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VOWEL HIATUS RESOLUTION IN KAVALAN*

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ABSTRACT

This paper examines how vowel hiatus is handled in Kavalan, an endangered Formosan plains tribe language spoken by fewer than one hundred people on the eastern coast of Taiwan. Based on first-hand data, this paper shows that Kavalan is a language that typically disallows vowel sequences. Vowel hiatus is mainly resolved by gliding, but deletion occurs if the adjacent vowels are identical. While Kavalan generally disallows vowel hiatus, a low-high vowel sequence is tolerated before the word-final coda. The paper argues that the reason vowel hiatus unexpectedly occurs in such position is to prevent a post-vocalic vowel from gliding in a stressed syllable.

Key words: Kavalan, vowel hiatus, gliding, deletion, Optimality Theory

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1. INTRODUCTION

Languages may differ in how they handle vowel hiatus. Some languages may allow vowel hiatus to occur freely, others may completely prohibit it, still others may tolerate it only in limited circumstances. For languages that do not permit the free occurrence of vowel hiatus, strategies like gliding, coalescence, vowel deletion, and consonant insertion may be adopted to resolve vowel hiatus (Casali 1997, Rosenthall 1994, 1997).

This paper is concerned with how vowel hiatus is handled in Kavalan, an endangered Formosan plains tribe language spoken by fewer than one hundred people on the eastern coast of Taiwan (Chang 2000, Li 2007). There have been a number of studies of Kavalan, including Blust (2003), Chang (1997, 2000, 2005), Chang and Lee (2002), Chang and Tsai (1998), Hsieh (2007), Jiang (2006), Lee (1997, 2007, 2009, 2010), Li (1978, 1982, 1996:55-162, 2007), Li and Tsuchida (2006), Li and Wu (2000), Liao (2002, 2004), D. Lin (2006), H. Lin (2012), J. Lin (1996), Shen (2005), and Tsai (1997). However, unlike other Formosan languages such as Bunun, Atayal, Paiwan, Thao, Tsou, and Amis (Y. J. Chen 2011; Huang 2002, 2006; C. Tseng 2009; Wu 2002, 2003; Yeh 2011), the way in which vowel sequences are dealt with in Kavalan has not been examined in detail. Though Chang (2000) and Li and Tsuchida (2006) have briefly addressed the issue, there is currently no consensus as to whether vowel hiatus is allowed in Kavalan.

Chang (2000) mentions two phonological processes that are related to vowel sequences, one involving the deletion of one of the adjacent identical vowels (e.g., /bur**a-a**n/ > [bur**a**n] 'give (PF)[1]{Chang 2000:52}), the other involving the change of high vowels into glides when adjacent to another vowel (e.g., /quni p**a i**su/ > [quni p**aj**su]) 'Where are you going?' {Chang 2000:51}). The two phonological processes have clearly taken place to repair vowel sequences, entailing that surface vowel sequences are not allowed in Kavalan. Furthermore, the list of Kavalan canonical root forms given in Chang (2000:48) (which includes V, CV,

[1] The glosses in the paper make use of the following abbreviations: AF 'agent-focus'; PF 'patient focus'; NAF 'non-agent-focus'; sg 'singular'; Imp 'imperative'; Nom 'nominative'.

CVC, VCVC, CVCVC, CVCCVC, CVCVCVC, CVCVCVCVC, and CVCVCCVCVCV) also supports the assumption that Kavalan does not permit vowel hiatus since none of the root forms contain adjacent vowels. Though both the phonological processes and the list of Kavalan root forms in Chang suggest that Kavalan does not tolerate vowel hiatus, words containing surface vowel sequences can still be found in Chang. For example, one of the words given in Chang, *b**au**t* 'fish' {Chang 2000:47}, contains a [a.u] sequence. The reason why the high vowel [u] does not surface as [w] after the vowel [a] is left unexplained.

Li and Tsuchida (2006:6) also recognize a general identical vowel deletion rule that deletes one of the adjacent identical vowels (e.g., /qman t**i** **i**ku/ > [qman t**i**ku] 'I have eaten' {Li and Tsuchida 2006:6}). But unlike Chang, Li and Tsuchida consider Kavalan to allow non-identical vowel sequences, which include /ai/, /au/, /iu/, /ia/, /ua/, /ui/ and /aə/, to surface. Accordingly, the high vowels /i/ and /u/ should be allowed to occur freely next to a (non-identical) vowel on the surface. However, examples involving the gliding of high vowels can still be found in Li and Tsuchida (e.g., /m**a**-**i**nep/ > [m**aj**nep] 'sleep' {Li & Tsuchida 2006:108}). No discussion has been given to explain why gliding takes place in these examples.

Obviously, it remains unclear how vowel hiatus is manifested in Kavalan. Therefore, this paper aims to re-examine how vowel sequences are handled in the language. Based on first-hand data, this paper shows that Kavalan does not permit vowel hiatus in general. Vowel sequences are mainly repaired by gliding; but elision takes place when adjacent vowels are identical. There is, however, one situation in which a vowel sequence is tolerated. A low-high vowel sequence (i.e., a sequence containing a low vowel followed by a high vowel) is allowed to surface before the word-final coda. The post-vocalic high vowel could have undergone gliding. The paper argues that the reason vowel hiatus unexpectedly appears in such position is to prevent a post-vocalic vowel from gliding in the stressed syllable.

The rest of the paper is organized as below. Section 2 provides a brief background on Kavalan. Section 3 provides generalizations as to how vowel hiatus is handled in Kavalan. Section 4 provides an analysis of the observed generalizations based on Optimality Theory (Prince and

Smolensky 1993/2004, McCarthy and Prince 1993). Section 5 concludes the paper.

2. BACKGROUND ON KAVALAN

Kavalan has four vowels /i, u, ə, a/ and the following 16 consonants (Li 1982, J. Lin 1996, Chang 2000).

(1) Consonants of Kavalan

	Bilabial	Alveolar	Palatal	Velar	Uvular	Glottal
Stop	P	t		k	q	ʔ
Fricative	β	s z			ʁ	
Lateral Fricative		ɬ				
Nasal	m	n		ŋ		
Flap		ɾ				
Glide			j	w		

In the research literature on Kavalan, the glides /j, w/ are considered phonemes because there is a contrast between /a.i/ and /aj/ and /a.u/ and /aw/ in the language, for example /kn**a.u**/ 'earring' vs. /kn**aw**/ 'onion' and /m**a.i**/ 'not exist' vs. /ʔm**aj**/ 'rice (cooked)' (cf. Li and Tsuchida 2006:4).[2] Words in Kavalan must start and end with a consonant; if no underlying consonant is present, a glottal stop is inserted (Li 1982:481, Li and Tsuchida 2006:2). For example: /amiɬ/ → [**ʔ**amiɬ] 'bell', /sanu/ → [sanu**ʔ**] 'to speak'. Kavalan does not permit a surface consonant cluster at the syllable edge; a weak vowel [ɨ̯] is inserted between the consonant clusters (Li and Tsuchida 2006:4). For example, /qman/ → [q**ɨ̯**man] 'to eat'.[3] Stress in Kavalan predictably falls on the word-final syllable in the language. For example, [ʔamíɬ] 'bell'.

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[2] The surface forms of /kna.u/ 'earring', /ma.i/ 'not exist', and /ʔmaj/ 'rice (cooked)' are [ki̯na.uʔ], [ma.iʔ], and [ʔi̯maj], respectively, because Kavalan does not permit consonant clusters at syllable margins nor words ending (and starting) with a vowel.

[3] The requirement for the presence of consonants in the word-initial and the word-final positions, as well as the presence of a gliding vowel between consonant clusters, can be

3. VOWEL HIATUS RESOLUTION

Given that there are four vowels /i, u, ə, a/ in Kavalan, there are 16 possible combinations, including four identical vowel sequences /ii, uu, əə, aa/ and 12 different vowel sequences; among the 12 different vowel sequences, six involve the mid vowel *ə* /iə, əi, uə, əu, aə, əa/ and six are without *ə* /iu, ui, ai, ia, au, ua/. Nonetheless, not all of the 16 combinations exist in the language because the distribution of /ə/ is defective. As Li (1996:59) points out, unlike the other vowels, /ə/ seldom occurs in the word-initial or word-final position. /ə/ also cannot combine freely with another vowel. The only possible sequence involving /ə/, according to Li (1982, 1996) and Li and Tsuchida (2006), is /aə/ (note that not even the reverse combination /əa/ is possible). In Li and Li and Tsuchida, /aə/ is considered to be one of the possible vowel sequences, in

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accounted for by the constraint ranking ||ONSET, FINAL-C, *CC >> DEP-IO||, as illustrated in (5) (cf. H. Lin 2012).

