An OT analysis of *-in-* infixation in Takibakha Bunun

Song Jiang

Abstract. Infixation is one of the vital characteristics of Austronesian languages. However, there are still some phonological problems about infixation remained to be solved. This study will mainly focus on the past tense infix *-in-* in Takibakha Bunun. Firstly, the work will try to depict and generalize the distribution between *-in-* and *-i-*. Mostly, the different appearance of the PFV infix maybe due to the variation of the context environment, where [a] occupies the first vowel position. Secondly, the work will attempt to discuss how to account for such phenomenon in a phonological way. We will introduce Optimality Theory to do the analysis in this paper, and try to interpret the *-in-~ -i-* alternation of the infixation in Bunun. Thirdly, we will try to put the problem in a contrastive vision among other Formosan languages, to see whether such an analysis is general.

Keywords: Bunun, infixation, Optimality Theory, phonological pivot

1 Introduction

This work is about infixation in Takibakha Bunun, one of the Bunun dialects in Taiwan. The *-in-/-i-* infix widely exists across Bunun dialects, however, it's the only infix now discovered in Bunun. Although the morphological form of the infix is basically same, but there are some variations among the dialects. This work tries to depict the phonological characteristics of the infixation in Takibakha Bunun and attempt to give a formalized interpretation.

1.1 About Takibakha Bunun

Bunun is an Austronesian language spoken by people in central and southern Taiwan. According to Li (1998), there are five main Bunun dialects: Takitudu, Takibakha, Takibanuaz, Takivatan and Isbukun. Takibakha Bunun are mainly distributed in Tannan Village, Dili Village, Shuanglong Village of Nantou County, which are located in the central Taiwan.
Indigenous Orthographic System (issued by CIP and MOE 2005) is also used by speakers of Takibakha Bunun. The system will also be used in this paper as presenting data. IPA will also

be used in this paper as doing phonological analysis.

1.2 About the data source

The data presented in this paper are mainly from the elicited dictation, which were collected on the Field Methods course (Spring 2017, NTHU) and the 3-day field work carried out in Dili Village (Tamazuan) in May 2017. There are 10 informants, who can speak influent Takibakha Bunun, contributing to this work. They are most living in Dili Village or Shuanglong Village and at age around 60.

2   Vowel system of Takibakha Bunun

2.1 Vowel inventory

Accoding to Manqoqo (2009), Jiang (2012), it's different from other Bunun dialects that Takibakha Bunun has five phonemic vowels /a, i, u, e, o/. Besides, there are also six diphthongs /ia, ai, au, ua, iu, ui/ in the inventory. The vowel in Takibakha is as the following table (1).

(1)

	Front	Central	Back
High	i	iu, ui	u
Mid		e	o
		ia,ai	ua,au
Low		a	

Although /e/ and /o/ are phonemic, there is also some phonological process that can predict these two sounds.

2.2 /i, u/ lowering

De Busser (2009) supposed that high vowels may be lowered in some condition in Takibatan Bunun, as (2), which can also be found in Takibakha.

(2)   a. when preceded or followed by a uvular /q/.
      b. when followed by a velar nasal /ŋ/ or – less commonly – an alveolar nasal /n/.

According to De Busser's proposal, there is a sound change from /i, u/ to /e, o/.

2.3 Monophthongization

Some of the /e/ and /o/ are historically developed from /ai/ and /au/, and such diphthongs are still preserved in other Bunun dialects. Accoding to Jiang (2012), /ai, au/ and /e, o/ have

systematical correspondence, as the following table (3).

(3)   Sounds correspondence of /ai, au/ and /e, o/ in five Bunun dialects.

