TRACING THE PATH OF CONSTRAINT MOVEMENT: THE AUSTRONESIAN BINARY-FOOT REQUIREMENT AND WORD-MINIMUM PHENOMENA

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1 Introduction

1.1 Fundamental Questions Motivating this Research

- What can a theory of constraint interaction and movement tell us about sound change?
- Through comparative analysis, can we infer the constraint ranking of a historical language, i.e., proto-ranking?
- Does the outcome of sound change provide us with enough information to understand the nature of constraint movement?

1.2 Sound changes I will be discussing and the constraints that motivate them.

I will be discussing how the promotion of the BINARY FOOT requirement (FT-BIN) over time motivates widespread phonological changes in Austronesian.

FT-BIN: Feet are binary at the syllabic or moraic level (in this case, moraic)

Some of the changes that FT-BIN promotion appears to motivate are:

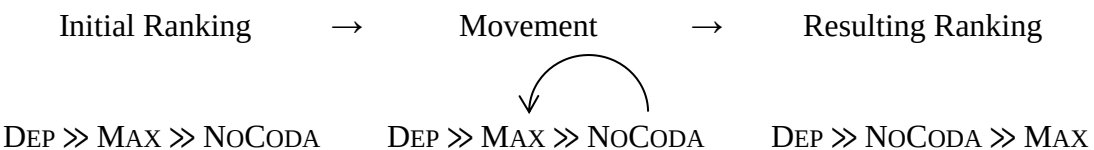
- schwa deletion in the environment VC_CV(C)#
- gemination of final-syllable onsets in two-syllable words with an open schwa penult
- shift of schwa to /o/ in the penultimate syllable (but not in other syllables)

These changes are listed in order of their attestation, with schwa-deletion being a near universal feature of Malayo-Polynesian. Gemination of final-syllable onsets is common, but absent in several subgroups, and the shift of schwa to /o/ in the penult is restricted to Eastern Malayo-Polynesian.

2 Background

Optimality Theory (OT, Prince and Smolensky 1993) explains differences in input and output as arising from the interaction of ranked violable constraints. Differences in various language's grammars occur from differences in the relative ranking of constraints.

Constraint movement The differences between languages are the result of constraint movement. Constraint movement is also involved in sound change (Holt 2015). In the following example, the promotion of NO CODA over MAX may result in the deletion of inherited coda consonants, a sound change that is attested in multiple Austronesian languages.



2.1 Constraint Movement in Theory

Sound change occurs with a necessary stage of variability in implementation (Labov 1965, Weinreich et al 1968). It is therefore necessary that a theory of constraint movement have variability in the framework.

Synchronic descriptions of variability often utilize a probabilistic approach (Kiparsky 1993, Reynolds 1994Boersama 1997, 1998, Cortzee and Pater 2011).

Because I am working with diachronic issues in sound change which include properly ordered sound changes and clear intermediate stages, I utilize a Diachronic Reranking model with discreet movement (Cho 1998, Oh 2002).

Diachronic Reranking Hypothesis Constraints first enter a stage of variable ranking, indicated by the use of a dotted line (Oh 2002).

$C_1 \gg C_2 \quad \rightarrow \quad C_1, C_2 \quad \rightarrow \quad C_2, C_1 \quad \rightarrow \quad C_2 \gg C_1$

In this model, the vertical dotted line operates such that the higher ranked constraint dominates the lower ranked constraint most of the time, but allows for reversed ranking outputs. Some tableaux may help visualize this approach. I use the same coda-deletion scenario from earlier:

a Candidate a is the only licit output

/CVCVC/	DEP	MAX	NOCODA
☞ a. [CVCVC]			*
b. [CVCV]		*!	
c. [CVCVCV]	*!		

b Candidates a and b are both licit, but a is more common than b

/CVCVC/	DEP	MAX	NOCODA
☞ a. [CVCVC]			*
☞ b. [CVCV]		*	
c. [CVCVCV]	*!		

c Candidates a and b are both licit, but b is more common than a

/CVCVC/	DEP	NOCODA	MAX
☞ a. [CVCVC]		*	
☞ b. [CVCV]			*
c. [CVCVCV]	*!		

d Candidate b is the only licit output

/CVCVC/	DEP	NOCODA	MAX
a. [CVCVC]		*!	
☞ b. [CVCV]			*
c. [CVCVCV]	*!		

- The Diachronic Reranking Hypothesis allows us to incorporate intermediate variability into our formal descriptions of sound change.
- Constraint movement happens gradually. Reranking, rather than being viewed as a singular event, is rather a gradual event with multiple intermediate stages and abundant variability.

An additional consequence of gradual movement is that constraints seem to move in short, rather than long, movements. Constraints may only promote/demote over an adjacent constraint.

> **Gradual Movement:** The promotion/demotion of constraints occurs in short, rather than long, movements. Given a proto-ranking A ≫ B ≫ C, constraint C may only come to dominate A if it first passes through an intermediate stage A ≫ C ≫ B.

