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On the Status of Onglides in Isbukun Bunun*

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This paper examines the internal evidence for the syllabic affiliation of onglides in Isbukun Bunun, a Formosan language spoken in southern Taiwan. It is shown that although the phonotactics of the onglides and the neighboring elements does not provide crucial evidence for the status of the glides, postconsonantal onglides are structurally closer to the nucleus based on their weight-carrying behavior in stress assignment. The proposed analysis implies that although Isbukun contains prevocalic consonant-glide sequences and postvocalic glide-consonant strings, complex syllable margins are in fact not tolerated in the language.

Key words: prenuclear glide, syllable, cooccurrence restriction, stress assignment, Optimality Theory

1. Introduction

Whether a postconsonantal onglide is structurally closer to the nucleus or to the onset has received the attention of phonologists in the studies of various languages. Given that syllable margins prefer consonantal elements but do not exclude vocalic ones, the semi-vocalic/semi-consonantal quality of glides naturally raises the question of their sub-syllabic constituency. In the literature on Chinese languages, it is controversial whether the glides are in the final, a constituent between the rime and the syllable node (e.g. R. Cheng 1966, C. Cheng 1973, Y. Lin 1989, Wang and Chang 2001), or in the onset (Bao 1990). Other proposals include treating the glides as the secondary articulation of the preceding consonants (Duanmu 1990, 2000), considering the glides as occurring in either the onset or the rime depending on the place of articulation of preceding consonants (Wan 1999), showing that the medial glides are structurally indeterminate between the onset and the rime (Bao 1996, H. Huang 2002a), and inferring that there should not exist an onset-rime dichotomy based on the variable behaviors of the glides (Yip 2003). The issue holds similarly for English; for example, Davis and Hammond (1995) argue that English *w* is part of the onset while the palatal glide *y* is grouped with the following vowels.[1]

Bunun is one of the Formosan Austronesian languages that contains prevocalic consonant-glide (CG) sequences on the surface. Based on the Isbukun dialect of

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[1] See the references therein on the same issue in Korean and French.

Bunun spoken in Kaohsiung County (henceforth Kaohsiung Isbukun), the paper aims to identify language-internal evidence for the syllabic affiliation of the medial glides in Bunun. Typical internal evidence for sub-syllabic constituency includes cooccurrence restrictions between the segments and the preceding/following elements as well as language-specific phonological processes relevant to the segments. It will be shown that although there seem to be some gaps in the combination between the onglides and the preceding consonants, the patterns do not provide crucial evidence for the structural status of the glides. The onglides are argued to belong in the nucleus of the syllable, based on the stress assignment rule in Kaohsiung Isbukun. The stress rule indicates that postconsonantal glides must be considered moraic, which in turn implies that the glides are not in the onset since onset consonants are widely assumed to be weightless.

The nucleus status of postconsonantal onglides in Isbukun Bunun is formalized as the result of constraint interaction within the framework of Optimality Theory (OT) (McCarthy and Prince 1993, Prince and Smolensky 1993). It is proposed that the high ranking of a markedness constraint against moraic onsets (*μ(Ons)) and a faithfulness constraint preserving the moras of the glided vowels (MAX-IO-μ) together leads to the representation of complex nuclei, which violates the lower-ranked constraint *COMPLEX(Nuc). OT provides a straightforward means to capture the structural affiliation of onglides by allowing representational constraints such as *μ(Ons) and *COMPLEX(Nuc) to interact directly with the constraints responsible for other phonological processes in the language such as MAX-IO-μ.

The paper is organized as follows. Section 2 presents the background on Bunun and discusses the findings in previous studies. Section 3 examines the cooccurrence relationship between the glides and the neighboring segments. Section 4 shows that the stress rules in Isbukun Bunun lend support to the moraic status of the onglides in the language and render an onset analysis unlikely. Section 5 discusses the implications of the analysis and concludes the paper.

2. Background on Bunun

Bunun can be classified into five main dialects, including the two northern dialects Takituduh and Takibakha, the central dialects Takbanuað and Takivatan, and the southern dialect Isbukun (Li 1988). Compared with the other dialects, Isbukun Bunun is spoken in a relatively wide region, including Nantou, Kaohsiung, Pingtung, and Taitung counties (Li 1997). There have been quite a number of studies related to Isbukun, such as He et al. (1986), Li (1987, 1988, 1997), H. Lin (1996), Nojima (1996), L. Huang (1997), Jeng (1999), Yeh (2000), Zeitoun (2000), and T. Lin et al.

(2001).

Among the previous studies on Bunun, Li (1988, 1997) and H. Lin (1996) give more detailed descriptions and analyses of Isbukun phonology. Based on a comparison of cognates from the five dialects, Li (1988) reconstructs Proto-Bunun phonemes and traces the historical derivations from Proto-Bunun to the daughter languages. Li (1997) focuses on Isbukun and gives a comprehensive survey of the phonology, morphology, and syntax of the variety spoken in Nantou County. The phonological rules that are identified include obstruent devoicing, consonant deletion, glottal insertion, palatalization, nasal place change, metathesis, identical segment deletion, and stem-final vowel omission. H. Lin (1996), also based on the Nantou variety, characterizes the segmental processes of Isbukun in terms of autosegmental representation (Goldsmith 1976, 1990, Clements and Hume 1995, among others) in addition to a brief discussion on the resyllabification rule, stress location, and the minimal word phenomenon in the dialect.