	Takibakha	Takituduh	Takbanuaz	Takivatan	Isbukun	Gloss
/ai/ vs. /e/	tenga	tainga	tainga	tainga	tangia'	'ear'
/au/ vs. /o/	lopaku	laupang	laupang	laupaku	laupaku	'now'

3   Syllable structure of Takibakha Bunun

According to Huang (2008), the maximal syllable of Isbukun Bunun is CGVC or CVGC, both of which are underlyingly CVVC. A complex margin is not allowed in Isbukun Bunun. Huang (2008) also assumpted that coda consonants are non-moraic; glided-vowels are moraic and a syllable is maximally bimoraic, as depicted in (4).

(4)
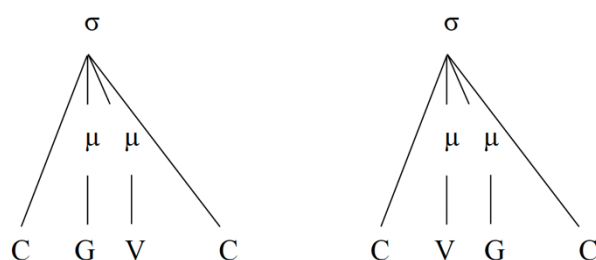
A minimal syllable is CV in that onsets are obligatory but codas are optional.
Lin (1996) proposed that the minimal word for Isbukun content words is a two-mora syllable/foot, where stress applies, as (5).

(5) $MinWd = (\mu\mu)_{FT}$

Takibakha performs similarly to the syllable structure of Isbukun.

4   Patterns of the *-in-* infixation

-in- is the only attested infix in Bunun, which is regarded as a past/resultative marker (abbreviated as PST) in De Busser (2009) and Shih (2009), or a perfective/experiential aspect marker (abbreviated as PFV/EXP) in Jiang (2012) and Shih (2017). In general, the affixed form with *-in-* most indicates actions happened in the past time, as (6). In this paper, *-in-* is regarded as a past tense or perfective aspect marker.

(6)   m-in-usbai   naip
      AF.PFV.escape   3SG.NOM
      "He has escaped."

The infix forms and position in Takibakha Bunun are various with respect to the stem where the infix resides. According to my investigation and induction, there are some types of variations of the *-in-* infixation, which can be divided into regular types and irregular types.

4.1 Regular type

Takibakha Bunun *-in-* infix is mostly placed after the first consonant, as shown in (7), which is similar to other dialects.

(7)   Past/Perfective verbs in Takibakha Bunun — Regular type I

Base	*Affixed Form (PST/PFV)*	*Gloss*
to'un	t-in-o'un	'be opened'
mudan	m-in-udan	'left'
musbai	m-in-usbai	'escaped'
simul	s-in-imul	'borrowed'
ma'un	m-in-a'un	'ate'

-in- will also appear after the first /a/ vowel, as shown in (8). Such phenomenon is also found in other dialects, like Takibatan and Isbukun.

(8)   Past/Perfective verbs in Takibakha and Isbukun Bunun — Regular type II

Base	*Affixed Form (Isbukun)*	*Gloss*
matua	metua (ma-i-tua)	'opened'
talia	telia (ta-i-lia)	'grew up'
qalavan	qelavan (qa-i-lavan)	'took away'
hanavun	henavun (ha-i-navun)	'be driven away'

In Takibakha dialect, the first /a/ alternates to /e/ in the affixed PST/PFV form. Synchronically, the infix stands after the first /a/ vowel in Isbukun dialect, however, it emerges as a single -i- in this circumstance rather than the normal type -in-. It could be inferred that the /e/ comes

from the /ai/ sequence via monophthongization, which is a normal phenomenon mentioned in section 2.2.

Comparing *matua~metua* and *ma'un~mina'un*, we can found that there is some restriction on the environment which determine the position of the infix. According to the field work in Dili Village, as (9), it could be concluded that the quantity of the prosodic word (PrWd) might be one of the critical factors.