(1) FINAL-C: A word must end with a consonant.
(2) ONSET: Syllables must have onsets.
(3) *CC: Consonant clusters in syllable margins are prohibited.
(4) DEP-IO: Output segments have input correspondents.
(5)

a. /amił/ → [ʔamił] 'bell'

/amił/ 'bell'	ONSET	FINAL-C	*CC	DEP-IO
☞a. ʔa.mił				*
b. ʔa.miłʔ			*!	**
c. a.mił	*!			

b. /sanu/ → [sanuʔ] 'to speak'

/sanu/ 'to speak'	ONSET	FINAL-C	*CC	DEP-IO
☞a. sa.nuʔ				*
b. ʔsa.nuʔ			*!	**
c. sa.nu		*!		

c. /qman/ → [qi̯man] 'to eat'

/qman/ 'to eat'	ONSET	FINAL-C	*CC	DEP-IO
☞a. qi̯man				*
b. qman			*!	

addition to /ai/, /au/, /iu/, /ia/, ua/, and /ui/. However, whether /aə/ exists is questionable. In the literature, only three examples containing the sequence are given; i.e., /p**aə**n/ 'bait' {Li 1982: 288; Li 1996:60; Li and Tsuchida 2006:4}, /β**aə**ŋ/ 'ditch' {Li 1982:288; Li 1996:60}, and /ʁaŋʁ**aə**ŋ/ 'moan' {Li 1982:288}. Interestingly, however, they are listed without /ə/ in the Kavalan Dictionary compiled by Li and Tsuchida (2006); that is, /p**a**nn/ 'bait' {Li and Tsuchida 2006:223}, /β**a**ŋŋ/ 'ditch' {Li and Tsuchida 2006:77}, and /məʁaŋŋ**a**ŋŋ/ 'moan' {Li and Tsuchida 2006:343} (though the last item is also listed as /məʁaŋŋ**aə**ŋ/ 'moan' with /aə/ on another page in the dictionary {Li and Tsuchida 2006:179}). Though the dictionary also contains three words with the /aə/ sequence (i.e., /**aə**n/ 'yes', /kaβaɬ**aə**n/ 'place name', and /məʁaŋŋ**aə**ŋ/ 'to moan, groan, as in pain'), they are all pronounced without /ə/ by my consultants (i.e., [**a**n], [kə.βa.ɬ**a**n], and [mə.ʁaŋ.ŋ**a**ŋ]). Notice that all of the examples containing /aə/ as listed in the literature are morpheme-internal. Therefore, the underlying form that corresponds to the output [a] (in my consultants' speech) could either be the sequence /aə/ (as assumed in Li 1982, 1996, and Li and Tsuchida 2006) or just a plain /a/; if it is the former case, there will be a deletion rule deleting /ə/ from the sequence. An examination of how a /aə/ sequence generated through morpheme concatenation is handled can help clarify how such a sequence is modified morpheme-internally. Unfortunately, due to the defective distribution of /ə/, no such sequence is generated through morpheme concatenation.

The discussion above shows that it is hard to determine whether the /aə/ sequence exists or not. Therefore, the present paper chooses not to address how such a sequence is handled in Kavalan. This leaves us nine combinations, three identical vowel sequences, /ii, uu, aa/, and six non-identical vowel sequences, /iu, ui, ai, ia, au, ua/.

Based on first-hand data,[4] the following two subsections describe the data and discuss how these vowel sequences are manifested within and across morphemes in Kavalan, respectively.

Due to the limitation of space, the discussion of the morpheme-external vowel sequences is limited to suffix-induced ones.

3.1 Morpheme-Internal Vowel Sequences

Examples containing underlying vowel sequences that are internal to morphemes are examined here. Relevant examples are given in (2) ~ (4). (2) contains a low-high vowel sequence in the underlying representation. As the examples show, gliding applies to resolve vowel hiatus, turning the post-vocalic high vowels into glides. Thus, /ai/ and /au/ surface as [aj] and [aw], respectively. The surface glides in (2) are considered as being derived from underlying vowels (also referred to as derived glides, as opposed to underlying/phonemic glides) in the present paper. However, since glides are phonemic in Kavalan, the surface glides in (2) may also be analyzed as underlying glides rather than as derived ones. While the examples in (2a~d) are ambiguous, the surface glides in (2e) and (2f) are clearly derived from vowels. (2e) and (2f) are examples involving reduplication. In the examples, the [aj] and [aw] sequences internal to the reduplicants (double underlined in the examples) have to be derived from vowel sequences since they correspond to [ai] and [au] in the corresponding bases.[5]

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[4] The data is based on the Hsinshe (新社) dialect of Kavalan spoken in Hsinshe Village, Fengbin Township, Hualien County gathered between October 2013 and June 2014. I am grateful to my Kavalan consultants below, especially my main consultant Sameg Engi, for their help with the language data.

1. Ariung (朱武雄, male, born in 1940)
2. Jiang Qiu-ying (江秋英, female, born in 1946)
3. Pan Jin-rong (潘金榮, male, born in 1944)
4. Pan Wu-ji (潘烏吉, female, born in 1931)
5. Sameg Engi (林阿份, female, born in 1941)
6. Ukit (潘金英, female, born in 1944)

[5] Notice that gliding fails to take place to resolve the vowel sequences in the bases of (2e) and (2f). That is, [mə.ki.-saj.~sa.iz] 'dance (of a spirit during a healing ritual)', and [su-βaw~βa.ut] 'stink (of fish)'. As will be shown in §3.3, Kavalan tolerates vowel

(2) Underlying low-high vowel sequence repaired by gliding

a.	/kap**ai**sinan/	[ka.p**aj**.si.nan]	‘a place name. It is said to bring disease for a Kavalan’
b.	/p**ai**zan/	[p**aj**.zan]	‘grains machine’
c.	/sak**au**san/	[sa.k**aw**.san]	‘a tool to scoop earth’
d.	/kin**au**sa/	[ki.n**aw**.sa]	‘two people’
e.	/məki-s**ai**~saiz/	[mə.ki.-s**aj**.~sa.iz]	‘dance (of a spirit during a healing ritual)’
f.	/su-β**au**~βaut/	[su-β**aw**~βa.ut]	‘stink (of fish)’

(3) and (4) are examples containing vowel sequences that start with a high vowel in the underlying representation. The examples in (3) are composed of a high-low vowel sequence and those in (4) are composed of a non-identical-high-vowel sequence. In both types of examples, gliding is also employed to resolve vowel hiatus, changing the pre-vocalic high vowels into glides. Thus, /ia/ and /ua/ surface as [ja] and [wa] in (3) and /iu/ and /ui/ are realized as [ju] and [wi] in (4).[6]

(3) Underlying high-low vowel sequence repaired by gliding

a.	/kz**ia**nan/	[kɨ̯.z**ja**.nan]	‘Venus’
b.	/βaɾβaɾ**ia**n/	[βaɾ.βa.ɾ**ja**n]	‘place where the wind is blowing all the time’
c.	/maβq**ia**t/	[maβ.q**ja**t]	‘to split off’
d.	/mas**ua**t/	[ma.s**wa**t]	‘to get up’
e.	/paq**ua**ɬ/	[pa.q**wa**ɬ]	‘to fine’
f.	/βn**ua**j/	[βɨ̯.n**wa**j]	‘kite’

sequences before the word-final coda. This explains why vowel sequences can surface unchanged in the base, but have to undergo gliding in the reduplicant.

[6] When the underlying vowel sequence is composed of non-identical high vowels, it is not entirely clear which vowel has undergone gliding since both vowels have the same vowel height and thus similar sonority. For example, the output form of /iu/ could be either [ju] or [iw]. The present paper assumes that it is the left vowel that has undergone gliding for the reasons to be given shortly in §3.4.

(4) Underlying non-identical-high-vowel sequence repaired by gliding

a.	/pan**iu**san/	[pa.n**ju**.san]	'fishing rod'
b.	/mn**iu**s/	[mɨ̯.n**ju**s]	'to whistle'
c.	/taɾz**iu**n/	[taɾ.z**ju**n]	'a single bar to swing with'
d.	/mt**iu**/	[mɨ̯.t**ju**ʔ]	'a female ritual functionary qualified to perform the death ritual'
e.	/siŋ**ui**t/	[si.ŋ**wi**t]	'to blow one's nose'
f.	/mβ**ui**q/	[mɨ̯.β**wi**q]	'to blossom'
g.	/mʁ**ui**n/	[mɨ̯.ʁ**wi**n]	'to give birth to a child'
h.	/maqz**ui**/	[maq.z**wi**ʔ]	'from there'

The surface glides in (3) and (4) are considered as derived glides rather than as surface glides for the reason that in deliberate speech, (when my consultants are asked to pronounce each words slowly), an underlying VV sequence is produced as VGV (i.e., [**i**.j**a**], [**u**.w**a**], [**i**.j**u**] and [**u**.w**i**]), with two clearly identifiable vowels, separated by a homorganic glide, as illustrated in (5) and (6).[7] The fact the underlying VV sequence surfaces with V.GV rather than V.V in deliberate speech

[7] Variation between GV (in normal speech) and VGV (in deliberate speech) is also observed across the morpheme boundary, as exemplified below. Deliberate speech is a speech variant. This paper will focus on normal (non-deliberate) speech.

(1)			Deliberate speech	
a.	/pamsi-an/	[pam.sjan]	[pam.si.jan]	'stab with spear (PF) '
b.	/qmaɾini-an/	[qɨ̯.ma.ɾi.njan]	[qɨ̯.ma.ɾi.ni.jan]	'turn around (PF) '
c.	/βuki-an/	[βu.kjan]	[βu.ki.jan]	'untie (PF) '
d.	/panmu-an/	[pan.mwan]	[pam.mu.wan]	'help (PF) '
e.	/paqawtu-an/	[pa.qaw.twan]	[pa.qaw.tu.wan]	'bring (PF) '
f.	/paʁu-an/	[pa.ʁwan]	[pa.ʁu.wan]	'embrace (PF) '

(2)			Deliberate speech
a.	/mŋatu-ika/	[mɨ̯.ŋa.twi.kaʔ]	[mɨ̯.ŋa.tu.wi.kaʔ] 'hold a ceremony (NAF Imp)'
b.	/kɬaβu-ika/	[kɨ̯.ɬa.βwi.kaʔ]	[kɨ̯.ɬa.βu.wi.kaʔ] 'get married (NAF Imp)'
c.	/qi-kɬamɬamu-ika/	[qi.kɨ̯.ɬam.ɬa.mwi.kaʔ]	[qi.kɨ̯.ɬam.ɬa.mu.wi.kaʔ] 'catch fire flies (NAF Imp)'

also suggests that onset is preferred in Kavalan, even if it can lead to unfaithful input-output correspondence.