The paper is based on the author's field work on the Isbukun dialect spoken in Kaohsiung County. Among the studies mentioned above, He et al. (1986), Nojima (1996), L. Huang (1997), Jeng (1999), and T. Lin et al. (2001) also describe the variety of Kaohsiung Isbukun.[2] However, these studies are more concerned with the morphology and syntax of the language and pay relatively little attention to its phonology.

The major reason to separate the discussion on Nantou and Kaohsiung Isbukun here is that their stress rules are different, which bears on the issue of whether stress provides evidence for the moraic status of the onglides. Li (1997:306) states that Nantou Isbukun mostly stresses the final syllable except in a few words. Lin (1996:40-41) reports that stress falls non-distinctively on either the final or penultimate syllable in Nantou Isbukun; younger speakers tend to place stress on the final syllables while older speakers stress the penults. He et al. (1986:7) observes that stress in Kaohsiung Isbukun is in general penultimate although a couple of disyllabic words show final stress.[3] In these descriptions, Isbukun stress is either mostly fixed (e.g. He *et al*. 1986, Li 1997) or variable in a way that is not phonologically conditioned (e.g. Lin 1996). Neither fixed nor non-phonologically-conditioned variable stress patterns provide crucial evidence to the moraic status of onglides since syllable-internal compositions do not play a role in deciding the locations of stress. However, as will be discussed in Section 4, stress

[2] The data in Nojima (1996) are based on Isbukun speakers from Kaohsiung and Taitung, and Jeng (1999) covers data from other dialects as well.

[3] According to He et al. (1986), the exceptional final stress pattern involves disyllabic words. Li (1997: 306) gives three examples to illustrate the exceptional penultimate stress pattern in Nantou Isbukun, all of which happen to have only two vocalic elements in the input. Whether these exceptions are correlated with the number of syllables in a word awaits further investigation.

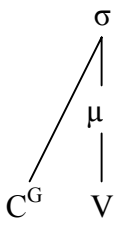
assignment in Kaohsiung Isbukun is in fact conditioned by the shape of the final syllable and thus lends support to the weight-carrying behavior and the non-onsethood of the onglides.

The segmental inventories of Nantou and Kaohsiung Isbukun are largely the same despite the subdialectal variations in stress. The phonemes of Isbukun include the fourteen consonants /p b t d k ʔ v s ð h m n ŋ l/ and the three vowels /i u a/. Surface glides [j w] are derived (Lin 1996, Li 1997) from the underlying vowels /i u/ in order to satisfy the requirement that syllables must have onset consonants.[4] As will become evident in the discussion in Section 4, the fact that surface glides are derived from underlying vowels in Isbukun is relevant for the observation in the paper that postconsonantal onglides are moraic: the onglides simply retain the moras associated with the corresponding underlying vowels even though they are not syllabic on the surface due to the onset requirement.

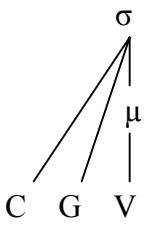
Although the derived status of the glides has been well established in previous studies, little attention has been paid to the syllabic affiliation of Bunun onglides except for Wu (2002), who aims to investigate issues related to glides in Tsou, Bunun, and Amis. Wu (2002) measures the duration of Isbukun onglides and suggests that they are too long to be the secondary articulation of the preceding consonants.[5] That is, a representation such as (1a) in the Moraic Model (Hyman 1985) is ruled out:

(1) Moraic Model (Hyman 1985):

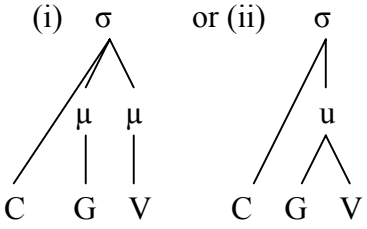
a. Secondary articulation on C



b. Nonmoraic



c. Moraic



Wu claims that the onglides link directly to the syllable node, i.e. (1b),[6] and adopts some phonetic constraints to rule out (1c-i) and (1c-ii) (pp.88-93) in the

[4] Glides are also derived from underlying vowels in the northern dialect Takituduh Bunun (H. Huang 2002b).

[5] Since glides are characterized by changing formant states, an accurate measurement of the duration of the glides would be difficult to achieve, as a reviewer pointed out. Wu (2002: 59-60) states that the endpoint of the onglide is signaled by the 'stable formant structures' of the following vowel (such as /a/) and that when the transition is unclear, 'the cursor is set at the midpoint or at the most obvious boundaries'.