There is so far no consensus on whether constraints can move immediately over long distances or whether they must move locally (where constraints must pass over intervening constraints one at a time). Examples of both are found in the literature (Ito and Mester 2004 Kiparsky 2015, Crist 2001, Holt,2003, Zubritskaya 1995). The Gradual Movement requirement of short rather than long-distance constraint reranking is therefore novel, but appears to play out in the data I will be considering.

3 Preliminaries: PAN phonology

3.1 Word Shape

PAN had a two-syllable canonical word. Consonant clusters were restricted to reduplicated monosyllables, a sub-set of the lexicon (Blust 2013, Chretien 1965, Dempwolff 1937, Ross 1992).

Canonical Word	CVCV(C)	*maCa, *pənuq, *takut
Reduplicated Monosyllable	CVCCVC	*dəmdəm, *bəjbəj, *tiktik

Roughly ninety percent of all reconstructed AN vocabulary conforms to the disyllabic requirement.

There are some three- and one-syllable words, but they form a small minority. Monosyllabic words for example were phonologically bound to adjacent content words (Blust 2013:539).

PAN *ka ‘conjunctive particle, and’
PAN *na ‘linker marking emphatic attribution’
PAN Case Markers (for example *sa and *si, both Nominative case markers)

3.2 The vowels

Three Main/Full Vowels: *a, *i, *u One Minor/Reduced Vowel: *ə

We can see a clear distinction in the treatment of main vs full vowels in the phonotactics of PAN. Main vowels have no restrictions and may appear in any position in a well-formed word. Schwa, however, was the subject of numerous unique distributional restrictions, outlined below:

- Schwa could not appear word-final position. (Blust 2000:88)
- Schwa could not appear word-initial position, with only two exceptions; the numerals *əsa 'one' and *ənəm 'six'.
- Schwa was absent from both prefixing and infixing morphology. The patient voice suffix *-ən was the only "schwa-full" affix.
- Schwa could not be immediately followed by a glide, *w or *y. (Mills 1975)

3.3 Stress Position

Austronesian languages provide evidence that PAN had a default-penultimate stress system, but with some morphological conditions that moved stress to the final syllable (Zorc 1978, Smith n.d.):

- Stative verbs shifted stress to the final syllable
- Vocatives shifted stress to the final syllable (along with *-q and *-ŋ suffixation)
- Stress shifted to the final syllable in some noun → verb derivations
- Final stress in list intonation (especially in enumeration)
- Final stress in closed-class words.

Word-final stress was also conditioned phonetically; stress shifted to the final syllable if the penult was open and contained a schwa nucleus.

a CV́CVC b CV́CCVC c CəCV́C

Some have attempted to reconstruct a contrastive stress system with Philippine evidence (Zorc 1978, Ross 1992, Wolff 1991), but in terms of attested stress systems in primary branches, there is strong support for a default penultimate stress system with phonetically conditioned final stress. At least three AN primary branches directly continue the PAN stress system:

Western Plains (Thao, from Blust 2003)
Thao reflects *ə as either *u*, *i*, or Ø. Stress, however, is always final if the word is reconstructed with a schwa in an open penultimate syllable.

a	*təbuS	→	tufúsh ‘sugarcane’	b	*bukəS	→	fúkish ‘head hair’
	*kəRiw	→	klhíw ‘hemp’		*RaməC	→	lhámic ‘root of tree or grass’
	*kəRət	→	klhít ‘cut; sever’		*ləmləm	→	ma-rúmrum ‘dim; unlit’

Paiwan (Chen 2004)
In Paiwan, stress falls on the penultimate syllable except where the penultimate syllable is a schwa, in which case it shifts to the final syllable.

kəmaláŋ ‘to know’
mipərəpár ‘to fly’

Malayo-Polynesian (multiple languages and subgroups therein)
Ilokano (Northern Luzon) has contrastive stress but stress is predictably word-final in words that are reconstructed with a penultimate schwa.

a	*dəkət	→	dəkkát ‘paste; adhesive’	b	*kaka	→	káka ‘elder sibling’
	*dəpah	→	dəppá ‘a fathom’		*kutu	→	kúto ‘louse’
	*təlu	→	talló ‘three’		*likaw	→	líkaw ‘curve; bend’

Kenyah (Long Wat dialect, Sarawak) has regular penultimate stress but shifts stress to the final syllable if the penultimate syllable is open with a schwa nucleus.

a	*təlu	→	*təláw* ‘three’	b	*duSa	→	*lúəh* ‘two’
	*CəbuS	→	*təbáw* ‘sugarcane’		*bulu(-n)	→	*búlun* ‘body hair’

Ngadha (Sumba-Flores; Djawanai 1977) is a Central-Malayo-Polynesian language but still reflects a system whereby stress shifts to the final syllable if the penult is a schwa.

a	-		*bəta* [bətʰːá] ‘broken, as a string’	b	*Sapuy	→	*ápi* ‘fire’
	-		*bəka* [bəkʰːá] ‘have pity on’		*Nipis	→	*nípi* ‘thin’
	*səpaq	→	*səpa* [səpʰːá] ‘chew leaves’		*pusuq	→	*púsu* ‘heart’

The list of languages with stress-shift after a penultimate schwa is extensive: Bilic (Tiruray, Schlegel 1971), Tondano, Greater Central Philippines (Tagalog, Cebuano, Palawan, etc), Kayan (Borneo, Clayre and Cubit 1974, Smith 2017), Batak (Adelaar 1981), Gayo (Eades and Hajek 2006), Kéo (CMP, Baird 2002).

