OK-σ does not interfere with the choice of glide formation here because the syllable types created by glide formation, CVC in (16) and CGVC in (17), are both tolerated in Squliq.

If the input contains two identical vowels, coalescence is observed, as shown below.

(18) Coalescence: identical vowels

/pnbu$_1$-u$_2$n/	OK-σ	ONSET	OCP-PLACE	DEP-IO-C	MAX-IO-V	UNIFORMITY-IO	V-NUC
a. pə.nə.bu.un		*!					
b. pə.nə.bwun			*!				*
☞ c. pə.nə.bu$_{1,2}$n						*	
d. pə.nə.bu$_2$n					*!		
e. pə.nə.bu.ʔun				*!			

The relatively high-ranked OCP-PLACE blocks the occurrence of gliding (18b) because it involves a glide-vowel sequence that is identical in place features. The coalescence candidate (18c), which violates the second lowest constraint in the hierarchy, is instead chosen as the output. The interactions of the constraints are again similar to those in the analysis of Isbukun coalescence.

The crucial difference between Squliq and Isbukun lies in the cases where a stem-final vowel is followed by a –VC suffix that begins with a vowel lower in sonority.

The tableau (19) below illustrates that although the input contains adjacent non-identical vowels, gliding does not take place in Squliq as in the case of Isbukun. Instead, the grammar winnows out the coalescence candidate.

(19) Coalescence: falling-sonority sequences followed by a consonant

/soja$_1$-u$_2$n/	OK-σ	ONSET	OCP-PLACE	DEP-IO-C	MAX-IO-V	UNIFORMITY-IO	V-NUC
a. sɨ.ja.un		*!					
b. sɨ.jawn	*!						*
☞ c. sɨ.jon						*	
d. sɨ.jun					*!		
e. sɨ.ja.ʔun				*!			

As shown by tableau (19), although the gliding candidate (b) violates the lower-ranked constraint V-NUC and the coalescence candidate (c) violates the relatively higher-ranked UNIFORMITY-IO, (b) loses to (c) by simultaneously invoking a violation of OK-σ. Given the input configuration in (19), OK-σ plays a crucial role in ruling out the choice of gliding; in contrast, the same OK-σ does not block gliding in the cases of different input forms such as those in (16) and (17). That is, the OT analysis proposed here suggests that whether gliding or coalescence takes place to modify a vowel cluster crucially depends on whether the modification process would result in a permitted syllable type in the language.

Recall that words with a similar configuration in Isbukun, such as /tupa-un/ [tupawn], favor the gliding candidate. Unlike OK-σ in Squliq that rules out CVGC, OK-σ in Isbukun tolerates both CGVC and CVGC, so the ranking UNIFORMITY-IO >> V-NUC leads to the choice of [tupawn] rather than *[tupon]. Notice that adding the undominated OK-σ to all the illustrating tableaux for Isbukun does not change the choices of optimal candidates. The apparent inertness of OK-σ in Isbukun constraint tables does not mean that syllables do not play a role in deciding the ways to modify a vowel cluster in the language. Instead, the seeming irrelevance is due to the fact that Isbukun permits a wider variety of syllable shapes. Through a comparison of Squliq and Isbukun, the role of syllables in resolving vowel clusters becomes clear in the two languages: Isbukun allows for the occurrence of gliding in any non-identical vowel sequences because OK-σ tolerates CGVC/CVGC, in which the complex nuclei GV/VG could be of any combination of vocalic elements except homorganic ones, while Squliq blocks gliding if it would lead to *CVGC because of a more stringent OK-σ requirement.

4. A comparison between Isbukun Bunun and Squliq Atayal: summary and discussion

The patterns of how Isbukun and Squliq handle vowel clusters can be summarized in the following table:

(20)   Isbukun v.s. Squliq

	$V_1 \neq V_2$ in features				$V_1 = V_2$ in features	
	$V_1 \leqq V_2$ in sonority		$V_1 > V_2$ in sonority			
	–V suffix	–VC suffix	–V suffix	–VC suffix	–V suffix	–VC suffix
Isbukun	gliding	gliding	gliding	gliding	coalescence	coalescence
Squliq	gliding	gliding	gliding	coalescence	coalescence	coalescence

As shown by the table, the two languages are similar to a great extent in terms of how adjacent vowel clusters are resolved: both employ gliding and coalescence, and the two strategies occur in complementary environments. When the adjacent vowels are alike, coalescence takes place in both languages regardless of whether the vowel sequence is created through a –V or a –VC suffix. When the vowels are non-identical, both languages adopt gliding except in cases where a falling sonority sequence is introduced through a –VC suffix. Similarity in segmental features is a key factor in determining the ways to resolve vowel clusters.