[6] Wu seems to suggest that the proposed analysis holds for all three languages, including Bunun. The interpretation by Wu that (1b) is adopted for Bunun is supported by the fact that the author believes that the Bunun word [si-sjal] violates the *COMPLEX constraint once (p.107).

proposed OT analysis.[7] The relatively long duration of the onglides may help us eliminate the possibility of (1a), which contains only two segments (rather than three segments as in (1b) and (1c)), if we assume that a string of *n* segment is necessarily shorter than that of *n+1* segment. However, phonetic measurement alone cannot help us choose among the rest of the representations, which contain the same number of segments and differ only in how the melodic content is linked to the syllable node through moras. Since mora is an abstract phonological unit posited to account for weight and length related phenomena (see Broselow (1995) for a review), phonological generalizations would constitute crucial evidence for the choice among (1b), (1c-i) and (1c-ii). The paper will show that (1c-i) is the correct representation for Isbukun onglides based on the patterns of stress assignment. The proposal that Isbukun postconsonantal onglides are moraic is compatible with the phonetic description in Wu (2002) that onglides are of a certain length.

The major problem of the onset analysis in Wu (2002) is that no independent evidence based on other generalizations regarding the language, either internal or external, is given to support the assumed output structure (1b). Because both the output structure and the high-ranking status of the phonetic constraints are assumed without independent motivation, the analysis is at best one of the numerous accounts that succeeds only at the technical level. In contrast, in the proposed OT analysis in Section 4, *μ(Ons) and MAX-IO-μ crucially lead to the representation (1c-i); the high ranking of the *μ(Ons) constraint against moraic onsets is typologically motivated, and the high-ranked MAX-IO-μ constraint, which preserves the moras of the glided vowels, is justified by the stress patterns in the language.

3. The phonotactics of Isbukun sequences containing the onglides

Evidence for syllable-internal structure very often comes from the cooccurrence restriction between a segment and its neighboring elements is a typical type of evidence for syllable-internal structure. Given the assumption that elements in separate constituents should be allowed to combine in all logical possibilities unless interactions with other considerations come into play, if elements in X can only appear with a limited set of segments in the adjacent Y position, X and Y are more likely to form one rather than separate constituents. The cooccurrence restrictions are then considered as the result of a constraint on the constituent that subsumes both X and Y.

An examination of the consonants that could precede the onglides [j w] in

[7] The phonetic constraints are CG=CC ('The duration of the consonant-glide sequence is approximately equal to two consonant[s].') and G=V ('The duration of a glide is approximately equal to one vowel.'), which are assumed to rule out (1c-i) and (1c-ii), respectively.

Isbukun shows that the onglides could follow nearly all the consonants:

(2) Consonants that precede the onglides [j w]:

	/i/ [j]		/u/ [w]	
/p/	mahulpiah	‘thick’	puah	‘flower’
/b/	labian	‘night’	buan	‘moon’
/t/[8]	saitia	‘he’	matua	‘open’
/d/	madia	‘many’	maindуduað	‘young people’
/k/	ʔakia	‘the statue of a god’	balikuan	‘butterfly’
/ʔ/	mapitʔia	‘cook’	pasiʔuaʔua	‘wild ducks’
/v/	kaviað	‘friend’		
/s/	mahansiap	‘be good at’	masuað	‘plant’
/ð/	busðiah	‘broken’	laiðuan	‘Saaroa’
/h/			patishuan	‘firefly’
/m/	miahan	‘the day after tomorrow’	masmuav	‘very’
/n/	hanian	‘day’	bunuað	‘plum’
/ŋ/	taŋia	‘ear’	tanbuŋuan	‘pillow’
/l/	muliahliah	‘tear apart’	ʔaluað	‘mouse’

In the case of the *j* glide, all consonants have been found to precede the onglide except *h*, which suggests that, by and large, no occurrence restrictions exist between *j* and the preceding tautosyllabic consonants. Although *hj*-syllables are missing, *hi* sequences are attested, as illustrated by *luhi* ‘small dog.’ As to the *w* onglide, the voiced labial fricative *v* is the only consonant not found before *w* so far. Based on the fact that most consonants can combine with a following *w* onglide, it can be inferred that there is in general no cooccurrence restriction between the *w* onglide and the preceding consonant. Although *vw*-syllables are not found, there are a few words that contain *vu* sequences, such as *davus* ‘wine’ and *ʔivut* ‘snake,’ suggesting that *v* can be followed by a back round articulation in the language. The legitimacy of *hi* and *vu* sequences increases the possibility that *hj*- and *vw*-syllables are simply rare or that the gaps are accidental. Whether the gaps of *the hj*- and *vw*-syllables exist awaits future investigation based on a more thorough word search.[9]

The fact that a great variety of consonants are allowed to precede the onglides does not imply that the glides are structurally not in the onset. A restriction between

[8] /t/ is actually realized as [č] before [i j] due to palatalization.
[9] The generalizations are based on a search of approximately 3,000 words.

X and Y suggests that the two elements are close in constituency, but the lack of such a restriction does not mean that they are necessarily separate constituents. Put another way, the data discussed so far are basically neutral with respect to the syllabic affiliation of the onglides.

