More odd conditions? Voiced obstruents as triggers and suppressors in Miri, Sarawak*

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Miri, an Austronesian language spoken in northern Sarawak, Malaysia, has two sets of vowel changes that are conditioned by voiced obstruents. In the first set, a last-syllable low vowel is fronted and raised to [e], or less commonly [i], if a voiced obstruent appears earlier in the word, while a penultimate low vowel immediately following the trigger is skipped. In the second, a high vowel in the final syllable undergoes breaking (diphthongisation) or lowering, depending upon specific conditions, *unless* there is a voiced obstruent anywhere earlier in the word. For both triggers and suppressors, this effect is cancelled by an intervening blocking consonant, which includes any nasal or voiceless obstruent except glottal stop. The challenge is to understand why voiced obstruents have this double function, acting as a trigger with low vowels and a suppressor with high vowels, given the lack of an *a priori* transparent relationship between low vowel fronting and high vowel breaking/lowering.

1 Background

Blust (2017) argues that, contrary to common belief, a surprising number of sound changes are conditioned in ways that appear to be unrelated to the phonetic environment. In other words, the relationship between the type of change taking place and the environment in which it occurs appears to have no linguistic significance in these cases, an observation that holds true even where the form of the change shows that speakers are aware of natural classes. For example, in the Papuan language Orokolo, intervocalic *t has become /k/ between vowels of the same or ascending height, but has become /l/ or /r/ between vowels of descending height, a change that has no

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clear phonetic motivation, but which presupposes that speakers are aware of the categorial membership of vowels as defined by height.

An unusual set of sound changes in Miri, a moribund Austronesian language spoken in northern Sarawak, Malaysian Borneo, initially appears to fit this perplexing pattern. However, further study shows that this change is in fact phonetically motivated in ways that involve the complex operation of the aerodynamic voicing constraint (Ohala 1983, 1997, 2011). Despite this explanatory success, the proposal advanced here does not quite succeed in eliminating all odd conditions, as several details of these changes in Miri (and other related languages) continue to elude any straightforward phonetic explanation.

2 The problem

Voiced obstruents have long been known to embody an inherent articulatory contradiction: airflow is needed to produce voice, and suppression of airflow is needed to produce an obstruent. Although many languages are able to live with this contradiction, many others have found ways to avoid it. The most common of these avoidance strategies undoubtedly is final devoicing, found in many of the world's languages (Blevins 2006, Iverson & Salmons 2011). Other, more exotic, strategies employed to cope with the same phonetic dynamics are the development of typologically rare voiced aspirates from earlier geminates in the Dayic languages of northern Sarawak (Blust 2006, 2016), and the nasalisation of final voiced stops as an alternative to final devoicing in a number of the languages of insular Southeast Asia (Blust 2018).

Quite apart from how the contradictory specifications for voiced obstruents affects these consonants themselves, the articulation of voiced obstruents also affects the perception of following vowel height as a result of physical constraints on the production of voice. Voice requires air to pass through the larynx, but with a stop there is no outlet, increasing the supraglottal pressure, and forcing the larynx to lower, which momentarily lengthens the pharyngeal cavity, an effect that continues briefly after the occlusion is released. When this happens, it alters the acoustic properties of the resonating chamber, thus lowering the frequency of the first formant, an effect that correlates perceptually (or in articulatory terms) with greater vowel height (Hudgins & Stetson 1935).[1]

This tendency is well established for the Mon-Khmer languages of mainland Southeast Asia (Henderson 1965), and Thurgood (1999: 205–209) documents it as well for the Chamic (Austronesian) languages that underwent areal adaptations to their Mon-Khmer neighbours. In these languages, which are subject to registrogenesis, voiced obstruents have two prominent effects on following vowels: they trigger breathy voice, which spreads through sonorants and possibly *s and *h, and raise the

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[1] I am much indebted to Erik Thomas for explaining the details of this process and providing references to the relevant literature.

height of following vowels unless this effect is blocked (in most languages) by a medial voiceless stop.