The paper suggests that the differences between Isbukun and Squliq lie in the shapes of the syllables that incorporate the stem-final segments and the suffix material. Gliding cannot take place in Squliq when the vowel of a –VC suffix forms a falling sonority sequence with the preceding vowel because the language does not permit *CVGC syllables; coalescence instead occurs since it avoids the creation of *CVGC. In contrast, Isbukun permits CVGC, so the language adopts the strategy of glide formation as long as the adjacent vowels are non-identical.

In the proposed OT analyses of Isbukun and Squliq, the similarities between the two languages are captured by the use of the same set of constraints and constraint rankings, and their differences are due to the fact that OK-σ permits different types of syllables in the two languages. A rule-based analysis of the data would be much less explicit in stating the similarities and differences because generalizations in rules are based on input configurations. The gliding and coalescence rules in Isbukun and Squliq can be formulated as below:

(21) A rule-based analysis of the Isbukun data:[21]

a. Gliding: [+syl, +high, α Features] → [-syl] / $\left\{\begin{array}{l}\text{[+syl, -α Features]} \underline{\quad} \\ \underline{\quad} \text{[+syl, -α Features]}\end{array}\right\}$

b. Coalescence:
   Structural description: [+syl, α Features]…[+syl, α Features]
   $\qquad\qquad\qquad\qquad\qquad\qquad$ 1 $\qquad\qquad\qquad$ 2
   Structural change: 1 and 2 merge

(22) A rule-based analysis of the Squliq data:

a. Gliding: [+syl, +high, α Features] → [-syl] / $\left\{\begin{array}{l}\text{[+syl, -α Features]} \underline{\quad} \text{]}_\sigma \\ \underline{\quad} \text{[+syl, -α Features] (C)]}_\sigma\end{array}\right\}$

b. Coalescence:
   i. Structural description: [+syl, α Features]…[+syl, α Features]
       $\qquad\qquad\qquad\qquad\qquad\qquad$ 1 $\qquad\qquad\qquad$ 2
       Structural change: 1 and 2 merge
   ii. Structural description: [+syl, -high]…[+syl, +high] C]$_\sigma$
       $\qquad\qquad\qquad\qquad\qquad\qquad$ 1 $\qquad\qquad\qquad$ 2
       Structural change: 1 and 2 merge

Although the rules above (especially (22)) are similar to the OT analyses in referring to the concept of syllables and thus equally express the idea that both gliding and coalescence are syllabically-conditioned, they suffer from a number of shortcomings. First of all, in the analysis of Squliq, the occurrence of coalescence has to be stated in two separate environments, one referring to identical vowels and the other to a falling sonority sequence in a closed syllable; it is unclear why coalescence must take place in

---

[21] Notice that given a non-identical high vowel sequence without a following consonant (i.e. /iu/ and /ui/), both the analyses in (21) and (22) give rise to two possible output forms: [ju]~[iw] for /iu/ and [uj]~[wi] for /ui/. The proposed OT analyses for Isbukun and Squliq, similarly, do not favor either of the two variants for both /iu/ and /ui/ sequences. Such ambiguity is actually desirable for the Isbukun data because speakers vary between the two pronunciations and both vowels in the /iu, ui/ sequences belong to the nucleus based on evidence from stress assignment (H. Huang 2005c). However, it seems that word-final /iu/ and /ui/ sequences in Squliq are better transcribed as [iw] and [uj] (rather than [ju] and [wi]), respectively, if we adopt the assumption that Squliq content words end with a consonant in the phonological output. If Squliq word-final non-identical high vowels indeed should be transcribed as the vowel-glide sequences [iw] and [uj], the rule-based analysis (22) would have to assume crucial ordering between the two branches of (22a) (i.e., the upper branch precedes and bleeds the lower one), and a high-ranked constraint demanding final consonants would need to be posited for the OT analysis.

the two environments. The OT analysis, in contrast, motivates the two separate environments for coalescence via the high ranking constraints OCP-PLACE and OK-σ, the former stating a common restriction on features of adjacent segments and the latter on syllable types, neither of which is made up specifically for the phenomenon of coalescence.