(9)   pre-/a/ infixation and post-/a/ infixation

pre-/a/ infixation	*Gloss*	*post-/a/ infixation*	*Gloss*
mal'u ~ mel'u	'had a break'	talia ~ telia	'grew up'
tan'a ~ tinan'a	'listened'	tak'itun ~ tek'itun	'be blocked'
taqu' ~ tinaqu'	'told'	ma'iup ~ me'iup	'blew'
qasbing ~ qinasbing	'sneezed'	matua ~ metua	'opened'
sak ~ sinak	'smelled'	hanavun ~ henavun	'be driven away'
mataz ~ minataz	'have been dead for a long time'	pacilis ~ pecilis	'drew'

It could be seen that a pre-/a/ infix most appear with a root not more than 2 moras, otherwise it will be after the /a/.

When the word is a vowel-initial word, *-in-* stands preceding the whole word, as listed in (10).

(10)   Past/Perfective verbs in Takibakha — Regular type III

Base	*Affixed Form*	*Gloss*
uluzi	in-uluzi	'danced'
unting	in-unting	'drove'
aliba	in-aliba	'hugged'
ancaqan	in-ancaqan	'carried on the shoulder'
evuku	in-evuku	'be given=1SG.NEU'

4.2 Free variation

The affixed form with *-in-* may have free variations, or varies among speakers. In Takibakha Bunun, standing preceding or after the first /a/ vowel are both grammatical for some words' infixed forms, as (11).

(11)   Past/Perfective verbs in Takibakha — Free variation I

Base	Affixed Form	Gloss
sadu	sedu/s-in-adu	'saw'
katdu	ketdu/k-in-atdu	'touched'
kalavan	kelavan/k-in-alavan	'scratched'
antalam	entalam/in-antalam	'replied'

Another kind of free variation is like (12), which shows a /e~i/ variation.

(12)   Past/Perfective verbs in Takibakha — Free variation II

Base	Affixed Form	Gloss
qanup	qinanup/qenanup	'saw'
tangic	tinangic/tenangic	'cried'
sadu	sinadu/senadu	'saw'

4.3 Irregular type

There are still some transformation which we classify them as irregular type in this paper, as in (13).

(13)   Irregular type of *-in-* infixation in Takibakha Bunun

Base	Affixed Form	Gloss
katdu	kenitdu	'touched'
masmu	mesmu	'swallowed'

According to the generalization of (9), *masmu* is two moras and should transform to **minasmu*, but actually it's *mesmu*. Unlike the free variation I, **minasmu* is ungrammatical. Thus we can attribute it to the Irregular type.

4.4 Other types of PST/PFV morpheme

Other than *-in-*, *inin-* can also indicate past or perfective meaning. Under some condition, *inin-* and *-in-* may alternate freely, as in (10). *inin-* may only appeared preceding the root, so it's regarded as a prefix.

(14)   Past/Perfective verbs in Takibakha — with *inin-*

Base	Affixed Form	Gloss
han	inhan/ininhan	'PST.be somewhere'
ancaqan	in-ancaqan/inin-'ancaqan	'carried on the shoulder'
angkuc	in-angkuc/inin-'angkuc	'hold'

mini- can also express the same meaning as the affixes above. Differently, *mini* can stick to morphological words directly and is more productive than other affixes. For example, *asa* 'like' cannot be affixed with *-in-* or *inin-*, only *mini-'asa* is grammatical in Takibakha Bunun. In this paper, we regard *mini-* as a kind of clitic due to the difference described above.

Another question is whether *inin-* is an alternation of the infix *-in-*. According to one of the informants' lexicon knowledge, *inin-* expresses a more previous timing than *in-*, which can tell the difference between *inin-* and *-in-*. Another evidence is that these two morphemes have various distribution, that *inin-* stands before the vowel-initial word (PrWd) with an intervening glottal stop [ʔ] ('), but *in-* sticks to the vowel without any intervening segment. We can thus tell there's difference between two morphemes, but it still need more evidence to prove this.

5   An Optimality Theory analysis

McCarthy and Prince (1993) proposed that infixes are underlyingly prefixes. The infixation phenomenon are conceived as a species of Prosodic Morphology, so the locus of the infix is determined directly by phonology rather than a Word Formation Rule.