(5) Underlying high-low vowel sequence surfacing with two identifiable vowels in deliberate speech

			Deliberate speech	
a.	/kz**ia**nan/	[kɨ̯.z**ja**.nan]	[kɨ̯.z**i.ja**.nan]	'Venus'
b.	/βaɾβaɾ**ia**n/	[βaɾ.βa.ɾ**ja**n]	[βaɾ.βa.ɾ**i.ja**n]	'place where the wind is blowing all the time'
c.	/maβq**ia**t/	[maβ.q**ja**t]	[maβ.q**i.ja**t]	'to split off'
d.	/mas**ua**t/	[ma.s**wa**t]	[ma.s**u.wa**t]	'to get up'
e.	/paq**ua**ɬ/	[pa.q**wa**ɬ]	[pa.q**u.wa**ɬ]	'fine'
f.	/βn**ua**j/	[βɨ̯.n**wa**j]	[βɨ̯.n**u.wa**j]	'kite'

(6) Underlying non-identical-high-vowel sequence surfacing with two identifiable vowels in deliberate speech

			Deliberate speech	
a.	/pan**iu**san/	[pa.n**ju**.san]	[pa.n**i.ju**.san]	'fishing rod'
b.	/mn**iu**s/	[mɨ̯.n**ju**s]	[mɨ̯.n**i.ju**s]	'to whistle'
c.	/taɾz**iu**n/	[taɾ.z**ju**n]	[taɾ.z**i.ju**n]	'a single bar to swing with'
d.	/mt**iu**/	[mɨ̯.t**ju**ʔ]	[mɨ̯.t**i.ju**ʔ]	'a female ritual functionary qualified to perform the death ritual'
e.	/siŋ**ui**t/	[si.ŋ**wi**t]	[si.ŋ**u.wi**t]	'to blow one's nose'
f.	/mβ**ui**q/	[mɨ̯.β**wi**q]	[mɨ̯.β**u.wi**q]	'to blossom'
g.	/mʁ**ui**n/	[mɨ̯.ʁ**wi**n]	[mɨ̯.ʁ**u.wi**n]	'to give birth to a child'
h.	/maqz**ui**/	[maq.z**wi**ʔ]	[maq.z**u.wi**ʔ]	'from there'

Here above we have shown how underlying vowel sequences with non-identical members are manifested in Kavalan. Morpheme-internally, underlying vowel sequences containing identical members are rare, if they exist. Nine words containing such a sequence are listed in Li (1996), but the same words are listed with a single vowel in the Kavalan Dictionary, for example, /ʁ**ii**s/ 'mosquito', /p**uu**q/ 'penult', and /ʁ**aa**k/ 'wine' given in Li (1996: 60) are listed as /ʁ**i**s/ (Li and Tsuchida 2006:352), /p**u**q/ (Li and Tsuchida 2006:232), and /ʁ**a**k/ (Li and Tsuchida 2006:341) in the dictionary. As it is unclear whether identical vowel sequences exist morpheme-internally, we will wait until the next subsection to see how identical vowel sequences are handled in the language.

3.2 Suffix-induced Vowel Sequences

Morpheme concatenation may also result in vowel sequences. For instance, a vowel-initial suffix attaching to a vowel final stem will produce a vowel sequence. Morpheme-external vowel sequences may be handled differently from morpheme-internal ones and, therefore, require additional investigation. Take Bunun for instance. Huang (2002) points out that while a high vowel adjacent to another vowel normally undergoes gliding morpheme-internally (e.g., /mind**ia**ʔ/ > [mind**ja**ʔ] 'pick' {Huang 2002:447}) gliding does not take place when a high vowel ending stem is followed by a vowel-initial suffix (e.g., /sisil**i-a/ >** [sisil**ia**], *[sisil**ja**] 'mimic (AF Imp)' {Huang 2002:452}). According to Huang, such an unexpected vowel sequence is due to the final stress in Bunun. The final syllable of the non-suffixed form is stressed (i.e., sisil**í)**. Even though it is no longer stressed after suffixation, it remains syllabic for the sake of paradigm uniformity, (i.e., sisil**iá**). The unexpected vowel sequence derived through morpheme concatenation, according to Huang (2002:458), is accounted for by the domination of IDENT-BA-σ́, which requires the stressed vowel in the base to stay as a vowel in the output, over ONSET, which bans vowel hiatus.

Just as in Bunun, stress in Kavalan also falls on the last syllable (e.g., ki̭bar**á**n 'self-appellation, Kavalan'). However, unlike Bunun, the final stress in the un-suffixed form in Kavalan does not give rise to surface vowel sequences.[8] (7) and (8) contain high-vowel ending stems followed by suffixes that begin with non-identical vowels while (9) involves high-vowel-initial suffixes that attach to stems ending with low vowels.[9] In all of the examples, gliding takes place on the high vowels, regardless of whether the high vowels are stressed in the un-suffixed form (as in 7 and 8) or not (as in 9), suggesting that IDENT-BA-σ́ does not outrank ONSET in Kavalan.

(7) Suffix-induced high-low vowel sequence repaired by gliding

	Stem	Affixed form		
a.	[pam.s**í**ʔ]	/pams**i**-**a**n/	[pam.s**já**n]	'stab with a spear (PF) '
b.	[qḭ.ma.ɾi.n**í**ʔ]	/qmaɾin**i**-**a**n/	[qḭ.ma.ɾi.n**já**n]	'turn around (PF) '
c.	[βu.k**í**ʔ]	/βuk**i**-**a**n/	[βu.k**já**n]	'untie (PF) '
d.	[pan.m**ú**ʔ]	/panm**u**-**a**n/	[pan.m**wá**n]	'help (PF) '
e.	[pa.qaw.t**ú**ʔ]	/paqawt**u**-**a**n/	[pa.qaw.t**wá**n]	'bring (PF) '
f.	[pa.ʁ**ú**ʔ]	/paʁ**u**-**a**n/	[pa.ʁ**wá**n]	'embrace (PF) '

(8) Suffix-induced non-identical-high-vowel sequence repaired by gliding

	Stem	Affixed form	
a.	[mḭ.ŋa.t**ú**ʔ]	/mŋat**u**-**i**ka/	[mḭ.ŋa.t**wi**.káʔ]
		'hold a ceremony (NAF Imp)'	
b.	[kḭ.ła.β**ú**ʔ]	/kłaβ**u**-**i**ka/	[kḭ.ła.β**wi**.káʔ]
		'get married (NAF Imp)'	
c.	[qi.-kḭ.łam.ła.m**úʔ**]	/qi-kłamłam**u**-**i**ka/	[qi.kḭ.łam.ła.m**wi**.káʔ]
		'catch fire flies (NAF Imp)'	

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[8] Prefixation may also result in vowel hiatus. This paper focuses on suffix-induced vowel sequences only due to the limitation of space.

[9] The suffixes in the data given here include /-an/ '(PF marker)', /-ika/ '(NAF Imp)', and /-iku/ '(1st person sg. Nom).

(9) Suffix-induced low-high vowel sequence repaired by gliding

	Stem	Affixed form		
a.	[ʔi.z**á**ʔ]	/iz**a-i**ka/	[ʔi.z**aj**.káʔ]	'use it (NAF Imp)'
b.	[qa.ła.łu.n**á**ʔ]	/qałałun**a-i**ka/	[qa.ła.łu.n**aj**.káʔ]	'be diligent (NAF Imp)'
c.	[ʁa.p**á**ʔ]	/ʁap**a-i**ka/	[ʁa.p**aj**.káʔ]	'measure with one's hand (NAF Imp)'

The discussion above also shows that non-identical vowel sequences are repaired identically within and across morpheme, through gliding.