4 Schwa was special, but how so? An argument for weightless segments

Most explanations for why schwa is unable to hold stress in MP appeal to either quality (schwa can't hold stress because it is schwa) or length (schwa can't hold stress because it is short). I argue that schwa was unstressable because it was a zero-mora vowel, i.e., schwa was weightless and did not contribute to lexical mora count.

This means that the mora was the stressable unit, and the lack of a mora rendered schwa unstressable under normal circumstances[1].

The unstressability of schwa is a product of quantity, not quality or length, but how common are weightless vowels and weightless syllables? There are actually many examples where schwa is analyzed as having no mora:

- Vowel-less and weightless syllables are posited for Georgian and Polish (Cho and King 2003)
- Weightless schwa-syllables are posited for Dutch (Kager 1989), German (Féry 2003), Malayalam (discussed more in the next slide), and others.

[1] see Kager 1993 who discusses how mora, rather than syllables, may be stress-bearing units.

4.1 English monosyllabic loan words in Malayalam

Malayalam has a weightless schwa and interesting segmental repairs that occur as a result. These seem to directly parallel the patterns observed in MP (discussed after).

- Malayalam has a minimal two-mora word.
- A schwa is automatically inserted at the end of words with a disallowed coda (Mohanan 1989).
- Schwa is weightless where it is inserted at the end of a word and therefore is unable to contribute to lexical mora count (Cyran 2001).
- Subminimal words lengthen consonants to satisfy Minimality (Namboodiripad et al. 2015).

a	English *pass*	→	Malayalam /paːs/	→	[paːsə]
b	English *bus*	→	Malayalam /bas/	→	[basːə]

In words with two syllables where one of the syllables has a weightless schwa, some sort of repair is required to save an otherwise sub-minimal word. In Malayalam we can see that two-syllable but one-mora words lengthen a consonant as a means to add a mora. As it turns out, the same strategy is used in numerous MP languages.

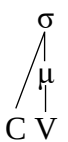
4.1.1 Variable weight

As we look at the data in the following sections, we will see cases where schwa, if it appears in a *closed* syllable, does not trigger minimal-word phenomena. Schwa in Austronesian languages acts differently in closed syllables because of variable coda weight. (See Rosenthall and van der Hulst 1999 for more on variable coda weight).

There are many cases where codas allow schwa to hold a mora, for example, in Malay.

In standard Malay codas may contribute to penultimate syllable weight but only if the vowel of the syllable is deficient (if it is a schwa).

a *táman* ‘garden’
láma ‘long time’



b *təmán* ‘frient’
ləmáh ‘weak’

c *tə́mpat* ‘place’
lə́mbah ‘valley’

The effects of variable coda weight are also found in languages where schwa deleted or shifted only in an open syllable. Thao, discussed earlier, is one such language. Schwa typically deleted in open penultimate syllables (with some exceptions), but is universally retained in closed syllables, penultimate or otherwise.

a	*kəRiw	→	*klhíw* ‘hemp’	b	*RaməC	→	*lhámic* ‘root of tree or grass’
	*kəRət	→	*klhít* ‘cut; sever’		*ləmləm	→	*ma-rúmrum* ‘dim; unlit’

Schwa was therefore a weightless segment, but interacted with codas in such a way that syllables of the shape CəC were equivalent to syllables of the shape CV and CVC. The total list of repairs and the environments which trigger them are listed below:

CəCVC$^{\mu}$	→	CəC:VC$^{\mu\mu}$	(gemination)
CəCVC$^{\mu}$	→	CVCVC$^{\mu\mu}$	(vowel shift)
CV(CəCVC)$^{\mu}$	→	(CVCCVC)$^{\mu\mu}$	(deletion)
Cə(CəCVC)$^{\mu}$	→	(CəCCVC)$^{\mu\mu}$	(deletion)
(CVCəC)$^{\mu\mu}$		No repair	
(CəCCVC)$^{\mu\mu}$		No repair	
(CəCCəC)$^{\mu\mu}$		No repair	

4.2 Subminimality and gemination repairs: evidence for a weightless schwa in Malayo-Polynesian

Ilokano Although Ilokano has a contrastive stress system, that contrast is neutralized in words with a penultimate schwa-syllable and the final-syllable onset automatically lengthens.

a	*dəpah	*dəpːá*	‘a fathom	b	*kaka	*káka* ‘elder sibling’
	*dəŋəR	*dəŋːág*	‘hear; listen’		*kutu	*kúto* ‘head louse’
	*təkən	*təkːán*	‘punting pole’		*likaw	*líkaw* ‘curve; bend’

Central Malayo-Polynesian Hawu data is from Walker (1982:6) who gives only two examples, which are reprinted below. Stress shift after schwa in Ngadha co-occurs with gemination, where Djawanai (1977:6) states that “The schwa /ə/ is usually very short and causes the lengthening of the following consonants…” Example a is from Hawu and b from Ngadha

a	[ʔəlːa] ‘wing’	b	[bətʰːá] ‘broken, as a string’
	[həɓːe] ‘to mend (as a mat)’		[səpʰːá] ‘chew leaves