As far as the elements to the right of the onglides are concerned, both the onglides *j* and *w* can be followed by the low vowel /a/, as illustrated by the words in (2) above; in addition, both can be followed by high vowels, although such examples are considerably fewer than those followed by /a/:

(3) High vowels that follow the onglides:

	Nucleus Vowel /i/		*Nucleus Vowel /u/*	
Onglides				
/i/ [j]	-----		liliu	‘fly (n.)’
			takius	‘thin’
			ʔiu	‘medicine’
			miuŋ	‘eyebrow’
			siuh	‘frog’
/u/ [w]	makuis	‘narrow’	-----	
	tuik	‘small squirrel’		
	sui	‘money’		

There are no *ji*- and *wu*- sequences in (3). Since [ji] and [i] (as well as [wu] and [u]) are presumably phonetically similar to each other but phonologically two different representations, an ensuing question regarding the gaps of *ji*- and *wu*-syllables is how the choice between the transcriptions of a glide-vowel sequence and a pure vowel is made. In the present study, it is assumed that the postconsonantal [ji] and [i] (as well as [wu] and [u]) transcriptions in the output representation are necessary only when there is a perceived systematic contrast in the two phonetic signals. Because this contrast is not observed, a word such as ‘small dog’ is transcribed as [luhi] but not *[lwuhji] for simplicity. The transcription of [lwuhji] would presuppose an underlying form with identical vowel sequences, which is obviously more complicated than a single vowel.

A related question on the gaps of *ji* and *wu* is whether such sequences could appear in morphologically complex forms. When two identical high vowels are juxtaposed due to morpheme concatenation, e.g. /tutu-un/ ‘pour out (PV),’ a homorganic glide-vowel sequence could result by turning the first vowel into a glide. The present study assumes a transcription with two vowels coalescing into one vowel (H. Huang 2004) rather than the first high vowel turning into a glide for the following

reasons. First, there seems to be no systematic vowel length contrast between the syllables that comprise heteromorphemic identical vowels and those that do not, e.g. /tutu-un/ [tutún] 'pour out (PV)' versus /ma-tidu/ [mačidú] 'touch' and [kintutúh] 'cheer'. Since the vowel in the final syllable of [tutún] is perceptually similar to that of a final-stressed non-suffixed word, the paper adopts the default hypothesis that they are similar in containing one segment. Assuming the output form [tutwún] would lead to postconsonantal homorganic glide-vowel sequences only in derived forms, which is a slightly more complex scenario. Second, the surface realization of underlying adjacent high vowel sequences seems to be different from that of adjacent low vowels only in terms of vowel quality, e.g. /tutu-un/ [tutún] versus /tupa-av/ [tupáv] 'tell (Imp-PV).' Given the lack of perceptual differences in segmentation, the analysis would be somewhat more complicated if the adjacent high vowels were treated as glide-vowel sequences on the surface while the low vowels were not. Third, homorganic glide-vowel sequences are crosslinguistically disfavored due to their acoustic characteristics (Kawasaki 1982). Based on the above reasons, the paper adopts a transcription with no *ji* and *wu* sequences in either intramorphemic or heteromorphemic environments, which implies that the onglides do not precede homorganic vowels. Since the gaps are due to the ban on homorganic glide-vowel sequences, such types of cooccurrence restrictions cannot be taken as evidence for a constituent that subsumes the onglide and the nucleus vowel.

To summarize, an examination of the elements that precede and follow the onglides in Isbukun Bunun shows that the glides combine fairly freely with elements on either side. The phonotactics does not provide crucial evidence for the constituency of the onglides. Nevertheless, stress patterns in the language suggest that the onglides are not in the syllable margin positions, as discussed below.

4. Stress assignment in Isbukun Bunun

Given that cooccurrence restrictions do not provide decisive evidence for the syllabic affiliation of onglides in Isbukun, the question of whether there are phonological processes in the language that are relevant to the status of onglides becomes crucial. It will be shown that the stress rule in Kaohsiung Isbukun bears on the issue of the constituency of the onglides in the language.

As briefly mentioned in Section 2, Kaohsiung Isbukun differs from the Nantou variety in that stress most often falls on the penultimate syllable.[10] H. Huang (2003) examines the stress patterns of Kaohsiung Isbukun, distinguishes stress-shifting from non-stress-shifting suffixes, and shows that the stress location in fact varies between

[10] Stress is also penultimate in Taitung Isbukun (Wu 2002:68).

the penultimate and the final syllable depending on the shape of the final syllable. If the nucleus of the final syllable contains a single vowel, stress falls on the penults. If the final syllable has a postconsonantal onglide or an offglide in addition to the nucleus vowel, stress is attracted to the final syllable. Whether there are coda consonants to the right of the offglides does not affect the above generalizations. Some data illustrating this point are given in (4) below:

(4) Isbukun stress patterns:

A simple vowel nucleus in the final syllable: penultimate stress

a.	/maludah/	[ma.lú.dah]	'beat (AV)'[11]
b.	/kalat/	[ká.lat]	'bite (AV)'
c.	/kalat-un/	[ka.lá.tun]	'bite (PV)'
d.	/tupa/	[tú.pa]	'tell (AV)'
e.	/siŋhaili/	[siŋ.háj.li]	'knife'