Second, the coalescence rule in Squliq (22b,ii) affects only those closed syllables with a falling sonority profile while the structural description of the gliding rule in (22a) excludes just such a configuration; the complementarity of the two environments appears coincidental in the rule-based analysis. Such complementarity is expected in the OT analysis since the ranking ONSET >> V-NUC and the undominated status of OK-σ mean that glide formation occurs to avoid onsetless syllables except when gliding would create an illegitimate syllable.

Moreover, the subtle differences in the structural descriptions of the gliding and coalescence rules for Isbukun and Squliq, e.g. the lack of coda consonants in (21) and their existence in (22), appear arbitrary in the rule-based analyses while they are actually correlated with the generalizations that Isbukun allows both CGVC/CVGC while Squliq prohibits CVGC. The absence of coda consonants in the structural description of Isbukun rules gives rise to the effect that the occurrence of gliding or coalescence is solely conditioned by the qualities of adjacent vowels, which is unobstructed by syllable structure constraints because the language tolerates all types of two-slot complex nuclei created by gliding, except homorganic sequences. In the rules for Squliq, the presence of a coda consonant technically ensures that coalescence only applies to sequences of nonhigh-high vowels before a true consonant coda, which in fact suggests that the motivation of coalescence is to avoid CVGC syllables. While the similarities between Isbukun and Squliq are manifested in the rule-based analysis by the structural specification of non-identical features in gliding and identical features in coalescence in both languages, how their differences are correlated with syllables is better captured in the OT analysis through the high-ranking OK-σ.

In the tableaux of the proposed OT analysis, OK-σ stands for a set of constraints on syllable wellformedness. Since Isbukun and Squliq are different in the inventories of permitted syllable types, an ensuing question is how OK-σ is decomposed into the basic constraints on the make-up of a syllable in the two languages. As mentioned in the background description of Isbukun Bunun, the language prohibits complex syllable margins, which means that *COMPLEX(Ons) and *COMPLEX(Cod) are undominated. The fact that Isbukun allows up to two segments in the nucleus suggests that *COMPLEX(Nuc) is relatively low-ranked; for example, the constraint must rank lower than MAX-IO-V so that input vowels would not be deleted to avoid complex nuclei. Squliq is similar to Isbukun in disallowing complex syllable margins, so *COMPLEX(Ons) and *COMPLEX(Cod)

are also undominated. *COMPLEX(Nuc) must be relatively lower-ranked too, because onglides are considered as part of the nucleus, based on the pattern that onglides and the nucleus vowels weaken together in pre-penultimate positions (H. Huang 2005b). The low ranking status of *COMPLEX(Nuc), however, does not account for why CGVC is legitimate but CVGC is not. The ban on CVGC syllables is presumably due to a sequence constraint against falling-sonority vowel-glide sequences (*VG) (H. Huang 2005a) ranking above *COMPLEX(Nuc).[22] The ranking of *VG above *COMPLEX(Nuc) in Squliq rules out CVGC but not CGVC syllables. Notice that the ranking between *VG and *COMPLEX(Nuc) must be just the opposite in Isbukun (*COMPLEX(Nuc) >> *VG), which explains why the two languages tolerate different types of syllable nuclei.[23]

5. Conclusion

This paper has tried to show the similarities and differences in how vowel sequences are handled in Isbukun Bunun and Squliq Atayal. Their similarities are most clearly seen when stem-final vowels are followed by a suffix composed of a single vowel: non-identical vowel clusters undergo gliding and identical vowels undergo coalescence. The occurrence of both gliding and coalescence in a single language to avoid an onsetless syllable is captured by the ranking OCP-PLACE, ONSET >> UNIFORMITY-IO >> V-NUC in the proposed OT analysis. The lowest-ranked V-NUC implies that the language adopts glide formation to satisfy the onset requirement unless gliding simultaneously invokes a violation of some other high ranked constraint, in this case OCP-PLACE. Under duress of OCP-PLACE, glide formation is blocked when the adjacent vowels are identical in features; in such cases coalescence is instead observed, which violates the second lowest constraint UNIFORMITY-IO.