Borneo In Borneo the more conservative languages tend to reflect gemination after penultimate schwa. My dissertation field work on Kayan, for example, found a previously unreported system of final-syllable onset gemination after a penultimate schwa-syllable.

təpːáʔ ‘pound rice’	*səpːún* ‘great grandparent’
mətːáŋ ‘ask’	*məpːáh* ‘to sweep’
məjːúʔ ‘lift; carry’	*dənːáʔ* ‘slow’

In Sabah (North Borneo) some interesting results of gemination are observable, including in Idaan Begak, where voiced plosives split to an initial voiced, and final devoiced, internal cluster. Other consonants are regular geminates (Goudswaard 2005).

*təbuh	*təbpu* ‘sugarcane’
*zəlay	*dəlːay* ‘job’s tears’
*dəpah	*rəpːa* ‘fathom’

South Sulawesi South Sulawesi languages all reflect an earlier system where the onsets of final syllables lengthen after schwa in an open penultimate syllable. In Makasarese and Tae', schwa has merged with *a, creating a phonemic distinction in words where gemination was historically predictable, but Buginese retains schwa unchanged. In Makasarese for example, *a* from *a is not followed by a geminate consonant, but *a* from *ə is.

a	*balu	*balu* 'widow'	b	*bəlaq	*balːa* 'splitting'
	*panaq	*pana* 'shoots'		*təlu	*talːu* 'three'

4.4 Schwa-deletion in Three-Syllable Words

All MP subgroups show an intermediate stage of penultimate schwa deletion in the environment VC_CV(C)#, although in many languages deletion is irregular. Ilokano provides some examples where deletion was regular:

a	*dəpah	*dəpːá* ‘a fathom	b	*qaŋəlit	*aŋlít* ‘foul odor’
	*dəŋəR	*dəŋːág* ‘hear; listen’		*qaləjaw	*aldáw* ‘day’
	*təkən	*təkːán* ‘punting pole’		*lisəqah	*lisʔá* ‘nit’

Schwa deletion occurs in three syllable words because the resulting output is always a well-formed 2-mora word: $CV(CəCVC)^{\mu} \rightarrow (CVCCVC)^{\mu\mu}$. If schwa deleted in a disyllable, the resulting monosyllable would still be subminimal: $(CəCVC)^{\mu} \rightarrow (CCVC)^{\mu}$.

4.4.1 Schwa deletion outside of the Philippines

In the Philippines (and in Chamorro, Blust 2000) this change is consistent. Outside of the Philippines, there is a mixture of regularity and irregularity with regard to schwa deletion.

PMP *baqəRuh ‘new’ → Proto-South Sulawesi/Proto Central Malayo-Polynesian *baʔRu
Tae’ *baʔru*, Rembong *waru*, Adonara *wuʔu*

PMP *qaləjaw ‘day’ → Proto-Oceanic *qalcaw
Samoan *aso*, Hawaiian *ao*, Tuvaluan *aho* Wuvulu *alo*, Tangoa *alo*, South Efate *al*

PMP *tuqəlaŋ ‘bone’ → Proto-Western Indonesian *tuʔ(ə)laŋ (with an optional schwa)
Idaan *tulːaŋ*, Kejaman *tuʔleə̯ŋ*, Malay *tulaŋ* but Maanyan *taʔulaŋ*, Samihim *tuʔulaŋ*

The issue of irregularity will be addressed in more detail in section 5.

4.5 Vowel Shift as an Alternative Minimal Word Repair Strategy

The final repair strategy for subminimal words is vowel-shift, from *ə to a full vowel, allowing the historical schwa-syllable to hold a mora. There are many examples of languages that shift schwa to a full vowel in all positions, for example, Chamorro, Palauan, Celebic, and most (but not all) CMP languages.

What we're really looking for, however, are languages that have shifted schwa to a full vowel in the penult only, since these are the only words that need to eliminate schwa for minimality.

4.5.1 Penultimate schwa shift in Eastern Malayo-Polynesian

Eastern Malayo-Polynesian consists of two subgroups, Oceanic and South Halmahera-East New Guinea (SHWNG). Blust 1978:211-212 pointed out that schwa acted differently in penultimate and ultimate syllables:

> … PAN *e [schwa] unconditionally yielded POC *o, but only penultimate *e [schwa] yielded Proto-SHWNG *o. In view of the other evidence to be considered, it is perhaps simplest to assume that penultimate *e [schwa] first shifted to *o in a language ancestral to the SHWNG and Oceanic groups, and that last-syllable *e [schwa] then followed this development in Proto-Oceanic, but merged with *a in SHWNG.

As more data has become available, it is clear that *ə became *o in penultimate position but was left unchanged in the final syllable in Proto-South Halmahera-West New Guinea, and by extension, in Proto-Eastern Malayo-Polynesian.