During suffixation, a vowel final stem may be followed by an identical vowel. In Kavalan, suffixes may start with /a/ (e.g., /-an/ 'PF marker') or /i/ (e.g., /-ika/ 'NAF Imp), but not /u/. Therefore, /a.a/ and /i.i/ sequence may be induced during suffixation. When this happens, one of the identical vowels is deleted, as illustrated in (10).[10]

(10) Identical vowel sequence repaired by deletion

a.	/mɾaz**a-a**n/	[mɨ̯.ɾa.z**a**n]	'bother (PF) '
b.	/saquŋ**a-a**n/	[sa.qu.ŋ**a**n]	'lie (PF) '
c.	/βur**a-a**n/	[βu.r**a**n]	'give (PF) '
d.	/ʁaziz**i-i**ka/	[ʁa.zi.z**i**.kaʔ]	'come closer (NAF Imp)'
e.	/pasazu**i-i**ka/	[pasasu**i**ka]	'go over there (NAF Imp)'
f.	/saʔis**i-i**ku/	[saʔis**i**ku]	'make wine (1st person sg. Nom)'

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[10] Alternatively, it can be analyzed as involving coalescence, in which two underlying vowels are merged in the output. A coalescence analysis is more abstract and, therefore, requires additional evidence. Take Bunun for instance. Huang (2006:5-6) argues that identical vowel sequences are repaired by coalescence rather than deletion in Isbunkun Bunun (e.g., /$tu_{\mu}tu^{1}_{\mu}$-$u^{2}_{\mu}n$/ → [$tu_{\mu}tu^{1,2}_{\mu\mu}n$]) because only the coalescence analysis can explain why the stress, which typically falls on the penultimate syllable, lands on the last syllable in the examples (e.g., [$tu_{\mu}.tú^{1,2}_{\mu\mu}n$], *[$tú_{\mu}.tu^{1,2}_{\mu\mu}n$]). Take Squliq Atayal as another example. Huang (2006:12) also adopts a coalescence analysis for identical vowel sequences since a coalescence analysis better conforms to the pre-penultimate vowel reduction rule in Squliq Atayal. Kavalan lacks evidence from stress assignment or other phonological processes to support the coalescence analysis. Therefore, the paper adopts the more straightforward analysis of vowel deletion.

3.3 Unexpected Surface Vowel Sequences

The examples above show that Kavalan does not permit either morpheme-internal or morpheme-external vowel hiatus. There are, however, exceptions, as illustrated in (11).

(11) Unexpected low-high vowel sequence on the surface

a.	/β**ai**n/	[β**a.i**n]	*[β**aj**n]	'a type of sea crab'
b.	/p**ai**z/	[p**a.i**z]	*[p**aj**z]	'a fan'
c.	/ɾ**ai**n/	[ɾ**a.i**n]	*[ɾ**aj**n]	'wave in the open sea'
d.	/q**au**s/	[q**a.u**s]	*[q**aw**s]	'shoulder strap'
e.	/**au**ɬ/	[ʔ**a.u**ɬ]	*[ʔ**aw**ɬ]	'a type of shark'
f.	/**au**n/	[ʔ**a.u**n]	*[ʔ**aw**n]	'female name'

In (11), vowel sequences surface unexpectedly. All of the examples with unexpected vowel sequences are composed of a low-high vowel sequence on the surface. These examples should be compared with those in (2), which have the same low-high vowel sequence in the underlying representation. For ease of reference, the examples in (2) are repeated below in (12). Just as in (11), the examples in (12) are also composed of a low-high vowel sequence underlyingly; but they surface as VG as expected, after gliding has taken place on the post-vocalic high vowel. A comparison of (11) and (12) reveals that while the post-vocalic high vowels in (11) are followed by a coda consonant, those in (12) are not. Therefore, the reason gliding fails to take place in (11) may be to prevent a GC sequence from occurring at the syllable margins. That is, /CVVC/ → *[CV**GC**].

(12) Underlying low-high vowel sequence repaired by gliding normally

a.	/kap**ai**sinan/	[ka.p**aj**.si.nan]	'a place name. It is said to bring disease for a Kavalan'
b.	/p**ai**zan/	[p**aj**.zan]	'grain machine'
c.	/məki-**sai**~saiz/	[mə.ki.-**saj**.~sa.iz]	'dance (of a spirit during a healing ritual)'
d.	/sak**au**san/	[sa.k**aw**.san]	'a tool to scoop earth'
e.	/kin**au**sa/	[ki.n**aw**.sa]	'two people'
f.	/su-**βau**~βaut/	[su-**βaw**~βa.ut]	'stink (of fish)'

Nonetheless, the generalization fails to explain why vowel sequences surface in (13). All of the examples in (13) end with a high vowel in the underlying representation. They surface with a glottal coda because words in Kavalan have to end with a consonant (cf. §2). Therefore, for the inputs in (13), while *GC can still easily rule out output forms such as *[β**ajʔ**], *[ɬ**ajʔ**], *[m**ajʔ**], it fails to reject forms such as *[β**aj**], *[ɬ**aj**], *[m**aj**], which involve the simple gliding of the word-final high vowel. These unattested output forms do not contain the un-favored sequence and cannot be ruled out by *GC. *GC falls short in explaining why gliding cannot occur in (13).

(13) *GC fails to explain the unexpected vowel hiatus

a.	/β**ai**/	[β**a.i**ʔ]	*[β**aj**]	'grandmother'
b.	/ɬ**ai**/	[ɬ**a.i**ʔ]	*[ɬ**aj**]	'a type of seashell'
c.	/m**ai**/	[m**a.i**ʔ]	*[m**aj**]	'not exist'

Another possible explanation for the unexpected vowel hiatus in (11) and (13) is word minimality. Word minimality sets a minimum length for the size of a word and requires a word to be minimally disyllabic/ bimoraic. In Kavalan, word minimality does play a role since most of Kavalan content words are minimally disyllabic; monosyllabic words are generally limited to function words such as grammatical markers and pronouns (Chang 2000:48). Word minimality could be the reason for surface vowel hiatus. Take Bunun for instance, while a high-low vowel sequence in the language is usually repaired by gliding (e.g., /mad**ai**ŋ/ > [mad**aj**ŋ] 'give' {Huang 2002:447}), gliding fails to take place if it would result in words that are shorter than disyllabic (e.g., /h**ai**p/ > [h**a.i**p], *[h**aj**p] 'now' {Huang 2002:448}). The unexpected vowel hiatus, according to Huang (2002), is due to word minimality. Back to Kavalan, if we examine (11) and (13), which have surface vowel sequences, we can find that these examples are all disyllabic in the underlying representation. In other words, if gliding took place, the surface form would be shorter than disyllabic (e.g., /β**ai**/ → *[β**aj**ʔ] 'grandmother'). On the other hand, in all of the examples given above, where gliding has applied normally, there are always more than two syllables in the word. Therefore, word minimality may explain why gliding takes place in (12), but not in (11) or (13), since gliding will result in violation of word minimality in the latter, but not in the former.

Nonetheless, (14) shows examples whose underlying representations are longer than two syllables. Still, gliding fails to apply even if it will not cause the surface forms to violate word minimality. Therefore, word minimality still cannot be the cause of the unexpected vowel sequence on the surface.

(14) Word minimality cannot to explain the unexpected hiatus

a.	/pasatz**ai**/	[pa.sat.z**a.i**ʔ]	*[pa.sat.z**aj**]	'to cause to sing'
b.	/kzum**ai**/	[kɨ̯zu.m**a.i**ʔ]	*[kɨ̯zu.m**aj**]	'next year'

Closer examination of the examples in (11), (13) and (14), which contain unexpected vowel sequences, reveals something interesting—the unexpected vowel sequences all appear word-finally, or more precisely, before the word-final coda since every Kavalan word must end with a coda (cf. §2). Given that the surface vowel sequences are always composed of low-high vowel sequences and that high vowels are the target of gliding, the vowels that fail to undergo gliding in these examples are always the last vowel of the word. This finding is supported by the examples in (15), which show that when the surface vowel sequences are followed by suffixes and pushed away from word-final position, gliding will resume, changing the post-vocalic high vowels to glides.

(15) Post-vocalic vowel resumes to undergo gliding after suffixation

	Stem		Affixed form	
a.	/mŋ**au**/	[mɨ̯.ŋ**a.u**ʔ]	/mŋ**au**-iku/	[mɨ̯ŋ**aw**.wi.kuʔ]
	'to open one's mouth'		'I open my mouth'	
b.	/β**ai**/	[β**a.i**ʔ]	/β**ai**-an/	[β**aj**.jan]
	'grandmother'		'grandmother's house'	
c.	/m**ai**/	[m**a.i**ʔ]	/qam**ai**-an/	[qa.m**aj**.jan]
	'not exist'		'will not exist (PF)'	

3.4 Interim Summary

To summarize, Kavalan is a language that generally prohibits vowel hiatus. Vowel hiatus is repaired by two different strategies in two different kinds of environments. Vowel hiatus is mainly repaired by gliding unless when the vowel sequence is composed of identical vowels, in which case deletion occurs instead. Despite the fact that vowel hiatus is prohibited in general, Kavalan actually permits vowel hiatus to occur in a very limited situation. In Kavalan, vowel hiatus is tolerated before the word-final coda and is composed of a low-high vowel sequence.

Table 1. Repair strategies of vowel hiatus

Vowel Sequence	Repair Strategies		
	Deletion	Gliding	Not repaired
Identical vowels (e.g., /a.a/)	✓		
Low + **high** (e.g., /a.i/)		✓	✓ (before the word-final coda)
High + **low** (e.g., /i.a/)		✓	
High$_i$ + **high$_j$** (e.g., /i.u/)		✓	

Before ending this subsection, two more things are worth noting. First, here above, sequences involving non-identical high vowels in the underlying representation (i.e., /iu/ and /ui/) are considered as repaired by gliding the pre-vocalic, rather than the post-vocalic, vowel (e.g., /iu/

→ [**j**u], *[i**w**]), cf. examples in 4 and in 8). However, since both vowels have the same vowel height and thus similar sonority, it is not entirely clear which vowel has undergone gliding. For example, the output form of /iu/ could be [ju] or [iw]. There is a strong reason to assume it is the pre-vocalic vowel that has undergone gliding (e.g., /**i**u/ → [**j**u]) in the sequence. As mentioned, in deliberate speech, a homorganic glide appears to separate the high-low vowel sequence (e.g., /ua/ → [u.**w**a]). In deliberate speech, the same glide-insertion process is also found to separate a vowel sequence composed of two non-identical high vowels (e.g., /ui/ → [u.**w**i]), but no such process can be spotted when a sequence is composed of a low-high vowel sequence (e.g., /ai/ → [aj], *[a.**j**i]). Since a non-identical-high-vowel sequence patterns like a high-low vowel sequence in terms of glide insertion in deliberate speech, and since a high-low vowel sequence unambiguously involves pre-vocalic gliding in the normal speech, the present paper thus assumes that for non-identical-high-vowel sequences, it is also the pre-vocalic vowel that has undergone gliding (that is, /**i**u/ → [**j**u], /**u**i/ → [**w**i]).