An additional onglide/offglide in the final syllable: final stress

f.	/piskaubu-av/	[piš.kaw.bwáv]	'cheat (Imp. NAV)'
g.	/tupa-un/	[tu.páwn]	'tell (PV)'
h.	/mahansiap/	[ma.han.šjáp]	'be good at (AV)'
i.	/matisbai/	[ma.čiš.báj]	'escape (AV)'
j.	/mindia/	[min.djá]	'pick up (AV)'

The contrast between (4a-e) and (4f-j) shows that stress is penultimate as long as the final syllable contains a simple nucleus vowel, no matter whether the final syllable contains a coda consonant (a-c, f-h) or not (d-e, i-j). The data (4f-j) illustrate that the presence of onglides/offglides in the final syllable leads to a final stress pattern.

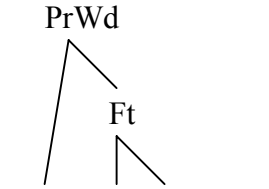
The stress patterns are analyzed as the result of constructing a quantity-sensitive trochaic (left-headed) foot at the right edge of a word, under the assumptions that coda consonants are nonmoraic and that onglides/offglides are moraic. In this analysis, the unmarked penultimate stress in Isbukun is due to a left-headed foot at the right edge of the word. When the final syllable contains a simple nucleus vowel, i.e. a monomoraic light syllable, stress falls on the second-to-the-last syllable as expected (illustrated by (5a) below). If the final syllable contains an additional onglide/offglide, stress falls on the final syllable (5b) because stressing the penult would violate the quantity-sensitivity requirement by placing the final heavy (bimoraic) syllable in the weak position of the foot (5c).[12]

[11] The abbreviations 'AV, PV, NAV, Imp.' respectively stand for 'Agent Voice, Patient Voice, Non-Agent Voice, and Imperative.'

[12] Notice that when both the penultimate and the final syllables are heavy, stress will fall on the final

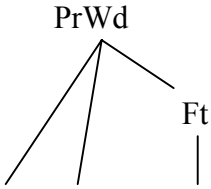
(5) Metrical structure of Isbukun words:

a. Penultimate stress



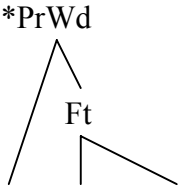
[k a_μ. (l $á_\mu$. t u_μ n)]

b. Final stress



[m a_μ. h a_μ n. (š j_μ $á_\mu$ p)]

c.



[m a_μ. (h $á_\mu$ n.š j_μ a_μ p)][13]

The stress rules as stated above are built on the crucial assumptions that the glided vowels in prenuclear and postnuclear positions remain moraic in the output forms. If the surface glides lose their moras associated with the corresponding vowels in the underlying representation, we would not be able to capture directly the correlation between the variable stress location and the types of final syllables. The moraic analysis of the onglides and offglides allows the phonologically conditioned nature of the stress rule in Kaohsiung Isbukun to be explicitly stated explicitly.

One might argue that the stress patterns can be successfully derived without assuming that Isbukun postconsonantal onglides are moraic in the surface representation. A comparison between two rule-based analyses of the stress patterns, one assuming moraic onglides and the other nonmoraic onglides, is offered below. The analysis in (6) illustrates a mora-deletion approach, which gives rise to surface nonmoraic onglides.

(6) An analysis of Isbukun stress, according to which onglides are nonmoraic:

Stress:	Stress the penultimate syllable.	
Gliding:	Turn a high vowel into the corresponding glide when it is adjacent to another vowel.	
Mora deletion:	Delete the mora of a non-syllabic segment.	
Derivation:	/mi$_\mu$ndi$_\mu$a$_\mu$/	/tu$_\mu$pa$_\mu$/
Syllabification	mi$_\mu$n.di$_\mu$.a$_\mu$	tu$_\mu$.pa$_\mu$
Stress	mi$_\mu$n.dí$_\mu$.a$_\mu$	tú$_\mu$.pa$_\mu$
Gliding[14]	mi$_\mu$n.dj$_\mu$á$_\mu$	-----
Mora deletion	mi$_\mu$n.djá$_\mu$	-----
	[mi$_\mu$n.djá$_\mu$]	[tú$_\mu$pa$_\mu$]

syllable, such as [piš.kaw.bwáv], because stressing the penult would place the final heavy syllable in the nonhead position of the foot. Pre-tonic heavy syllables, such as [aw] in [piš.kaw.bwáv], do not violate the quantity-sensitivity requirement because the adopted weight-to-stress principle forbids heavy syllables in the weak position of a foot rather than all prosodically weak positions.

[13] Parentheses '( )' indicate foot structure and angle brackets '[ ]' refer to prosodic word boundaries.

[14] The gliding rule must be followed by an adjustment that shifts the stress to the neighboring vowel once a stress-carrying high vowel becomes a glide in order to fulfill the onset requirement.