PMP *CəCVC$^{\mu}$	→	PEMP *CoCVC$^{\mu\mu}$
PMP *CVCəC$^{\mu\mu}$	→	PEMP *CVCəC$^{\mu\mu}$
PMP *CəCəC$^{\mu}$	→	PEMP *CoCəC$^{\mu\mu}$

Some examples from Ma'ya, Taba, and Buli, all SHWNG languages, demonstrate this:

Ma'ya

	a	*təlu	*t**o**l* 'three'	b	*qinəp	*wen**e**f* 'to sleep'
		*qatəluR	*t**o**l* 'egg'		*bituqən	*tu**e**n* 'star'
		*dəŋəR	*d**o**n* 'to hear'		*qitəm	*mat-'met**e**m* 'black'

Taba

	a	*dəpa	*l**o**f* 'a fathom'	b	*ənəm	*onam* 'six'
		*təlu	*t**o**l* 'three'			

Buli

	*qatəp	*yat**a**f* 'roof'/ *fa-yatf-o* 'cover with tatch'
	*dəŋəR	*l**o**ŋ**a*** 'to hear'
	*Rəbək	***o**p**a*** 'to fly'

5 Constraint movement in MP historical phonology

Before moving on to the movement analysis, I first discuss what rankings are expected to trigger the three types of attested repairs, beginning with deletion, followed by gemination and vowel shift.

5.1 Constraint ranking for schwa deletion

In nearly all MP languages schwa deleted (regularly or irregularly) in the environment VC_CV(C). Ranking FT-BIN above MAX-IO gives the desired output, with deletion only in three-syllable words.

a

/qaləjaw$^{\mu\mu}$/	FT-BIN	MAX
a. [qa$^{\mu}$ (ləjaw)$^{\mu}$]	*!	
☞ b. [(qaljaw)$^{\mu\mu}$]		*

b

/təbuh$^{\mu}$/	FT-BIN	MAX
☞ a. [(təbuh)$^{\mu}$]	*	
b. [(tbuh)$^{\mu}$]	*	*!

5.2 Constraint ranking for gemination after penultimate schwa

Gemination after penultimate schwa is found throughout the Philippines, Borneo, the Lesser Sunda Islands, and the South Sulawesi subgroup. There are multiple approaches one may take to trigger gemination. For example, FT-BIN may interact with *GEM. In order for gemination to surface FT-BIN must outrank *GEM.

a

/qaləjaw$^{\mu\mu}$/	FT-BIN	*GEM
a. [qa$^{\mu}$ (ləjaw)$^{\mu}$]	*!	
☞ b. [qa$^{\mu}$ (ləj:aw)$^{\mu\mu}$]		*

b

/təbuh$^{\mu}$/	FT-BIN	*GEM
a. [(təbuh)$^{\mu}$]	*!	
☞ b. [(təb:uh)$^{\mu\mu}$]		*

An alternative approach is to have FT-BIN interact with DEP (μ).

a

/qaləjaw^{μμ}/	FT-BIN	DEP (μ)
a. [qa^{μ} (ləjaw)^{μ}]	*!	
☞ b. [qa^{μ} (ləj:aw)^{μμ}]		*

b

/təbuh^{μ}/	FT-BIN	DEP (μ)
a. [(təbuh)^{μ}]	*!	
☞ b. [(təb:uh)^{μμ}]		*

There are several reasons why DEP (μ) is preferable to GEM. There are languages that developed geminate consonants through total assimilation of consonants in a cluster but not as a reaction to an open penultimate schwa (Batak for example). This suggests that *GEM was not highly ranked. DEP (μ) is also able to do more work than *GEM. For example, it prevents not only gemination but vowel shift, as both are mora addition strategies. It also interacts with constraints in such a way as to allow for penultimate vowel deletion, since vowel deletion is also a mora-addition strategy.

5.3 Constraint Ranking for penultimate vowel shift

Only one subgroup, SHWNG, shifted schwa to a full vowel in the penultimate syllable *only*. This change might have occurred in PEMP, with additional changes occurring in OC. If IDENT (V) is ranked below FT-BIN we can trigger penultimate vowel shift while leaving schwa in other positions unchanged.

a

/təbuhᵘ/	FT-BIN	IDENT (V)
a. [(təbuh)ᵘ]	*!	
☞ b. [(tobuh)ᵘᵘ]		*

b

/daləmᵘᵘ/	FT-BIN	IDENT (V)
☞ a. [(Úləm)ᵘᵘ]		
b. [(dalom)ᵘᵘ]		*!