In the proposed analyses, the differences in how Isbukun and Squliq deal with vowel clusters are correlated with the permitted syllable types of the two languages.

---

[22] The *VG constraint is in turn dominated by an ANCHORING constraint that protects the segment at the right edge of a word from changes, which accounts for the absence of non-final offglides and the presence of final offglides in the Squliq dialect under investigation.

[23] The constraint ONSET also contributes to the content of OK-σ; it is separated from OK-σ in the tableaux simply to highlight the fact that in both languages the onset requirement motivates the occurrence of gliding/coalescence. What segments are allowed to appear in a certain position within syllables is also important in the description of syllable wellformedness. For example, in Squliq, /b r z g/ appear only in prevocalic position (Egerod 1966:122), and syllable-initial glides are banned when they precede weak or homorganic vowel nuclei (H. Huang 2004). This type of constraint is omitted from discussion here because it is the constraints on the possible number of segments within syllables that are more relevant for the data.

Syllable peaks in Isbukun allow up to two vocalic elements of any combination (except homorganic ones), so glide formation, the primary strategy to deal with vowel clusters, occurs in both rising- and falling-sonority sequences. In contrast, Squliq disallows CVGC syllables, so gliding is prohibited when it would lead to falling-sonority sequences [aj, aw] before a true consonant coda. The analysis captures the correlation between syllables and the occurrence of gliding/coalescence by recognizing the undominated OK-σ in the constraint hierarchies of both languages and allowing it to interact with other lower constraints. While OK-σ in Isbukun would not interfere with the choice of gliding as predicted by the ranking UNIFORMITY-IO >> V-NUC because the language tolerates a wider variety of complex nuclei, OK-σ in the analysis of Squliq rules out the gliding candidate when glide formation would yield the illegitimate configuration CVGC, and in such cases the coalescence candidate therefore wins. The proposed analysis shows that in the two languages the strategies to deal with vowel sequences depend not only on the segmental features of the adjacent vowels but also on prosody.

It is also shown that the correlation between the permitted syllable types and the occurrence of either gliding or coalescence cannot be easily captured in a rule-based analysis that characterizes the conditioning environments based on input configurations. An input-oriented analysis for the set of data presented here would necessarily involve discrete statements of the conditioning environments of gliding/coalescence, which obviate the motivations for these phonological processes. The differences in the ways that vowel clusters are resolved in Isbukun and Squliq depend upon whether they would result in a legitimate type of syllable, and the correlation can be explicitly expressed in a framework that allows direct interactions of syllabic constraints and segmental modifications.

References

Casali, Roderic F. 1997. Vowel elision in hiatus contexts: which vowel goes? *Language* 73.3:493-533.

Cheng, Ju Chang (錢玉章). 2001. *A Phonological Perspective of Phonetic Symbolic System of Atayal: The Case of Tausa*. Hsinchu: National Hsinchu Teachers College MA thesis. [In Chinese]

Egerod, Søren. 1965. Verb inflexion in Atayal. *Lingua* 15:251-282.

Egerod, Søren. 1966. A statement on Atayal phonology. *Essays offered to G. H. Luce: By His Colleagues and Friends in Honor of His 75th Birthday*, Vol. 1, ed. by Ba Shin, 120-130. Artibus Asiae Supplementum 23. Ascona: Artibus Asiae.

Egerod, Søren. 1980. *Atayal-English Dictionary*. Scandinavian Institute of Asian Studies Monograph Series No. 35. London and Malmö: Curzon Press.

He, Ru-fen, Si-qi Zeng, Wen-su Li, and Qing-chun Lin. 1986. *An Outline of the Formosan Native Languages (Bunun)*. Series of the Minority Languages in China No. 31. Beijing: Minzu. [In Chinese]

Huang, Hui-chuan J. 2003. Competition between syllabic and metrical constraints in two Bunun dialects. Paper presented at the 15th North American Conference on Chinese Linguistics. East Lansing: Michigan State University. To appear in *Linguistics*.

Huang, Hui-chuan J. 2004. The avoidance of high-sonority onset in Squliq Atayal. Paper presented at the 11th Annual Meeting of the Austronesian Formal Linguistics Association. Berlin: Centre for General Linguistics, Typology, and Universals Research (ZAS).