A comparable mora-retention analysis would be exactly the same in terms of the rules and derivation except that the mora deletion rule is removed. Both the mora-deletion and the mora-retention analyses correctly predict the variable stress location in Isbukun, but they differ in whether the onglides are moraic on the surface.[15]

The fact that the account of Isbukun stress patterns could be compatible with nonmoraic onglides challenges the proposed representation of moraic onglides, which is based on the necessity of such an assumption in capturing the stress patterns. In the mora-deletion analysis, the final syllable of the derived form [min.djá] contains an onglide that is presumably either co-moraic with the following vowel (as in (1c-ii)) or links directly to the syllable node (as in (1b)).

The analysis with nonmoraic onglides, however, is disadvantageous. First of all, the mora-deletion analysis is obviously more complicated than the mora-retention analysis because it contains one more rule. Moreover, the motivation for the mora-deletion rule is unclear. Mora-deletion rules commonly apply to avoid violating the upper limit on the number of moras within a syllable (such as bimoraicity) or to satisfy some metrical requirements (such as the so-called trochaic shortening). The mora deletion rule for the Isbukun data appears unmotivated unless we make the arbitrary assumption that all Isbukun syllables are monomoraic. Under the monomoraic assumption, however, one would have to infer that Isbukun is presumably not a quantity-sensitive language, since the assumption implies that Isbukun does not have the distinction between light and heavy syllables. The phonologically conditioned nature of Isbukun variable stress would, as a consequence, be obscured if the language were not viewed as quantity-sensitive.

A related, third criticism against the analysis with nonmoraic onglides is that the mora deletion rule increases the opacity of the overall analysis. Without the mora deletion rule, the stress rule is relatively transparent in that stress locations can be predicted from the distance from the right edge of a word in terms of moras: stress falls on the syllable that contains the second-to-the-last mora. The stress rule remains transparent in the mora-retention analysis because the following glide formation rule changes the syllabicity of high vowels without affecting their moraicity. Positing an additional mora deletion rule would only render the stress rule opaque without providing any advantages. In the mora-deletion analysis, the location of stress is not systematically correlated with the distance from the right edge in terms of

[15] Notice that the two competing analyses differ in whether the mora of a glided vowel is preserved, rather than whether a mora is inserted for a surface glide, because Bunun glides come from underlying vowels and vowels are underlyingly associated with moras.

either syllables or moras in the surface representation.[16]

The moraic status of the onglides implies that the glides are not in the onset, because onset consonants are commonly weightless and assumed to be nonmoraic (Clements and Keyser 1983, Hayes 1995, among others). The moraic onglides would belong in the nucleus or the rime if the nucleus/rime nodes are recognized.

The discussion on Isbukun onglides so far is restricted to postconsonantal ones, i.e. those that are not syllable-initial. Given the assumption that onset consonants are nonmoraic and the observation that Isbukun avoids onsetless syllables, a question arises regarding how syllable-initial onglides behave in stress assignment. The onset requirement in Isbukun forces syllable-initial onglides to fill the onset position, and the nonmoraic onset assumption in turn predicts that the initial onglides do not bear a mora. Syllable-initial onglides are indeed nonmoraic, as justified by the penultimate stress pattern in words such as /haiap/ [hájap] 'know (AV)' and /kusbai-a/ [kusbája] 'fly (Imp.AV)' (cf. /kusbai/ [kusbáj] 'fly (AV)'). The fact that onglide-beginning syllables (such as [ja] in [kusbája]) are treated as light but syllables with postconsonantal onglides (such as [dja] in [mindjá]) are heavy suggests that the nonmoraic onset requirement forces the syllable-initial glides to lose the moras associated with the corresponding underlying vowels.[17]

To summarize the discussion so far, it is argued that Isbukun stress patterns support the representation in which postconsonantal onglides are moraic, i.e. (1c-i), based on their weight-carrying behavior. In the rule-based literature, the representation (1c-i) itself is responsible for the non-onset status of the onglides. In the framework of OT, the representation (1c-i) can be viewed as the result of the interaction among constraints, each of which denotes a preference for some unmarked structure or faithfulness between corresponding representations. Because the constraints are not invented specifically to account for the structural affiliation of onglides, a formalization of the way that constraints interact to give rise to the non-onset status of the onglides allows us to see how the issue of sub-syllabic constituency is connected to other aspects of phonology.

In the proposed OT analysis, the non-onset status of the onglides is conceptualized to be the result of the retention of the underlying moras of the surface glides and the prohibition against moraic elements from the onset. Being moraic, the

[16] The paper gives two rule-based analyses here to illustrate how the moraic onglide analysis differs from the nonmoraic analysis because their differences can be plainly expressed in terms of whether a mora-deletion rule exists. The discussion would involve some technical details that are not relevant to the main point of the paper if the comparison is given within a constraint-based framework such as OT, because of the opacity nature of the nonmoraic analysis (although the moraic glide analysis can be readily achieved by ranking the MAX-IO-μ constraint high in the hierarchy).