5.4 Proto-Malayo-Polynesian position of FT-BIN

The inherited ranking (reconstructable to PMP) is shown below on tableaux with schematized inputs. I have tried to simplify the presentation by only including the necessary constraints and candidates based on attested subminimal word repairs. Epenthesis, for example, is not considered for this reason.

a

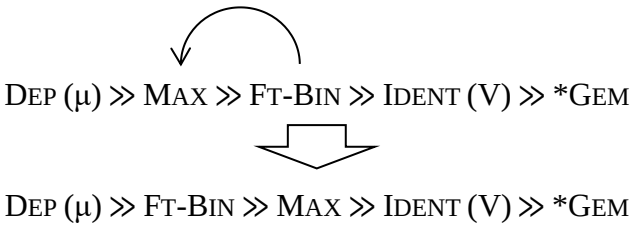
/CVCəCVC$^{\mu\mu}$/	DEP (μ)	MAX	FT-BIN	IDENT (V)	*GEM
☞ a. [CV$_{\mu}$ (CəCVC)$^{\mu}$]			*		
b. [CV$_{\mu}$ (CəC:VC)$^{\mu\mu}$]	*!				*
d. [CV$_{\mu}$ (CVCVC)$^{\mu\mu}$]	*!			*	
e. [(CVCCVC)$^{\mu\mu}$]		*!			

b

/CəCVC$^{\mu}$/	DEP (μ)	MAX	FT-BIN	IDENT (V)	*GEM
☞ a. [(CəCVC)$^{\mu}$]			*		
b. [(CəC:VC)$^{\mu\mu}$]	*!				*
d. [(CVCVC)$^{\mu\mu}$]	*!			*	
e. [(CCVC)$^{\mu}$]		*!	*		

5.5 Post PMP developments (schwa-deletion first, gemination second)

Post-PMP sound change worked to reinforce a two-mora minimum. This is achieved via promotion of FT-BIN. With the correct proto-ranking, we can see that the first promotion event triggers penultimate schwa deletion in three syllable words, but leaves two syllable words unchanged. Deletion in a two-syllable word generates an output which still violates FT-BIN, resulting in a tie that is broken by MAX-IO militating against deletion.



a

/CVCəCVC$^{\mu\mu}$/	Dep (μ)	Ft-Bin	Max	Ident (v)	*Gem
a. [CV$^{\mu}$ (CəCVC)$^{\mu}$]		*!			
b. [CV$^{\mu}$ (CəC:VC)$^{\mu\mu}$]	*!				*
d. [CV$^{\mu}$ (CVCVC)$^{\mu\mu}$]	*!			*	
☞ e. [(CVCCVC)$^{\mu\mu}$]			*		

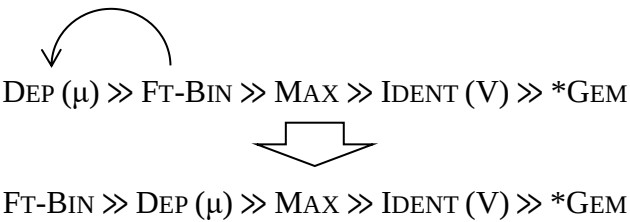
b

/CəCVC$^{\mu}$/	Dep (μ)	Ft-Bin	Max	Ident (v)	*Gem
☞ a. [(CəCVC)$^{\mu}$]		*			
b. [(CəC:VC)$^{\mu\mu}$]	*!				*
d. [(CVCVC)$^{\mu\mu}$]	*!			*	
e. [(CCVC)$^{\mu}$]		*	*!		

A great number of Austronesian languages reflect this change, especially in the Philippines where nearly all languages have deleted schwa in open penults in three-syllable words. Once the penultimate schwa is deleted, no further word-alterations are necessary, and gemination never targets previously three-syllable words.

5.6 Gemination

In the Philippines only a subset of the languages geminated consonants after a penultimate schwa. The proposed proto-ranking, DEP(μ) >> MAX >> FT-BIN captures this fact as a consequence of the continued promotion of FT-BIN in some but not all languages. Note that the input for previously three-syllable words has changed to match the output of the previous reranking.



a

/CVCCVC$^{\mu\mu}$/	Ft-Bin	Dep(μ)	Max	Ident (v)	*Gem
a. [CV$^{\mu}$ (CəCVC)$^{\mu}$]	*!				
b. [CV$^{\mu}$ (CəC:VC)$^{\mu\mu}$]		*!			*
d. [CV$^{\mu}$ (CVCVC)$^{\mu\mu}$]		*!		*	
☞ e. [(CVCCVC)$^{\mu\mu}$]					

b

/CəCVC$^{\mu}$/	Ft-Bin	Dep(μ)	Max	Ident (v)	*Gem
a. [(CəCVC)$^{\mu}$]	*!				
☞ b. [(CəC:VC)$^{\mu\mu}$]		*			*
d. [(CVCVC)$^{\mu\mu}$]		*		*!	
e. [(CCVC)$^{\mu}$]	*!		*		

Promotion over MAX but not DEP(μ).

Palawan

*bəRas → *bəgás* ‘uncooked rice’ *qaləjaw → *ʔaldáw* ‘day’

Cebuano

*bəRas → *bugás* ‘uncooked rice’ *qaləjaw → *adláw* ‘day’

Chamorro

*bəRas → *pugas* ‘uncooked rice’ *qaləjaw → *atdaw* ‘day’

Promotion over MAX and DEP(μ).

Ilokano

*dəŋəR → *dəŋːág* ‘hear; listen’ *qaləjaw → *aldáw* ‘day’

Isnag

*bəRas → *bagːát* ‘uncooked rice’ *qaləjaw → *alxáw* ‘day’

Tae’

*bəRas → *barːaʔ* ‘uncooked rice’ *baqəRu → *baʔru* ‘new’

The observed sound changes therefore suggest the following constraint movement path: FT-BIN was promoted gradually in such a way as to first trigger penultimate vowel deletion, followed by gemination.