Table 2. Non-identical-high-V sequences undergo prevocalic gliding

Vowel Sequence	**Glide Insertion (in deliberate speech)**	**Gliding Position (in normal non-deliberate speech)**
Low + high	×	post-vocalic
	e.g., /p**ai**zan/ → [p**aj**.zan] *[p**a.ji**.zan]	e.g., /p**ai**zan/ → [p**aj**.zan]
High + low	✓	pre-vocalic
	e.g., /mas**ua**t/ → [ma.s**u.wa**t]	e.g., /mas**ua**t/ → [ma.s**wa**t]
High$_i$ **+ high**$_j$	✓	pre-vocalic
	e.g., /siŋ**ui**t/ → [si.ŋ**u.wi**t]	e.g., /siŋ**ui**t/ → [si.ŋ**wi**t]

The pre-vocalic-gliding analysis for non-identical-high-vowel sequences also has the advantage of conforming to the generalization for the surface vowel hiatus. Recall that in Kavalan, a low-high vowel sequence is allowed to appear before the word-final coda, suggesting that the final vowel in Kavalan is restrained from gliding. Therefore, when the non-identical-high-vowel sequence occurs before the word-final coda, the rightmost vowel will stay intact under the pre-vocalic-gliding analysis (e.g., /siŋ**ui**t/ > [si.ŋ**wi**t]), conforming to the generalization. By contrast, a post-vocalic-gliding analysis will have the rightmost vowel will glided under the post-vocalic-gliding analysis (e.g., */siŋ**ui**t/ > [si.ŋ**uj**t]) glided, making the non-identical-high-vowel sequence an exception to the no-final-vowel-gliding generalization.

The second thing that is worth noting is that since Kavalan has phonemic glides and since a high vowel adjacent to another vowel normally undergoes gliding, the surface glides [j, w] will have two sources, the underlying glides /j, w/ and the underlying vowels /i, u/. A question that quickly arises is which is which? Fortunately, phonemic glides and derived glides pattern differently in Kavalan when followed by a vowel-initial suffix, which gives us a guideline in distinguishing between phonemic and derived glides. The examples below show that a surface glide before a vowel-initial suffix sometimes takes the role of onset, as in (16), and sometimes spans over the syllable boundaries, simultaneously being the coda and onset in the suffixed words, as in (17). The most plausible explanation for the variation could be that the surface glides in the two sets of examples are derived from different sources. Clearly, the surface glides in (17) are derived from vowels since they correspond to vowels in the un-suffixed forms. Therefore, the surface glides in (16) should be phonemic.[11]

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[11] The different patterning between phonemic and derived glides is by no means unique to Kavalan. The phenomenon is also observed in other languages such as Suliq Atayal (Huang 2014), Sinvaudjan Paiwan (Yeh 2011), and Sundanese and Karuk (Levi 2004, 2008).

(16) Phonemic glide

	Suffixed Form		**Stem**	
a.	/qiɾuz**aj-a**n/	[qi.ɾu.z**a.ja**n]	/qiɾuz**aj**/	[qi.ɾu.z**aj**]
	‘to harvest millet (PF)’			
b.	/puqat**iw-a**n/	[pu.qa.t**i.wa**n]	/puqat**iw**/	[pu.qa.t**iw**]
	‘to take something over (PF)’			
c.	/pasaβaβ**aw-i**ka/	[pa.sa.βa.β**a.wi**.kaʔ]	/pasaβaβ**aw**/	[pa.sa.βa.β**aw**]
	‘to raise (NAF Imp)’			

(17) Derived glide

	Suffixed Form		**Stem**	
a.	/pasatz**ai-a**n/	[pa.sat.z**aj.ja**n]	/pasatz**ai**/	[pa.sat.z**a.i**ʔ]
	‘to make someone sing (PF)’			
b.	/qip**au-a**n/	[qi.p**aw.wa**n]	/qip**au**/	[qi.p**a.u**ʔ]
	‘to pick plants’			
c.	/mŋ**au-i**ku/	[mɨ̯ŋ**aw.wi**.kuʔ]	/mŋ**au**/	[mɨ̯ŋ**a.u**ʔ]
	‘to open one’s mouth (1st person sg. Nom)’			

To capture the distinction between phonemic and derived glides, we follow Huang (2014) in assuming that phonemic and derived glides differ in the feature [voc]; phonemic glides are [-voc] just as other true consonants, while derived glides are [+voc] just as vowels.[12] In addition, we follow Levi (2008), McCarthy and Prince (1993:171), Orphão de Carvalho (2015), and Rubach (2000), among others, in assuming that derived glides and their corresponding vowels are identical by feature but differ in syllabificational (or moraic) status; a derived glide is parsed in the syllable margin, as opposed to a surface vowel, which is parsed in the syllable nucleus.[13] The phonological representations for surface vowels, derived glides, and phonemic glides in Kavalan are given below.

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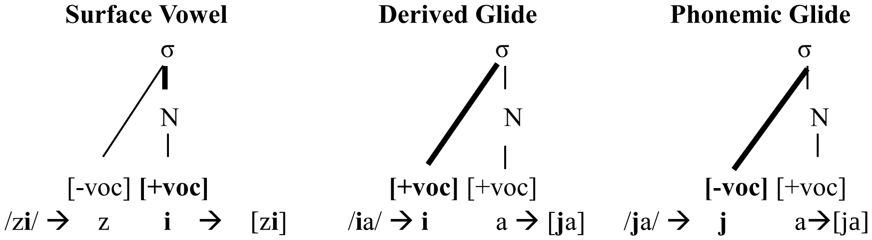
[12] Please refer to work such as Nevins and Chitoran (2008) and Padgett (2008) for arguments that vowels carry the feature of [+voc], as opposed to underlying glides which are specified with [-voc].

[13] A possible, but less common analysis, is to propose that a derived glide does not differ from a vowel in terms of syllabificational or moraic status and that a derivational glided is associated to the nucleus position, together with its adjacent vowel. Such analysis

(18)



4. AN OPTIMALITY THEORETIC ANALYSIS

4.1 Vowel Hiatus Resolved by Gliding and Deletion

This section provides an OT analysis of vowel hiatus resolution in Kavalan. Consider first the fact that Kavalan normally disallows vowel sequences and repairs them by gliding and deletion. That vowel sequences are not preferred is not surprising, since there is a universal tendency for syllables to start with onsets; vowel hiatus involves an onsetless syllable and violates the universal markedness constraint of ONSET. Gliding is the main strategy adopted in Kavalan. It takes place when a high vowel is adjacent to a non-identical vowel, turning it into a derived glide. Universally, a vowel is banned from being associated to syllable margins (onset or coda), as captured by the *M/V constraint (where M = Margin) as proposed in Prince and Smolensky (1993/2004). Derived glides, which are merely positional variants of vowels and carry

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would have two [+voc] segments occupying the nucleus position, violating *COMPLEX(NUC), and would usually require supporting evidence. Huang (2005) and Yeh (2011), for instance, have convincingly argued that derived glides in Isbukun Bunun and Sinvaudjan Paiwan are linked to the nucleus position, respectively, based on evidence from stress assignment in the two languages. Stress in both languages typically lands on the penultimate syllable, but when a word-final syllable contains a derived glide, stress is attracted to it, which is clear evidence that a derived glide is moraic and is associated to the nucleus position. But, no such evidence is available in Kavalan, since stress in Kavalan is word-final and is never affected by the presence of derived glides. Therefore, this paper simply assumes that a derived glide is linked to the syllable margin and that *COMPLEX(NUC) is dominant in the language.

[+voc] just as vowels do, should also be prevented from occurring at the the syllable margins. The constraint *M/[+voc] is proposed here to account for the fact. The gliding of a high vowel violates *M/[+voc] since it involves the parsing of a [+voc] segment to the syllable margin. As gliding is adopted in Kavalan to prevent vowel sequences, the ONSET constraint must dominate the *M/[+voc] constraint, as illustrated in Tableaux (1) and (2).

(19) ONSET: Syllables must have onsets.

(20) *M/[+voc]: [+vocalic] segments are prohibited from syllable margins. (Huang 2014, cf. Prince & Smolensky 1993/2004)

Tableau 1 ||ONSET >> *M/[+voc]|| predicts gliding for high-low vowel sequence

/masuat/ → [ma.swat] 'to get up'

/masuat/	ONSET	*M/[+voc]
a. ma.s**u.a**t	*!	
☞b. ma.s**wa**t		*

Tableau 2 ||ONSET >> *M/[+voc]|| predicts gliding for a low-high vowel sequence

/paizan/ → [paj.zan] 'grain machine'

/paizan/	ONSET	*M/[+voc]
a. p**a.i**.zan	*!	
☞b. p**aj**.zan		*

For non-identical vowel sequences, such sequences could well be repaired by the use of other strategies such as by deleting one of the vowels, by inserting a segment between the vowels, or by merging the two vowels. As none of these strategies is employed to resolve vowel hiatus in this environment, the constraints that these non-adopted strategies violate, i.e., MAX-IO, DEP-IO, and UNIFORMITY, must dominate the constraint that the adopted strategy violates, that is, *M/[+voc], as exemplified in Tableau (3).