[17] Presumably, the mora of the syllable-initial glide is not deleted but docks onto the preceding syllable; the hypothesis is based on the surface pronunciations [$\text{há}_{\mu}\text{j}_{\mu}.\text{ja}_{\mu}\text{p}$] and [$\text{ku}_{\mu}\text{s.bá}_{\mu}\text{j}_{\mu}.\text{ja}_{\mu}$] (rather than [$\text{há}_{\mu}.\text{ja}_{\mu}\text{p}$] and [$\text{ku}_{\mu}\text{s.bá}_{\mu}.\text{ja}_{\mu}$]). See the discussion below.

onglides are forced into the nucleus position in order to avoid a configuration with moraic onsets. The adopted constraints and the illustrating tableau are given below.

(7) Constraints employed:

a. *μ(Ons): Onset consonants cannot be moraic.
b. MAX-IO-μ: The mora associated with an input segment must be preserved in its output correspondent. (McCarthy and Prince 1995)
c. *COMPLEX(Nuc): Complex nuclei are prohibited.

(8) Isbukun postconsonantal onglides:[18]

/ma$_{\mu}$ha$_{\mu}$nsi$_{\mu}$a$_{\mu}$p/	*μ(Ons)	MAX-IO-μ	*COMPLEX(Nuc)
a. m$\underline{\text{a}}_{\mu}$.h$\underline{\text{a}}_{\mu}$n.$\underline{\check{\text{s}}^{\text{j}}}a_{\mu}$p (1a)		*!	
b. m$\underline{\text{a}}_{\mu}$.h$\underline{\text{a}}_{\mu}$n.$\underline{\check{\text{s}}\text{j}}a_{\mu}$p (1b)		*!	
☞ c. m$\underline{\text{a}}_{\mu}$.h$\underline{\text{a}}_{\mu}$n.$\check{\text{s}}j_{\mu}a_{\mu}$p (1c-i)			*
d. m$\underline{\text{a}}_{\mu}$.h$\underline{\text{a}}_{\mu}$n.$\underline{\check{\text{s}}\text{j}}a_{\mu}$p (1c-ii)		*!	*
e. m$\underline{\text{a}}_{\mu}$.h$\underline{\text{a}}_{\mu}$n.$\underline{\check{\text{s}}\text{j}}_{\mu}a_{\mu}$p	*!		

The candidates (a, b, c, d) correspond to the structures shown in (1a, 1b, 1c-i, 1c-ii), respectively. Candidates (a, b, d) are ruled out by the high-ranked MAX-IO-μ constraint because they delete an underlying mora. Candidate (e) avoids a MAX-IO-μ violation by keeping the mora of the glided vowel; however, it invokes a fatal violation of *μ(Ons) by allocating the glide to the onset. Candidate (c) is selected by the grammar as the optimal output form because it satisfies both MAX-IO-μ and *μ(Ons) by violating the relatively lower ranked *COMPLEX(Nuc).

In the case of syllable-initial onglides, the glides must occupy the onset position in order to satisfy the ONSET constraint ('syllable must have onset consonants') in Isbukun, so a candidate such as [h$\underline{\text{a}}_{\mu}$.j$_{\mu}a_{\mu}$p] in which the second syllable is onsetless, is ruled out by ONSET. The tableau (9) below illustrates how a syllable-initial onglide would be nonmoraic once it was allocated to the onset position, because the high-ranked *μ(Ons) rules out the candidate with moraic onsets (9d):

[18] Underlining indicates that the segments are in the onset.

(9) Syllable-initial onglides:

/ha$_{\mu}$i$_{\mu}$a$_{\mu}$p/	*μ(Ons)	MAX-IO-μ	*COMPLEX(Nuc)
a. h$\underline{\text{a}}_{\mu}$.j$\underline{\text{a}}_{\mu}$p		*!	
☞ b. h$\underline{\text{a}}_{\mu}j_{\mu}$.j$\underline{\text{a}}_{\mu}$p[19]			*
c. h$\underline{\text{a}}_{\mu}$j.j$\underline{\text{a}}_{\mu}$p		*!	
d. h$\underline{\text{a}}_{\mu}$.j$\underline{\text{a}}_{\mu}a_{\mu}$p	*!		

The surface pronunciations of the words /haiap/ and /kusbai-a/ are perceptually [háj.jap] and [kus.báj.ja] respectively. In the tableau (9), it is assumed that the high-ranked MAX-IO-μ constraint leads to the selection of (b) as the optimal output, which is compatible with the surface pronunciation of a doubly articulated glide. In summary, syllable-initial glides link to the onset position due to ONSET, they are nonmoraic because of *μ(Ons), and the moras of the surface syllable-initial glides satisfy MAX-IO-μ by linking to the preceding vowel.[20]

In the proposed analysis, the high-ranked constraints *μ(Ons) and MAX-IO-μ are crucial in deciding the structural affiliation of the onglides, and their high ranking status is independently supported by cross-linguistic and within-language generalizations. The constraint *μ(Ons) is presumably undominated in almost all languages, and MAX-IO-μ must be high-ranked in Isbukun in order to account for the variable stress patterns. There may be many different OT analyses on the status of onglides in Isbukun, each of which achieves technical success by employing a different set of phonetic/phonological constraints and constraint rankings. The paper attempts to manifest that the correct formal analysis on constituency must be supported by independent generalizations regarding the language.