For instance, the position of *-um-* infixation in Tagalog is determined by a Prosodic Constraint (**P**) –NoC$_{ODA}$, and a Morphological Constraint (**M**) –Align (A$_{FFIX}$, PrWd).

For **P>>M**, the infix may stand word-internally to satisfy the prosodic requirement by sacrificing alignment, as in (15).

(15)   Tagalog *-um-* infixation (McCarthy and Prince 1993)

Base	*Affixed Form*	*Gloss*
/aral/	/um-aral/	'teach'
sulat	s-um-ulat	'write'
gradwet	gr-um-adwet	'graduate'

5.1 An OT analysis of regular types

The *-in-* infixation in Takibakha Bunun can also be analyzed in this way, with a set of **P** and **M** constraints. Here comes three contraints as (16) ~ (18).

(16)   **NoCODA**

   Syllables must be open.

(17)   **ONSET**

   Syllables must have onsets.

(18)   **ALIGN ([in]$_{AF}$, L, STEM)** (A$_{LIGN}$-*in*)

   The left edge of the affix *-in-* must coincide with the left edge of some stem.

The constraint (18) expressed the fact that *in* is a prefix rather than a suffix. For example, the input consists of e.g. {[in]$_{Af}$, [ma'un]$_{Rt}$}$_{Stem}$. For Regular Type I in (7), the infixation phenomenon can be interpreted as a confliction among the constraints (15) ~ (18). The ranking and the tableau is like (19).

(19)   N$_O$C$_{ODA}$, O$_{NSET}$>>A$_{LIGN}$-*in*, in Takibakha Bunun

Input: /in, ma'un/	N$_O$C$_{ODA}$	O$_{NSET}$	A$_{LIGN}$-*in*
a. in-ma'un	**!	*	
☞ b. m-in-a'un	*		m
c. ma'-in-un	*		ma'!

As mentioned in Section 3, the onset is obligatory in Takibakha Bunun. An orthographically onset-less word is phonetically /ʔ/-initial. Such a phenomenon has been attested in most Austronesian languages. Hayes and Abad (1989) proposed that the /ʔ/ is inserted post-lexically, in that it's predictable. Thus, a glottal-initial word in Takibakha Bunun is also regarded as a vowel-initial word in the underlying form, but it must strictly obey O$_{NSET}$. The process can be expressed by the ranking that O$_{NSET}$>>D$_{EP}$-IO, as in (20). In that the initial glottal stop is produced by epenthesis, the initial glottal stop doesn't belong to the Grammatical Word (GrWd) or the stem. Thus, the initial glottal stop will not generate any violation marks. The tableau (20) can show how the correct result of Regular type III, depicted in (10), devolves from this ranking.

(20) The tableau of Regular type III in Takibakha Bunun

Input: /in, unting/	N$_O$C$_{ODA}$	O$_{NSET}$	D$_{EP}$-IO	A$_{LIGN}$-*in*
☞ a. 'in-unting	**		*	
b. 'un-in-ting	**		*	un!
d. in-unting	**	*!		

Other than standing before the first vowel, -in- infix may also stand after the first vowel when it's an /a/ and PrWd is more than two moras, as depicted in (9). In that only the leftmost /a/ will trigger the infix to stand after it. The correct output cannot be evaluated from the current ranking in (20), as the tableau below.

(21)   Tableau of Regular type II in Isbukun Bunun

Input: /in, qasbing/	NOCODA	ONSET	DEP-IO	ALIGN-*in*
💣☀ a. q-in-asbing	**			q
☹ b. qa-i-sbing	**			qa!

So, we should introduce a new constraint to solve the positional problem, rather than only P and M constraints raised by McCarthy and Prince (1993).

Kiparsky (1986) uses the term "pivot" to refer to the portion of a stem over which an infix "skips".[1] Yu (2007) adopted the notion of "pivot" and applied it to OT analysis. The pivot refers to the morphological and/or phonological unit, to which an infix attaches. Yu raised some kinds of potential pivots, as in (22).