DEP (μ) ≫ MAX ≫ FT-BIN ≫ IDENT (V) ≫ *GEM

DEP (μ) ≫ FT-BIN ≫ MAX ≫ IDENT (V) ≫ *GEM

FT-BIN ≫ DEP (μ) ≫ MAX ≫ IDENT (V) ≫ *GEM

5.7 Irregularity and constraint ranking

The previous section outlined a series of promotions of FT-BIN which explains observed outputs in Philippine languages quite well.

In many languages outside of the Philippines, a complication arises in the irregular deletion of schwa in three-syllable words. Some examples below show both how schwa is irregularly deleted in multiple MP branches, as well as how the irregularity affects different lexemes in different subgroups, which makes it unlikely that a specific condition acted upon the process.

5.7.1 Various implementation of penultimate schwa deletion in three-syllable words

*baqəRuh ‘new’

SS	*baʔRu	Tae’ *baʔru*
CMP	*baʔRu	Rembong *waru*, Adonara *wuʔu*

*bəRəqat ‘heavy’

WIN	*bəRʔat	Maanyan *ma-veʔat*, Idaan *bəgkat*, Malay *bərat*
CMP	*bəRʔat	Manggarai *berat*, Adonara *baʔat*

*qapəju ‘gall’

WIN	*qə(m)pəd:u	Kelabit *pədtu*, Malay *həmpədu*, Iban *əmpədu*
SS	*pəz:u	Tae’ *paʔdu*
CEL	*apəju	Bare’e *apoju*, Uma *poju*

*haRəzan ‘ladder’

WIN	*Rəz:an	Idaan *gədtan*, Kelabit *ədtan*, Hovongan *hacan*
SUM	*Rədan	Nias *ora*, Karo Batak *rədan*, Mentawai *orat*
CEL	*əjan	Uma *oda*, Bare’e *eja*, Wolio *oda*
CMP	*Rəd:an	Manggarai *redeŋ*, Rotinese *eda*, Kamarian *elan*

*qaləjaw ‘day’

WIN →	*ləd:aw	Lebo’ Vo’ *ɗaw*, Kelabit *ədto*, Idaan *sədtaw*
WIN →	*aldaw	Ukit *alo*, Punan Bah *elow*, Melanau *law*
CMP	*ləd:aw	Bimanese *liro*, Kodi *loddo*, Tetun *loro*
SS	*əz:aw	Buginese *esso*, Makasarese *allo*,
OC →	*qalcaw	Samoan *aso*, Hawaiian *ao*, Tuvaluan *aho*
OC →	*qalcaw	Wuvulu *alo*, Tangoa *alo*, South Efate *al*

*tuqəlaŋ ‘bone’

WIN →	*tuʔlaŋ	Idaan *tul:aŋ*, Kejaman *tuʔleꝺ̲ŋ*, Malay *tulaŋ*
WIN →	*tuʔəlaŋ	Maanyan *taʔulaŋ*, Samihim *tuʔulaŋ*

5.7.2 Diachronic Reranking, Lexical diffusion, and variability in sound change implementation.

As already discussed, the Diachronic Reranking Hypothesis requires an intermediate stage of variability. Variability is observable in synchronic applications, but what about in diachronic sound change?

In several cases the deletion of schwa in three-syllable words applied to some but not all words. This suggests that the sound change was lexicalized in different lexemes at different rates but that lexicalization was not complete before other sound changes took over. This follows the predictions of the LEXICAL DIFFUSION hypothesis, which states that sound change is lexicalized gradually, as the change works its way through the lexicon (Wang and Cheng 1977)

Diachronic Reranking and Lexical Diffusion appear to have interacted with one another in MP. We can see signs that FT-BIN first overtook MAX even in languages where deletion of schwa is not regular.

I will demonstrate how DR and LD may have interacted to produce diverging outputs in the reflexes of some three-syllable words in Western Indonesian languages with the following lexemes:

PMP *tuqəlaŋ ‘bone’, PMP *haRəzan ‘ladder’ (> pre-PWIN *aRəzan), PMP *qapəju ‘gall; bile’.

Stage one: variable ranking between MAX and FT-BIN

/tuqəlaŋ/ /aRəzan/ /qapəju/	DEP (μ)	MAX	FT-BIN
(☞) a. [tuqəlaŋ]			*
(☞) a. [aRəzan]			*
(☞) a. [qapəju]			*
b. [tuqəlːaŋ]	*!		
b. [aRəzːan]	*!		
b. [qapəjːu]	*!		
(☞) c. [tuqlaŋ]		*	
(☞) c. [aRzan]		*	
(☞) c. [qapju]		*	

/tuqəlaŋ/ → [tuqəlaŋ]/[tuqlaŋ]
/aRəzan/ → [aRəzan]/[aRzan]
/qapəju/ → [qapəju]/[qapju]

Various sound changes are implemented in Western Indonesian before FT-BIN was fully promoted to the top of the tableau.

First, Pre-penultimate vowels fell together as *ə in Proto-Western Indonesian

Second, schwa further deleted where it was word-initial.