(21) MAX-IO: No deletion of segments.

(22) UNIFORMITY-IO: An output segment cannot correspond to two input segments.

(23) DEP-IO: No epenthesis of segments

Tableau 3 ||MAX-IO, DEP-IO, UNIFORMITY-IO >> *M/[+voc]|| predicts that a high-low vowel sequence is repaired by gliding
/masuat/ → [ma.swat] 'to get up'

/masu$_i$a$_j$t/	ONSET	DEP-IO	UNIFORMITY-IO	MAX-IO	*M/[+voc]
a. ma.s**u**$_i$.**a**$_j$t	*!				
b. ma.s**u**$_i$.**ʔa**$_j$t		*!			
c. ma.s**o**$_{i,j}$t			*!		
d. ma.s**a**$_j$t				*!	
☞e. ma.s**wa**t					*

As Tableau (3) shows, when the two underlying vowels surface without change, as in candidate (a), ONSET is violated. Vowel hiatus can be resolved by strategies like insertion (candidate b), coalescence (candidate c), deletion (candidate d), or gliding (candidate e), each strategy violates one of the faithfulness constraints in the tableau. The domination of ONSET and the other faithfulness constraints over *M/[+voc] correctly predicts that gliding is the strategy adopted to modify the non-identical vowel sequence in Kavalan.

One more thing is worth noting before ending the analysis for gliding. In a sequence of non-identical high vowels (i.e., /iu/ and /ui/), it is assumed that the pre-vocalic one is glided, while the post-vocalic vowel is intact (e.g. /pan**iu**san/ → [pa.n**ju**.san], *[pa.n**iw**.san] 'fishing rod', cf. discussion in §3.4). But given the constraint ranking in Tableau (3), it is equally possible that the post-vocalic vowel is glided. Since the underlying vowel sequence surfaces as GV but not VG, VG has to be a less preferred structure in the language. In the GV sequence the pre-vocalic glide is parsed in the onset position, while in the VG structure , the post-vocalic glide is parsed in the coda position. Therefore, the preference for GV (pre-vocalic gliding) over VG (post-vocalic gliding) may be explained by NOCODA. Nonetheless, the use of the simple constraint of NOCODA to explain the dis-preference of post-vocalic gliding may be problematic. This is because, although the most canonical form of Kavalan, CVCVC, suggests that coda, which is required word-finally, is not preferred elsewhere, word-internal coda is not entirely absent (for example, *qa**r**.bu**q**.but* 'throb', *mu**l**.nap* 'to whisper', and *ku**m**.ret* 'icy'). Therefore, NOCODA should not be the reason for why post-vocalic gliding is not preferred. Both GV and VG involve the parsing of a [+voc] segment into a syllable margin, the former has [+voc] linked to the onset and the latter to the coda; therefore, a more plausible explanation for the dis-preference of the post-vocalic gliding is that VG not only has a marked structure of coda, but the coda is also associated with a [+voc] feature, which a syllable margin does not like to license. Since pre-vocalic gliding is preferred to post-vocalic gliding, parsing the [+voc] segment to onset, which is universally less marked than coda, must have cost less. Onset and coda obviously react differently with respect to the association of a [+voc] segment. Therefore, the *M/[+voc] proposed in (20) requires modification. Work such as Hammond (1999), Baertsch (2002), and Baertsch & Davis (2003), Smith (2004) has proposed that the margin structure constraint (i.e., *Margin/X or *M/X) can be further divided. For instance, Hammond (1999:44) splits *M/X into *ONSET/X and *CODA/X, which respectively requires that X not be an onset and coda. To explain the fact that a post-vocalic vowel is more likely to stay intact than a pre-vocalic one in Kavalan, the *M/[+voc] constraint is divided into *CODA/[+voc] and *ONSET/[+voc], with the former constraint dominating the latter, as illustrated in (26).

(24) *CODA/[+voc]: [+vocalic] segments are prohibited from the coda position.

(25) *ONSET/[+voc]: [+vocalic] segments are prohibited from the onset position.

(26) *CODA/[+voc] >> *ONSET/[+voc]
/pan**iu**san/ 'fishing rod'
[pa.n**ju**.san] > [pa.n**iw**.san]

The domination of *CODA/[+voc] over *ONSET/[+voc] captures the preference of the language for a post-vocalic vowel to stay intact. The ranking predicts that when vowels in adjacency are repaired, it will always be the pre-vocalic one that glides. However, in a low-high vowel sequence, it is the post-vocalic vowel that undergoes gliding. For example, in /paizan/ that contains a low-high vowel sequence, the /ai/ sequence is repaired by gliding the vowel /i/ (i.e., [p**aj**.zan]) rather than the vowel /a/ (i.e., *[p**ai̯**.zan]). Cross-linguistically, it is uncommon for gliding to take place on high sonority vowels, especially low vowels (Prince 1983; McCarthy and Prince 1993; Zec 1988; Rosenthall 1994, 1997). McCarthy and Prince (1993:172), for example, propose a constraint called a=VOWEL, which restricts the vowel /a/ to syllable nuclei, to capture the fact. Likewise, Rosenthall (1994, 1997) proposes the {A}=V constraint, which requires non-high vowels to be parsed in a nuclear position. To explain that /a/ is never glided to [a̯] in Kavalan, the present paper adopts the {A}=V constraint from Rosenthall.

(27) {A}=V: Non-high vowels must be parsed as nucleus. (Rosenthall 1997:50, Levi 2008:1962)

(28) {A}=V[14]
/paizan/ → [paj.zan] 'grain machine'
p**aj**.zan > p**ai̯**.zan

In a low-high vowel sequence, the fact that it is the post-vocalic vowel, which generally does not change, that glides shows that *CODA/[+voc] must be crucially dominated by {A}=V, which bans gliding of /a/ (compare candidate b with candidate d in Tableau 4). Notice that to prevent violating *CODA/[+voc] the post-vocalic vowel in

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[14] Notice that the correspondence of /a/ to common glides like [j] or [w] is suboptimal since that would cause /a/ to change not only structurally (linking to a syllable margin and violating {A}=V), but also featurally (/a/ → [j] changes the feature value of [high]).

the environment can, of course, remain intact or be deleted; the former will result in vowel hiatus, violating ONSET, while the latter will violate MAX-IO. Since neither strategy is adopted, *CODA/[+voc] must be dominated by ONSET (compare candidate a with candidate d) and MAX-IO (compare candidate c with candidate d).

Tableau 4 ||{A}=V, MAX-IO >> *CODA/[+voc]|| predicts that a low-high vowel sequence is repaired by the gliding of the post-vocalic vowel

/paizan/ → [paj.zan] 'grain machine'

/paizan/	ONSET	{A}=V	MAX-IO	*CODA/[+voc]
a. p**a.i**.zan	*!			
b. p**ai̯**.zan		*!		
c. p**a**.zan			*!	
☞d. p**aj**.zan				*

In sum, there is a general preference for the post-vocalic vowel to stay intact in the language. Gliding usually targets the vowel on the left-hand side, unless it is a low vowel /a/, which is too sonorous to glide.

The preceding discussion considers underlying sequences in which the adjacent vowels are not alike. In Kavalan, when the adjacent vowels are identical, deletion is employed instead. A question that quickly arises is as to why gliding does not take place to repair vowel sequences with identical members. The reason, as argued here, is that Kavalan does not allow a sequence of [+voc] segments with identical place features. Such sequence is cross-linguistically marked (Kawasaki 1982, Rosenthal 1994, Huang 2006) and is penalized by OCP-PLACE.

(29) OCP-PLACE: Sequences of [+voc] segments with identical place features such as [uu, wu, uw, ii, ji, ij, aa, a̯a, aa̯], are disallowed. (cf. Huang 2006:7)

Since the gliding of a vowel next to an identical vowel cannot escape the violation of OCP-PLACE, deletion takes place instead. The deletion of one of the identical vowels will incur a violation in MAX-IO. As gliding does not take place to repair sequences of identical vowels, the

OCP-PLACE constraint, which gliding violates, must outrank MAX-IO, which the attested strategy violates, as illustrated in Tableau (5).[15]

Tableau 5 ||OCP-PLACE >> MAX-IO|| predicts that an identical vowel sequence is repaired by deletion

/ʁazizi**-i**ka/ → [ʁa.zi.z**i**.kaʔ] 'come closer (NAF Imp)'

/ʁaziz**i-i**ka/	OCP-PLACE	MAX-IO
a. ʁa.zi.z**i.i.**kaʔ	*!	
b. ʁa.zi.z**ji.**kaʔ	*!	
☞c. ʁa.zi.z**i**.kaʔ		*

Furthermore, since an identical vowel sequence is repaired by deletion, rather than by other possible strategies, such as insertion or coalescence, MAX-IO must also be dominated by DEP-IO and UNIFORMITY-IO, as illustrated in Tableau (6).