(22)   Potential pivots of infixation

Edge pivots	Prominence pivots
Leftmost consonant, vowel, or syllable	Stressed vowel, syllable, or foot
Rightmost vowel or syllable	

Back to the data, Takibakha Bunun remains the leftmost /a/ and sacrifices the alignment. It seems that the leftmost vowel has a priority that the leftmost vowel can keep identity. To keep the edge feature, another constraint should be introduced, as (23).

(23)   **IDENT-BA (LEFTMOST [lo])**
        Let α be a leftmost segment in the base, and β be a correspondent of α in the affixed form. If α is [γ lo], then β is [γ lo].

In that /a/ is the only vowel with the feature [+lo], the grammar will posit the *-in-* infix after the /a/ vowel to keep the leftmost [lo] feature. Without regard to the monophthongization, such a process can be interpreted by the ranking IDENT-BA>> ALIGN-*in*, as in tableau (24).

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[1]   Cited from C. L. Yu. (2007). The phonology-morphology interface from the perspective of infixation. New challenges in typology: Broadening the horizons and redefining the foundations, 189, 35.

(24) Tableau of Regular type II

Input: /in, qasbing/ Base: /qasbing/	Dᴇᴘ-IO	Iᴅᴇɴᴛ-IO (Affix)	Iᴅᴇɴᴛ-BA (L[lo])	Aʟɪɢɴ-*in*
☞ a.　　qa-i-sbing				qa
b.　　q-in-asbing			*!	q
c.　　q-an-asbing		*!		q
d.　　qa-in-asbing	*!			q

Candidate d is repaired by an epenthesis [+lo] preceding the infix, and it's eliminated due to the dominated Dᴇᴘ-IO. Candidate c changes the vowel quality of the infix, and it's eliminated due to the dominated Iᴅᴇɴᴛ-IO (Affix). Thus Aʟɪɢɴ-*in* must be sacrificed to satisfy Iᴅᴇɴᴛ-BA (L[lo]), and other repairing methods are unavailable.

Another problem is why *-in-* tranforms to *-i-*. Comparing with *ta-i-lia* and **ta-in-lia*, it's obvious that *-in-* transforms to *-i-* for avoiding the CC cluster. Thus *CC should outrank Mᴀx-IO, as (25).

(25) Tableau of /n/-deletion

Input: /in, talia/ Base: /talia/	Iᴅᴇɴᴛ-BA (L[lo])	*CC	Mᴀx-IO	Aʟɪɢɴ-*in*
☞ a.　　ta-i-lia			*	ta
b.　　ta-in-lia		*!		ta
c.　　t-in-alia	*!			t

However, a CC cluster is acceptable in lexicon, like *qasbing.* So, it should be analyzed as 'the emergence of the unmarked' (TETU). Thus, the Mᴀx-IO should be separated into two constraints, for affix and root respectively. The ranking would be as (26).

(26) Tableau of /n/-deletion

Input: /in, talia/ Base: /talia/	Mᴀx-IO (Rt)	*CC	Mᴀx-IO (Af)
☞ a.　　ta-i-lia			*
b.　　ta-in-lia		*!	

Input: /qasbing/	M$_{AX}$-IO (Rt)	*CC	M$_{AX}$-IO (Af)
c. qabing	*!		
☞d. qasbing		*	

Recall the data in (9), it has been found that the prosodic quantity is one of the critical factors which determines the position of the *-in-* infix. *ma'un* becomes *m-in-a'un* when it's affixed, but not **ma-i-'un*.

According to Huang (2008), the metrical constraints of Isbukun bunun are given below.