5. Discussion and conclusion

The paper examines the internal evidence that might bear on the structural affiliation of onglides in Isbukun Bunun, including the phonotactics of the onglides and relevant phonological processes. It is shown that while there seem to be some gaps in how the onglides combine with the preceding consonants, there are in general no systematic cooccurrence restrictions that might bear on the issue of sub-syllabic

[19] The transcription represents a structure in which the root node of [j] is simultaneously linked to the preceding syllable node (through a mora) and linked directly to the syllable node of the following syllable (nonmoraic).

[20] It seems that both nasals and glides are ambisyllabic in intervocalic position (Lin 1996: 35). If the double articulation of nasals is phonological in nature, there should be a separate constraint accounting for the patterning of nasals and glides in a unified manner. The analysis here focuses on the fact that syllable-initial glides are nonmoraic; whether MAX-IO-μ forces the double articulation of the glides awaits more research.

constituency. The stress assignment rule in the language, on the other hand, suggests that the onglides are best treated as moraic in order to capture the phonologically conditioned nature of the variable stress patterns in Isbukun. The moraic status of the onglide in turn implies that the onglide is not in the onset, given the widely held assumption that onset consonants are weightless. In the proposed OT analysis, the constraint MAX-IO-μ ensures that onglides are moraic, and the moraic onglides are forced into the nucleus by the *μ(Ons) constraint against weight-carrying onset consonants.

Notice that the onglide is moraic but not syllabic in that it does not occupy the nucleus of the syllable by itself. Sharing the nucleus with the neighboring vocalic element avoids having an onsetless syllable, which is banned in Bunun, and leads to the non-syllabicity of the glided vowel. The glide nevertheless retains the mora associated with the underlying vowel, which is justified by the behavior of the glides in stress assignment. Although the non-syllabicity of high vowels in postconsonantal /ia, wa/ sequences appears clear in perception, which one loses syllabicity in a string of adjacent high vowels, such as /iu, ui/ in /takius/ 'small, little' and /makuis/ 'thin', cannot be readily told. This question bears on the issue of onglides because whether an onglide exists at all in the output representation must be clarified first. Assuming gliding of the preceding vowel would mean that there is an onglide (e.g. [ta.kjus]) but gliding of the following vowel would entail the absence of an onglide and the presence of an offglide (e.g. [ta.kiws]). The difficulty in deciding which high vowel turns into a glide is also observed in the northern dialect Takituduh Bunun (H. Huang 2002b:447). The paper concludes that onglides are moraic and affiliate to the nucleus, which actually entails that the choice between the onglide/offglide transcriptions ([ta.kjus]/[ta.kiws]) is not crucial in Bunun: the language simply requires that the two adjacent vocalic elements be both moraic and linked to the nucleus position. When the nucleus is shared by vowels of different height, the higher sonority of low vowels gives rise to the impression that they are the nucleus vowels. When two high vowels are associated with the same nucleus, their comparable sonority gives rise to the ambiguity between the onglide/offglide transcriptions. Since postconsonantal surface glides are moraic, one may term the onglide-vowel and vowel-offglide sequences as falling-sonority and rising-sonority diphthongs, respectively.

Because there could be at most one consonant preceding the onglide in Bunun, allocating the onglides to the nucleus implies that complex onset consonants do not exist in the language. Although the paper does not focus on offglides, their similar weight-carrying behavior and the fact that there could be at most one true consonant following the tautosyllabic offglides (based on the author's fieldwork and confirmed

by an examination of the words that appear in the published sources) suggest that complex codas are not allowed either. Despite the appearance of surface prevocalic consonant-glide sequences and postvocalic glide-consonant strings, Bunun is in fact a language that does not tolerate complex syllable margins.

The proposed analysis is built on the variable stress patterns in Kaohsiung Isbukun, which provides evidence for the moraic onglides. Although stress in Nantou Isbukun does not exhibit the type of phonologically determined final/penultimate stress patterns and thus does not directly bear on the issue of the constituency of the onglide, the closely related Kaohsiung variety furnishes clear arguments. The fact that awareness of the different patterns in the subdialects may help clarify theoretical issues necessitates a thorough examination of the rich subdialectal variations in Formosan languages.

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論郡社布農語韻核前滑音的音節內部歸屬

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本文檢視郡社布農語語料，以聲清是否有相關音韻現象提供了對於韻核前滑音在音節內部歸屬的證據。文中指出，韻核前滑音在結構上屬聲或屬韻並不能由與音節首輔音的組合型態得知，但是此語言的重音規則顯示韻核前滑音應帶音拍，因此在結構上應與韻核較爲接近。此一分析間接表示布農語雖然在元音前可以有輔音後接滑音的音串、元音後允許滑音與輔音的組合，但實際上聲母及韻尾均最多只容納一個音段。

關鍵詞：韻核前滑音、音節、並存限制、重音、優選理論