Tableau 6 ||DEP-IO, UNIFORMITY-IO >> MAX-IO|| predicts an identical vowel sequence is not repaired by insertion or coalescence

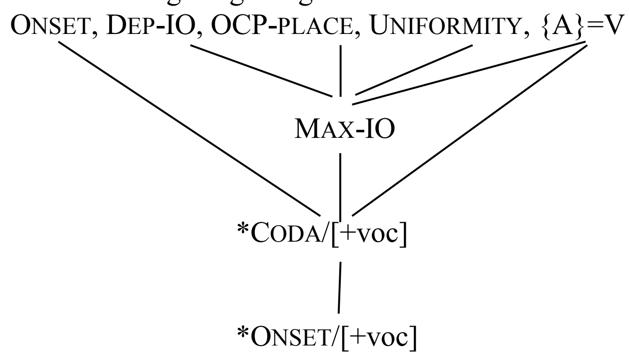
/βura-an/ →[βu.ran] 'give (PF)'

/βura$_i$-a$_j$n/	OCP-PLACE	DEP-IO	UNIFORMITY-IO	MAX-IO
a. βu.ra$_{i.}$-a$_j$n	*!			
b. βu.ra$_{i.}$**ʔ**a$_j$n		*!		
c. βu.r**a**$_{i,j}$t			*!	
☞d. βu.r**a**$_j$n				*!

In (30), we summarize the constraints proposed so far for the two repair strategies.

[15] Notice that for vowel sequences beginning with a high vowel, the deliberate speech, which has a homorganic glide inserted between the vowel (e.g., /pamsi-an/ → [pam.si.jan] 'stab with spear' (PF), cf. (5), (6)), will of course violate the OCP-constraint. But since it is a variant of speech, it may require a constraint ranking that is different from the normal (non-deliberate) speech. The discussion of how deliberate speech is analyzed within Optimality Theory does not lie within the scope of this paper.

(30) Constraint ranking for gliding and deletion



The domination of UNIFORMITY, and DEP-IO above MAX-IO and *M/[+voc] (including *CODA/[+voc] and *ONSET/[+voc]) means that vowel hiatus will be resolved by deletion and gliding rather than by other strategies such as insertion and coalescence. The occurrence of gliding and deletion in different environments follows from combining ||MAX-IO >> *M/[+voc]|| and ||OCP-PLACE >> MAX-IO||. The domination of MAX-IO over *M/[+voc] suggests that gliding is a preferred strategy to modify vowel hiatus. Deletion is employed only when adjacent vowels are identical.

4.2 Unexpected Vowel Hiatus

Now we shall consider the unexpected vowel sequences, which occur before the word-final coda. As mentioned, the unexpected vowel hiatus is always a low-high vowel sequence and the post-vocalic high vowel, which fails to undergo gliding, is always the rightmost vowel of the word. Since stress in Kavalan regularly falls *on* the last syllable, the reason why gliding fails to apply before the word-final coda could be to prevent gliding in the stressed syllable. However, gliding is not entirely prohibited in the stressed syllables. As shown in (31), pre-vocalic vowels undergo gliding regularly and appear in the stressed syllables. Post-vocalic vowels, on the other hand, never change in the stressed syllable (cf. 11, 13, 14).

(31) Pre-vocalic gliding appears in the stressed syllables

a.	/βaɾβaɾ**ia**n/	[βaɾ.βa.ɾ**já**n]	'a place where the wind blows all the time'
b.	/maβq**ia**t/	[maβ.q**já**t]	'to split off'
c.	/mas**ua**t/	[ma.s**wá**t]	'to get up'
d.	/paq**ua**ɬ/	[pa.q**wá**ɬ]	'to fine'
e.	/βn**ua**j/	[βɨ̯.n**wá**j]	'kite'
f.	/mn**iu**s/	[mɨ̯.n**jú**s]	'to whistle'
g.	/taɾz**iu**n/	[taɾ.z**jú**n]	'a single bar to swing with'
h.	/siŋ**ui**t/	[si.ŋ**wí**t]	'to blow the nose'
i.	/mβ**ui**q/	[mɨ̯.β**wí**q]	'to blossom'
j.	/mʁ**ui**n/	[mɨ̯.ʁ**wí**n]	'to give birth to a child'

In other words, in the stressed syllables, pre-vocalic vowels are more likely to glide than post-vocalic ones. Nonetheless, the preference for post-vocalic vowels to remain intact is not restricted to stressed syllables. It is also observed elsewhere in the language. As mentioned in §3.4, the general preference for the faithful parsing of a post-vocalic vowel is reflected by the fact that, when adjacent vowels are of equal sonority, it is the pre-vocalic vowel that undergoes change (e.g. /pan**iu**san/ → [pa.n**ju**.san], *[pa.n**iw**.san] 'fishing rod'). This is predicted by the constraint ranking of ||*CODA/[+voc] >> *ONSET/[+voc]|| (cf. 26).

However, even though the coda does not welcome [+voc] segments, outside the stressed syllable, post-vocalic gliding still has to take place outside the stressed syllable to avoid vowel hiatus when the pre-vocalic vowel cannot glide due to a higher demand (i.e., {A}=V), even if this means that a [+voc] segment will be licensed as a coda (e.g., /p**ai**zan/ → [p**aj**.zan] 'grain machine'). Nonetheless, within a stressed syllable, post-vocalic gliding never occurs, even if the pre-vocalic vowel cannot glide, resulting in vowel hiatus (e.g., /m**ai**/ → [m**a.i**ʔ] 'not exist'). Obviously, there is a ranking paradox between *CODA/[+voc] and ONSET. To ensure that ||*CODA/[+voc] >> ONSET|| holds inside the stressed syllable, while ||ONSET >> *CODA/[+voc]|| holds elsewhere, the *CODA/[+voc] constraint has to be given a σ́ counterpart, which should dominate ONSET, which in turn should dominate the general *CODA/[+voc] constraint in order to make an onsetless syllable possible only in a stressed syllable. That is, ||*CODA/[+voc]-σ́ >> ONSET >> *CODA/[+voc]||. Thus, the lack of gliding in the low-high vowel sequence before the final coda cannot be explained by the prominent nature of stress alone. It is caused by the combinational effect of stress and the general preference of the language for a post-vocalic vowel to stay as a vowel. As shown in Tableau (7), ranking *CODA/[+voc]-σ́, which resists post-vocalic gliding, above ONSET, which triggers gliding, can properly predict the lack of post-vocalic gliding in the stressed syllable.

(32) *CODA/[+voc]-σ́: Within a stressed syllable, a [+vocalic] segment is prohibited from the coda position.

Tableau 7 ||*CODA/[+voc]-σ́ >> ONSET|| predicts the surface of vowel hiatus before the word-final coda

/βai/ →[βaiʔ] 'grandmother'[16]

/βai/	*CODA/[+voc]-σ́	ONSET	*CODA/[+voc]
a. β**áj**	*!		*
b. β**áj**ʔ	*!		*
☞c. β**a.í**ʔ		*	

In Tableau (7), candidates (a) and (b) are ruled out because the derived [j], carrying [+voc], is parsed as a coda in the stressed syllable. The attested output candidate (c) surfaces with vowel hiatus to prevent the violation of the higher ranked constraint *M/[+voc]-σ́. The surface vowel sequence is the result of the domination of *M/[+voc]-σ́ over ONSET. Notice that the deletion of one of the vowels could satisfy both *CODA/[+voc]-σ́ and ONSET. The fact that such deletion does not take place shows that MAX-IO must dominate ONSET, as illustrated in (33). The domination of MAX-IO over ONSET also suggests that deletion is not used to repair vowel hiatus unless to prevent adjacent [+voc] segments with the same place features.

[16] Notice that a candidate that is pronounced the same as (b) [βájʔ], but has the post-vocalic glide linked to the nucleus position, does not violate *CODA/[+voc]-σ́; but it is rejected by the *COMPLEX(NUC) constraint, which is top-ranked in the language (cf. fn. 13).

(33) ||MAX-IO >> ONSET||
/βai/ → [βaiʔ] 'grandmother'
β**a.í**ʔ > β**á**ʔ

The *CODA/[+voc]-σ́ constraint is a positional markedness constraint that targets the stressed syllable. It has no function over unstressed syllables. Thus, gliding takes place outside the stressed syllable as a result of the constraint ranking ||ONSET >> *CODA/[+voc]||, as illustrated in Tableau (8).

Tableau 8 ||*CODA/[+voc]-σ́ >> ONSET|| does not prevent post-vocalic gliding outside the stressed syllable

/paizan/ → [paj.zan] 'grain machine'

/paizan/	*CODA/[+voc]-σ́	ONSET	*CODA/[+voc]
a. p**a.i**.zan		*!	
☞b. p**aj**.zan			*

Notice also that *CODA/[+voc]-σ́ will not prohibit a pre-vocalic vowel from gliding, as illustrated in Tableau (9), because the pre-vocalic vowel, when glided, is parsed as the onset, not the coda, of the stressed syllable.

Tableau 9 *CODA/[+voc]-σ́ does not prevent a pre-vocalic vowel from gliding

/masuat/ → [ma.swat] 'to get up'

/masuat/	*CODA/[+voc]-σ́	ONSET
a. ma.s**u.á**t		*!
☞b. ma.s**wá**t		

Similarly, *CODA/[+voc]-σ́ will not prohibit an underlying VG sequence from surfacing faithfully since the phonemic glide, though parsed in the coda position, carries [-voc], not [+voc].