(27) a. **WSP**: Heavy syllables are stressed.

   b. **F$_T$B$_{IN\mu}$**: A foot must be bimoraic.

   c. **F$_T$B$_{IN\sigma}$**: A foot must be disyllabic.

   d. **F$_T$T$_{YPE}$(=Trochaic)**: Feet have initial prominence.

   e. **A$_{LL}$-F$_T$-R$_{IGHT}$**: Every foot stands at the right edge of the PrWd.

   f. **P$_{ARSE}$-S$_{YLL}$**: Syllables are parsed by feet.

Notice that (27b) and (27c) are two separate type of F$_T$B$_{IN}$. It's better for analysis to separate them and give them different ranking. F$_T$B$_{IN\mu}$ is relatively higher-ranked than F$_T$B$_{IN\sigma}$, in that a monosyllabic word, like *sak* 'smell', may lengthen the vowel, as [sa:k], to satisfy F$_T$B$_{IN\mu}$. F$_T$B$_{IN\sigma}$ is dominated by WSP and F$_T$T$_{YPE}$=T, because a heavy syllable may appear at final position as a monosyllabic foot.

Comparing *mina'un* and **mai'un*, we can find that *mina'un* obeys F$_T$B$_{IN}$ better. To rule out the non-parsed form [mai'un], a constraint called MStem≈PStem (Downing 1999), which means a morphological stem must be a prosodic stem, will be introduced. The ranking and the tableau are showed in (28).

(28)

Input: /in, ma'un/ Base: /ma'un/	MW≈PW	F$_T$B$_{IN\mu}$	A$_{LL}$-F$_T$-R	I$_{DENT}$-BA-L(lo)	F$_T$B$_{IN\sigma}$
☞ a. mi.(ná'un)				*	
b. (mái)'un			'un!		*
c. (mái'un)		*!			
d. mai'un	*!				

Input: /in,talia/ Base: /talia/	MW≈PW	F$_T$B$_{IN\mu}$	A$_{LL}$-F$_T$-R	I$_{DENT}$-BA-L(lo)	F$_T$B$_{IN\sigma}$
a. (tìna).(liá)			lia	*!	
☞ b. (tài).(liá)			lia		*

Since that Bunun allows unparsed syllable like (28a), but bans the form like [(mì).(ná'un)]. We can thus say that P$_{ARSE}$-S$_{YLL}$ is dominated by F$_T$B$_{IN}$.

5.2 Monophthongization

What's different from Isbukun is that Takibakha resolves an /ai/ or /au/ hiatus through coalescence rather than gliding, except for the word-final position. According to Huang's analysis, gliding violates constraint (29a) V-N$_{UC}$, and coalescene violates

constraint (29b) U$_{NIFORMITY}$. They are both dominated by (29c) H$_{IATUS}$.

(29) a. **V-N$_{UC}$**: Every [-consonantal] segment must be linked to the nucleus without sharing it with other elements.
  b. **U$_{NIFORMITY}$-IO**: No element of the output has multiple correspondents in the input.
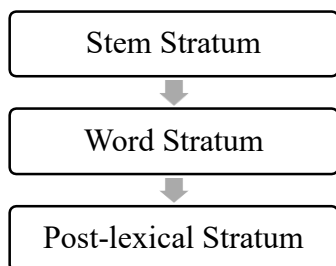 c. **H$_{IATUS}$**: *VV

So, the difference between Isbukun and Takibakha can be interpreted as different ranking of V-N$_{UC}$ and U$_{NIFORMITY}$, as the following tableau. (30).

(30)

Input: /ta$^1_\mu$i$^2_\mu$lia/ (Isbukun)	H$_{IATUS}$	U$_{NI}$	V-N$_{UC}$
a. (ta$^1_\mu$i$^2_\mu$).(lia)	*!		
b. (te$^{1.2}_{\mu\mu}$).(lia)		*!	
☞ c. (ta$^1_\mu$j$^2_\mu$).(lia)			*
Input: / ta$^1_\mu$i$^2_\mu$lia/ (Takibakha)	H$_{IATUS}$	V-N$_{UC}$	U$_{NI}$
a. (ta$^1_\mu$i$^2_\mu$).(lia)	*!		
☞ b. (te$^{1.2}_{\mu\mu}$).(lia)			*
c. (ta$^1_\mu$j$^2_\mu$).(lia)		*!	