How these changes impact three-syllable words depends on the lexicalization of the outputs of the previous tableau. For example, *tuqəlaŋ ‘bone’ was lexicalized with schwa deletion, so the previously antepenultimate *u became penultimate in the lexicon. Other words, like *haRəzan ‘ladder’ and *qapəju ‘bile’, do not appear to have lexicalized with schwa-deletion. The antepenultimate vowels were therefore reduced.

The final tableau, where FT-BIN overtook MAX and moved on to overtake DEP (μ), would have /tuqlaŋ/, /Rəzan/, and /qəpəju/ as inputs.

Final stage

	/tuqlaŋ$^{\mu\mu}$/ /Rəzan$^{\mu}$/ /qəpəju$^{\mu}$/	FT-BIN	DEP(μ)	MAX
	a. [tu$^{\mu}$ (qəlaŋ)$^{\mu}$]	*!		
	a. [(Rəzan)$^{\mu}$]	*!		
	a. [qə(pəju)$^{\mu}$]	*!		
	b. [tu$^{\mu}$ (qəlːaŋ)$^{\mu\mu}$]		*!	
☞	b. [(Rəzːan)$^{\mu\mu}$]		*	
☞	b. [qə(pəjːu)$^{\mu\mu}$]		*	
☞	c. [(tuqlaŋ)$^{\mu\mu}$]			
	c. [(Rzan)$^{\mu}$]	*!		*
	c. [(qəpju)$^{\mu\mu}$]		*	*!

/tuqlaŋ/ → tuqlaŋ ‘bone’
/Rəzan/ → Rəzːan ‘ladder’
/qəpəju/ → qəpədːu ‘gall’

5.8 Penultimate vowel shift

The approach I have taken to diachronic reranking predicts that sound changes which require more constraint movement will be less attested across a language family. We find such a sound change in the shift of schwa to /o/ in a single subgroup, Eastern Malayo-Polynesian. The rarity of this change is due to the double requirement that FT-BIN be sufficiently highly ranked while IDENT (V) must be simultaneously ranked low enough to allow vowel shift to occur in the first place.

DEP (μ) ≫ MAX ≫ FT-BIN ≫ IDENT (V) ≫ *GEM

DEP (μ) ≫ FT-BIN ≫ MAX ≫ IDENT (V) ≫ *GEM

FT-BIN ≫ DEP (μ) ≫ MAX ≫ *GEM ≫ IDENT (V)

a

/CəCVCᵘ/	Ft-Bin	Dep(μ)	Max	Ident (V)	*Gem
a. [(CəCVC)ᵘ]	*!				
☞ b. [(CəC:VC)ᵘᵘ]		*			*
c. [(CVCVC)ᵘᵘ]		*		*!	
d. [(CCVC)ᵘ]	*!		*		

b

/CəCVCᵘ/	Ft-Bin	Dep(μ)	Max	*Gem	Ident (V)
a. [(CəCVC)ᵘ]	*!				
b. [(CəC:VC)ᵘᵘ]		*		*!	
☞ c. [(CVCVC)ᵘᵘ]		*			*
d. [(CCVC)ᵘ]	*!		*		

The multiple movements necessary to achieve a necessary ranking predict that vowel shift will be quite rare as a mora addition strategy, which is indeed the observed pattern in Austronesian.

6 Conclusions

Three sound changes, deletion of the penultimate schwa-syllable in three-syllable words, gemination of final-syllable onsets after a penultimate schwa, and the shift of schwa to a full vowel (/o/) in the penultimate syllable, all appear to restore subminimal words to a two-mora minimum. FT-BIN promotion over intervening constraints may motivate these changes and the inherited ranking of constraints results in specific outcomes.

- The initial promotion is also the most widely attested since it includes only a single movement:
  MAX ≫ FT-BIN → FT-BIN ≫ MAX.
- Gemination is triggered by a second movement:
  DEP (μ) ≫ MAX ≫ FT-BIN → DEP (μ) ≫ FT-BIN ≫ MAX → FT-BIN ≫ DEP (μ) ≫ MAX
- The third sound change, penultimate vowel shift, requires multiple constraint movements and is predictably the least attested:
  DEP (μ) ≫ MAX ≫ FT-BIN ≫ IDENT (V) ≫ *GEM → FT-BIN ≫ DEP (μ) ≫ MAX ≫ *GEM ≫ IDENT (V)

When sound change occurs that eliminates a marked structure, the choice of output depends on the rankings of other constraints. In Diachronic OT, we can clearly see that the motivation for a certain sound change to occur more frequently than another equally motivated sound change is the result of inherited rankings and the requirement that constraints must move step-by-step in gradual movements.

Finally, variation in the implementation of sound change, such as the variable deletion of schwa in three-syllable words, is the product of intermediate variability as predicted by the Diachronic Reranking Hypothesis. In MP, we see that the swift promotion of FT-BIN occurred before lexicalization of all syncopated outputs. The Lexical Diffusion model of sound change, along with Diachronic Reranking, provides an explanation for medial schwa deletion which has until now been treated as a random subgroup-wide irregularity.

THANK YOU FOR LISTENING!

QUESTIONS/COMMENTS?

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