Tableau 10 *CODA/[+voc]-σ́ allows a phonemic VG sequence to surface
/puqatiw/ → [pu.qa.tiw] 'to take something over'

/puqatiw/[17]	*CODA/[+voc]-σ́	ONSET
a. pu.qa.ti.**ú**ʔ		*!
☞b. pu.qa.t**íw**		

Finally, the constraint ranking also correctly predicts that when suffixation pushes the surface vowel sequence away from the right edge of the word and the domain of stress, gliding resumes to apply normally on the post-vocalic vowel, as illustrated in Tableau (11).

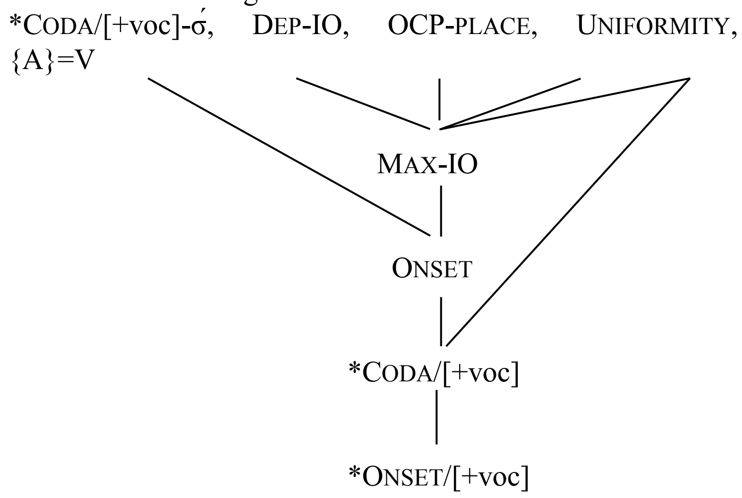
Tableau 11 ‖*CODA/[+voc]-σ́ >> ONSET >> *CODA/[+voc]‖ predicts gliding when the vowel sequences are pushed leftward
/βai-an/ →[βaj.jan] 'grandmother's house'

/βai-an/ Base: β**a.í**ʔ	*CODA/[+voc]-σ́	ONSET	*CODA/[+voc]
a. βa.**i.á**n		*!	
☞b. βa**j.já**n			*

The final constraint ranking proposed to account for Kavalan vowel hiatus is summarized in (34).

[17] The word-final glide [w] is considered as phonemic rather than derived because, when preceding a vowel-initial suffix, it is re-syllabified as the onset of the following syllable, for example, /puqatiw/ [pu.qa.tiw] → /puqatiw-an/ [pu.qa.ti.wan] 'to take something over (PF)' (cf. discussion in §3.4)

(34) The final constraint ranking for Kavalan vowel hiatus



In the proposed analysis, the surface vowel hiatus results from the combinational effect of stress and the general preference in the language for a post-vocalic vowel to stay intact. The analysis proposed properly explains why the surface vowel hiatus observed before the word-final coda is always a low-high vowel sequence. Due to the fact that *CODA/[+voc]-σ́ only prohibits post-vocalic gliding, a pre-vocalic vowel will undergo gliding whenever possible to prevent surface vowel hiatus. Therefore, when an underlying vowel sequence begins with a high vowel /i, u/, pre-vocalic gliding naturally takes place in the stressed syllable, just as it always does elsewhere. Consequently, surface vowel hiatus beginning with a high vowel is never found, not even within a stressed syllable. Nonetheless, in a stressed syllable, an underlying vowel sequence beginning with a low vowel /a/ can only surface with vowel hiatus because the pre-vocalic vowel /a/ cannot glide in the language.

5. CONCLUSION

This paper has examined how vowel hiatus is handled in Kavalan. Previous studies disagree with respect as to whether vowel sequences are permitted in Kavalan. Vowel hiatus is either considered as totally banned (Chang 2000) or free to occur (Li and Tsuchida 2006). Based on first-hand data, this paper argued that neither viewpoint is correct. This paper showed that Kavalan is a language that generally disallows vowel hiatus, but tolerates a low-high vowel sequence before the word-final coda. Away from the word-final position, vowel hiatus is mainly repaired by gliding, but deletion takes place when the adjacent vowels are identical. For an unexpected vowel hiatus, which is restricted to the word-final position, the stress in the language, which lands on the final syllable, is argued to play an important role. Since stressed syllables are phonologically prominent and well known to resist changes (Beckman 1995, 1997, 1998; Casali 1997; Lombardi 1999; Zoll 1997, 1998), the occurrence of vowel hiatus before, and only before, the word-final coda is thus derived naturally.

Since phonologically prominent positions tend to resist changes, these positions also tend to license more phonological contrasts. Non-prominent positions, on the other hand, usually license a less-marked subset of the full inventory of a language because they are more receptive to neutralization processes. In Kavalan, the distinction between vowel and glide adjacent to another vowel is neutralized outside the stressed syllable because the language prohibits onsetless syllables. Consequently, in an unstressed syllable, only glide is found post-vocalically (e.g., [aj], but not *[ai]); underlying vowels adjacent to a vowel automatically turn into glides or undergo deletion to avoid onsetless syllables. Stressed syllables, on the other hand, are resistant to change. Therefore, a post-vocalic vowel in a stressed vowel remains unmodified, even if it is marked as being onsetless. In a stressed syllable, the contrast between the vowel and glide post-vocalically is maintained (e.g., [**á**j] vs. [a.**í**]) as a consequence.

This paper has proposed an OT analysis to account for the lack of vowel hiatus away from the word-final position and for the existence of hiatus before the word-final coda. The domination of DEP-IO and UNIFORMITY over *M/[+voc] (including *ONSET/[+voc] and *CODA/[+voc]) and MAX-IO predicts that gliding and deletion, but not insertion and coalescence, are employed to repair vowel hiatus. The occurrence of gliding and deletion in different environments follows from combining ||MAX-IO >> *M/[+voc]|| and ||OCP-PLACE >> MAX-IO||. The domination of MAX-IO over *M/[+voc] predicts that gliding is a preferred strategy between the two to repair vowel hiatus. The domination of OCP-PLACE over MAX-IO, on the other hand, shows that deletion is employed when identical vowels are adjacent. In the case of the unexpected vowel hiatus before the word-final coda and the normal application of gliding elsewhere, such phenomenon can be accounted for by the constraint ranking ||*CODA/[+voc]-σ́ >> ONSET >> *CODA/[+voc]||. The domination of *CODA/[+voc]-σ́ over ONSET predicts that post-vocalic gliding is not allowed in the stressed syllable even if it will result in vowel hiatus. The domination of ONSET over *CODA/[+voc], on the other hand, predicts that gliding shall occur normally outside the stressed domain, even if it will result in the linking of a [+voc] segment to the coda position, which linking is not preferred in Kavalan.

In the paper, the lack of post-vocalic gliding in the stressed syllable is attributed to a positional markedness constraint. An equally plausible analysis for the lack of gliding in the stressed position may be to adopt a positional faithfulness constraint. Nonetheless, a positional faithfulness constraint that merely makes reference to the stress position will not work, because, even though post-vocalic gliding is absent in the stressed syllable, there is no restriction on the occurrence of pre-vocalic gliding. Since the post-vocalic vowel which is banned from gliding is the last vowel of the word, a positional faithfulness constraint that refers to the rightmost vowel may technically work, but it is conceptually problematic because the right edge is rarely the target of positional faithfulness cross-linguistically (Beckman 1998, Bye and de Lacy 2000, Cohn and McCarthy 1994:50, Nelson 1998, 2003).[18] Even if a positional

[18] A right edge positional faithfulness constraint does not conform to the phenomena of edge asymmetries. Several researchers have pointed out that phonological materials tend to resist changing at the left, but not at the right edge of a constituent. Cohn and McCarthy (1994:50), for instance, note that alignment constraints that refer to the right edge are restricted. Similar asymmetry can be found in Beckman (1998) who proposes faithfulness constraints that refer to the left, but not the right, edge of a constituent. Likewise, Nelson (1998, 2003) argues that anchoring constraints may apply to heads, left edges or both edges, but never to the right edge of a constituent. Bye and deLacy (2000) even propose that no constraint of any kind may refer to the right edge of a constituent.

faithfulness constraint can finally deal with the lack of post-vocalic gliding before the word-final coda, it is likely to miss out the generalization that the gliding of post-vocalic vowels is not preferred in places other than the word-final position. The proposed analysis acknowledges the generalization and proposes that the surface vowel hiatus before the word-final coda occurs as the result of a combinational effect of stress and of the general tendency for a post-vocalic vowel to preserve its vowel-hood.

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噶瑪蘭語元音串修補策略

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本文深究噶瑪蘭語元音串修補策略。為避免零聲母音節，噶瑪蘭語基本上不允許表層有元音串。底層有元音相鄰時，噶瑪蘭語採取滑音化以及元音刪減兩種修補策略。然而某些字組在表層型式中卻有元音相鄰的情形。本文認為元音修補策略的例外情形，是為了避免位於重音節有表層滑音連結到韻尾的情形。最後，本文以優選理論架構來捕捉元音修補策略及其例外情形與信實制約（MAX-IO）和音韻制約（ONSET，{A}=V，*ONSET/[+voc]，*CODA/[+voc] *CODA/[+voc]-σ́）之互動情形。

關鍵詞：噶瑪蘭語、元音修補策略、表層元音串、優選理論