To combine monophtongization with the lexical phonology in 5.1, a multi-stratal model raised in Kiparsky (2010, 2015) will be adopted, as (31).

(31)   A stratal OT model by Kiparsky (2014)

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┌─────────────────────────┐
│      Stem Stratum       │
└─────────────────────────┘
            ↓
┌─────────────────────────┐
│      Word Stratum       │
└─────────────────────────┘
            ↓
┌─────────────────────────┐
│   Post-lexical Stratum  │
└─────────────────────────┘
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Through Kiparsky's model, the ranking of morphology and the ranking of monophthongization (post-lexical phonology) will be in different stratums, as depicted in (32). However, it still needs independent motivation for the stratums. So, [telia]$_{PrWd}$ is grammatical, even though [e] is [-lo], which violates the pivot-preserving constraint, because monophthongization happens at Post-lexical Stratum which is independent of morphology.

(32) $[in]_{Af}+[talia]_{Rt} \rightarrow [tailia]_{Stem} \rightarrow [tailia]_{Word} \rightarrow [telia]_{PrWd}$

5.3 Free variation

One of the methods of resolving free variation is Free Ranking Theory observed by Prince and Smolensky (1993).

(33)   Interpretation of **free ranking** of constraint C_1, C_2
          Evaluation of the candidate set is split into two subhierarchies, each of which selects an optimal output. One subhirarchy has $C_1 \gg C_2$, and the other $C_2 \gg C_1$.

The free variation between pre-/a/ infixation and post-/a/ infixation, e.g. *sedu (saidu)* and *sinadu,* can be interpreted as the conflict between A$_{LIGN}$-*in* and I$_{DENT}$-BA-L[lo]. *sedu (saidu)* prefers (34a) and *sinadu* prefers (34b).

(34)

Input: /in, sadu/ Base: /sadu/		ALIGN	IDENT-BA
☞ a-1.	s-in-adu	s	*
a-2.	sa-i-du	sa!	
		IDENT-BA	ALIGN
b-1.	s-in-adu	*!	s
☞ b-2.	sa-i-du		sa

Another type is /i/ ~ /e/ variation, which can be interpreted by De Busser (2009)'s proposal mentioned in (2). It can be expressed as the following constraint (35).

(35) **LOWERING**

$*[q]+[hi] \cup *[hi]+[nasal]$

Then it can be interpreted as the conflict between LOWERING and IDENT-IO (Affix), as in (36).

(36)

Input: /in, qanup/		LOWERING	IDENT-IO (Affix)
a-1.	q-in-anup	*!	
☞ a-2.	q-en-anup		*
		IDENT-IO (Affix)	LOWERING
☞ b-1.	q-in-anup		*
b-2.	q-en-anup	*!	

6 Conclusion

-in- is only infix in Takibakha Bunun. Like other Austronesian languages, the infix is originally a prefix, and the position of the infix is determined by the conflict of Morphological Constraint (**M**) and Prosodic Constraint (**P**). Analogous to Tagalog *-um-* type infix (McCarthy and Prince 1993), *-in-* in Takibakha Bunun is also evaluated through the ranking **P**>**M**.

However, they are not the only factors which may affect the locus of the infix. The pivot (Kiparsky 1986; Yu 2007) also plays a critical role to determine the position where the infix stands. In Takibakha Bunun, the leftmost vowel acts as the pivot. To preserve the feature of the pivot, the **M** is sacrificed in Takibakha Bunun, under the ranking, Prosodic Constraint, Pivot-preserving Constraint >> Morphological Constraint. Besides, metrical constraints may also

work for locus-determining. The interaction among metrical constraints and Pivot-preserving Constraint decides whether the pivot needs to be preserved. To capture the formalization of the position of infix, not only **P** and **M** are critical factors, but also the pivot and metrical constraints. The infixation of Takibakha Bunun also provides evidence to Stratal OT, in which post- lexical phonology belongs to an independent layer after other lexical layers.