Huang, Hui-chuan J. 2005a. On syllable nuclei in Squliq Atayal. Paper presented at the 12th Annual Meeting of the Austronesian Formal Linguistics Association. Los Angeles: Department of Linguistics, University of California at Los Angeles.

Huang, Hui-chuan J. 2005b. Squliq Atayal syllable onset: simple or complex? Paper presented at the First Theoretical Phonology Conference. Taipei: National Chengchi University.

Huang, Hui-chuan J. 2005c. On the status of onglides in Isbukun Bunun. *Concentric* 31.1:1-20.

Huang, Lillian M. 1993. *A Study of Atayal Syntax*. Taipei: Crane.

Huang, Lillian M. 1994. Ergativity in Atayal. *Oceanic Linguistics* 33.1:129-143.

Huang, Lillian M. 1995. *A Study of Mayrinax Syntax*. Taipei: Crane.

Huang, Lillian M. 1997. Isbukun Bunun in Kaohsiung County. *Formosan Languages in Kaohsiung County*, 351-410. Kaohsiung County Documents Series No. 7. Kaohsiung: Kaohsiung County Government. [In Chinese]

Huang, Lillian M. 2000a. *A Reference Grammar of Atayal*. Formosan Language Series No. 1. Taipei: Yuanliu. [In Chinese]

Huang, Lillian M. 2000b. Verb classification in Mayrinax Atayal. *Oceanic Linguistics* 39.2:364-390.

Jeng, Heng-hsiung. 1977. *Topic and Focus in Bunun*. Institute of History and Philology, Special Publication No. 72. Taipei: Institute of History and Philology, Academia Sinica.

Jeng, Heng-syung. 1999. Bunun tense and aspect. *Selected Papers from the Eighth International Conference on Austronesian Linguistics*, ed. by Elizabeth Zeitoun and Paul Jen-kuei Li, 455-487. Taipei: Institute of Linguistics, Academia Sinica.

Kager, René. 1999. *Optimality Theory*. Cambridge: Cambridge University Press.

Lambert, Wendy Mae. 1999. *Epenthesis, Metathesis, and Vowel-Glide Alternation: Prosodic Reflexes in Mabalay Atayal*. Hsinchu: National Tsing Hua University MA thesis.

Li, Paul Jen-kuei. 1977. Morphophonemic alternations in Formosan languages. *Bulletin of the Institute of History and Philology, Academia Sinica* [*BIHP*] 49.1:375-413.

Li, Paul Jen-kuei. 1980. The phonological rules of Atayal dialects. *BIHP* 51.2:349-405.

Li, Paul Jen-kuei. 1981. Reconstruction of Proto-Atayalic phonology. *BIHP* 52.2: 235-301.

Li, Paul Jen-kuei. 1982a. Linguistic variations of different age groups in the Atayalic dialects. *Tsing Hua Journal of Chinese Studies*, New Series 14.1-2:167-191.

Li, Paul Jen-kuei. 1982b. Male and female forms of speech in the Atayalic group. *BIHP* 53.2:265-304.

Li, Paul Jen-kuei. 1985. Linguistic criteria for classifying the Atayalic dialect groups. *BIHP* 56.4:699-718.

Li, Paul Jen-kuei. 1987. The preglottalised stops in Bunun. *A World of Language: Papers Presented to Prof. S. A. Wurm on His 65th Birthday*, ed. by Donald C. Laycock and Werner Winter, 381-387. Pacific Linguistics C-100. Canberra: Department of Linguistics, Research School of Pacific Studies, The Australian National University.

Li, Paul Jen-kuei. 1988. A comparative study of Bunun dialects. *BIHP* 59.2:479-508.

Li, Paul Jen-kuei. 1995. The case-marking system in Mayrinax Atayal. *BIHP* 66.1: 23-52.

Li, Paul Jen-kuei. 1997. Isbukun Bunun in Hsinyi Township, Nantou County. *Formosan Languages in Kaohsiung County*, 300-350. Kaohsiung County Documents Series No. 7. Kaohsiung: Kaohsiung County Government. [In Chinese]

Lin, Hsiu-hsu. 1995. Syllable structure of Bunun: evidence from Tumpu Isbukun. *Proceedings from the First Symposium of Native Austronesian Languages on*

Taiwan, ed. by Paul Jen-kuei Li and Ying-chin Lin, 333-346. Taipei: Committee on Research and Education Development, Ministry of Education.