Some problems are still remained in this case. First, how does the free variation of-*in*- distribute. It's not well solved during the limited field work. Why some words have free variation but others not? Second, how to treat the prefix *inin*-? Whether it's one alternation of -*in*-? By recent observation, *inin*- performs differently with -*in*- both morphologically and semantically. Lastly, the irregular types are still hard to formalize. The questions above will be added to the future agenda.

To sum up the infixation in Takibakha Bunun, the ranking among the constraints so far is plotted in the graph (37) below:

(37)   Rankings among the constraints above
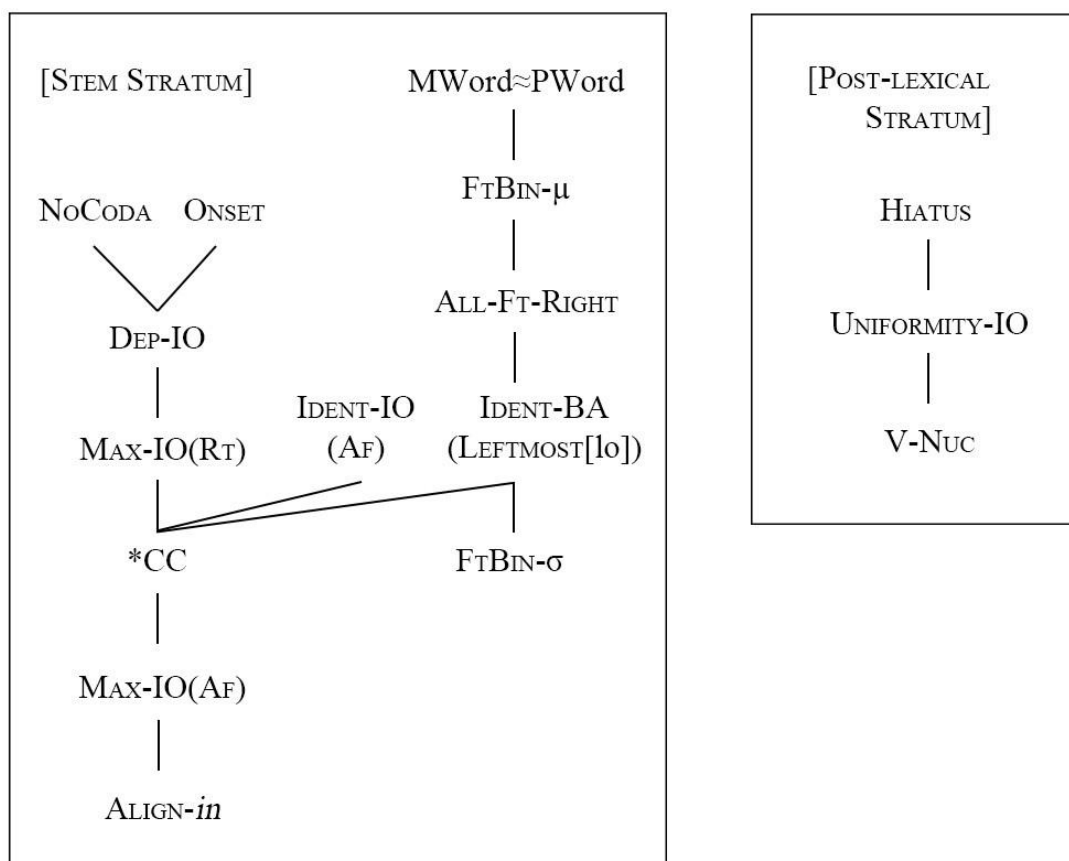
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Song Jiang
Graduate Institute of Linguistics,
National Tsing Hua University
Hsinchu, Taiwan
ajiangsong34@gmail.com