Lin, Hsiu-hsu. 1996. *Isbukun Phonology: A Study of Its Segments, Syllable Structure and Phonological Processes*. Hsinchu: National Tsing Hua University MA thesis.

Lin, Tai, Si-qi Zeng, Wen-su Li, and Bukun Ismahasan. 2001. *A Study on the Morphology of Isbukun Bunun*. Taipei: Ducewenhua. [In Chinese]

McCarthy, John, and Alan Prince. 1993. *Prosodic Morphology I: Constraint Interaction and Satisfaction*. Manuscript.

McCarthy, John, and Alan Prince. 1995. Faithfulness and reduplicative identity. *Papers in Optimality Theory*, ed. by Jill N. Beckman, Laura Walsh Dickey, and Suzanne Urvanczyk, 249-384. University of Massachusetts Occasional Papers 18. Amherst: GLSA, University of Massachusetts.

Nojima, Motoyasu. 1996. Lexical prefixes of Bunun verbs. *Gengo Kenkyu* 110:1-27.

Pater, Joe. 1999. Austronesian nasal substitution and other NC effects. *The Prosody Morphology Interface*, ed. by René Kager, Harry van der Hulst, and Wim Zonneveld, 310-343. Cambridge: Cambridge University Press.

Prince, Alan, and Paul Smolensky. 1993. *Optimality Theory: Constraint Interaction in Generative Grammar*. Manuscript. Printed by Malden: Blackwell, 2004.

Rau, Der-hwa Victoria. 1992. *A Grammar of Atayal*. Ithaca: Cornell University dissertation. Printed by Taipei: Crane, 1992.

Rau, Der-hwa Victoria. 2000. Phonological variation and sound change in Atayal. *Oceanic Linguistics* 39.1:144-156.

Rosenthall, Sam. 1994. *Vowel/Glide Alternation in a Theory of Constraint Interaction*. Amherst: University of Massachusetts at Amherst dissertation. Printed by New York: Garland, 1997.

Rosenthall, Sam. 1997. The distribution of prevocalic vowels. *Natural Language and Linguistic Theory* 15.1:139-180.

Rubach, Jerzy. 2000. Glide and glottal stop insertion in Slavic languages: a DOT analysis. *Linguistic Inquiry* 31.2:271-317.

Yamada, Yukihiro, and Ying-chu Liao. 1974. A phonology of Atayal. *Research Reports of the Kochi University* 23.6:109-117.

Yeh, Marie Meili. 2000. Reduplication in Bunun and Saisiyat. *Taiwan Humanities* 5:359-384. Taipei: Research Center for Humanistic Education, National Taiwan Normal University. [In Chinese]

Yip, Moira. 1993. Cantonese loanword phonology and Optimality Theory. *Journal of East Asian Linguistics* 2.3:261-291.

Zeitoun, Elizabeth. 2000. *A Reference Grammar of Bunun*. Formosan Language Series No. 5. Taipei: Yuanliu. [In Chinese]

Graduate Institute of Linguistics
National Tsing Hua University
101, Sec. 2, Kuang-fu Road
Hsinchu 300, Taiwan
hcjhuang@mx.nthu.edu.tw

元音串的處理：
郡社布農語與賽考利克泰雅語的比較分析

黃慧娟

國立清華大學

　　本文檢視布農語郡社方言與泰雅語賽考利克方言如何處理因後綴加插而導致的元音串，探討其相似與相異之處，並提出理論上的分析。雖然這兩個台灣南島語言在音位及節律特色等方面頗有差異，在元音串的處理上，它們卻一致採滑音形成及元音融合兩種策略，不同之處僅在於滑音形成及元音融合發生的語音環境條件。本文認爲這樣的差異其實和這兩個語言所允許的音節型態息息相關，文中並進一步闡述，相較於傳統衍生音韻學的架構中將陳述規律的重點放在音韻規則發生前的語音組合，以表層制約爲基本機制的架構，例如優選理論，比較能夠直接捕捉音節型態與元音串處理方式的關連性。

關鍵詞：音節韻核，元音並列，滑音形成，元音融合，優選理論