The problem addressed here is superficially different, in that breathy voice is absent, low vowels appear to front rather than raise following a voiced obstruent earlier in the word, and high vowels are lowered in some contexts, but diphthongise in others unless a voiced obstruent occurs earlier in the word, in which case they do not change. At least initially, then, voiced obstruents appear to condition two fundamentally distinct phonological processes in the same language, one fronting low vowels and the other suppressing either the breaking or lowering of high vowels. The challenge is to show why this type of conditioning should exist.

3 The language

Miri is an Austronesian language apparently still spoken by a few people near the coastal city of the same name just south of the mouth of the Baram river in northern Sarawak, Malaysian Borneo (Abdul Ghani & Ridzuan 1992: 133–134). The data in this paper were recorded from April to June 1971, at which time the language was already being abandoned by many community members who preferred to be considered 'Malays' (for a perspective on language shift from Miri to Malay from a slightly later time period see Abdul Ghani & Ridzuan 1992).[2]

As argued in Blust (1974), and repeated in several later publications, Miri belongs to the Berawan-Lower Baram division of North Sarawak, a collection of some 30–35 languages and dialects. Among the extant members of this group, it is most closely related to Narum, which is spoken near the market town of Marudi, about 35 miles inland as the crow flies, but closer to 57 miles as the river winds. It is more distantly related to Kiput, Belait and the Berawan languages within the Berawan-Lower Baram group, and to Bintulu, the Kenyah languages and Dayic (Kelabit-Lun Dayeh) in other primary branches of North Sarawak.

The Miri phoneme inventory is shown in (1).

(1)

p		t		k	ʔ		i		u
b		d	ʤ	g			e	ə	o
m		n	ɲ	ŋ				a	
	f	s			h				
		l							
		r							
w			j						

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[2] I worked with Mr Pito bin Mantali, a groundskeeper at Tanjong Lobang College, and a speaker of the Pujut dialect, who was probably in his early to mid sixties at the time. According to him, most younger people were not learning the language then, a situation that could only have worsened in the ensuing years.

The voiceless stops of Miri are unaspirated, some /m/ and /n/ may be post-ploded medial nasals [mᵇ] and [nᵈ] (nasals followed by an extra-short voiced stop), and /r/ is an alveolar tap or trill. The vowels have their canonical values, except that /e o/ are usually laxed when not preceding another vowel, and are long in the final syllable, which carries primary stress (hence /aɡes/ → [aˈɡɛːs] 'sandfly'). Distributionally, /ə/ and /a/ contrast in the penult, but have merged as the low vowel in the ultima, and are in free variation in the antepenult, with a preference for /a/.

Like almost all coastal languages of Sarawak, Miri has been heavily exposed to Malay since the establishment of the politically and culturally dominant Sultanate of Brunei in 1368. In more recent years, it has also been exposed to the national language, Bahasa Malaysia, which derives from a southern peninsular form of Malay. Because Malay loanwords may have been introduced at different time periods and from different dialects, they will be treated with caution in this paper: many reflect the same patterns of change found in the native vocabulary, but where there are exceptions these may be explainable by the chronology or source of borrowing.

4 The data

The data relevant to conditioning of vowel qualities by a preceding voiced obstruent will be presented in two parts, beginning with the effects on low vowels.

4.1 Low vowel fronting

Low vowel fronting is found in a number of the languages of northern Sarawak (Blust 2000). In most of these languages a low vowel fronts immediately after a voiced obstruent. For the North Sarawak languages this means any of eight inherited consonants, a series of plain voiced obstruents at labial, alveolar, palatal and velar places (Proto-North Sarawak (PNS) *b, *d, *ʤ, *g), and a parallel series of typologically rare voiced aspirates (PNS *bʰ, *dʰ, *ʤʰ, *gʰ).[3] In addition, some languages, such as Miri, have developed historically secondary /b/ and /ʤ/ through glide fortition, including the automatic glides between *i or *u and a following unlike vowel, and these also trigger LOW VOWEL FRONTING (LVF), as in *lia ([lija]) > *ləʤeh* 'ginger' or *dua ([duwa]) > *dəbeh* 'two'. The most common form of LVF is seen in the Long Terawan dialect of Berawan (LTB), where *a is fronted immediately after a voiced obstruent regardless of its position in the word, as in PNS *adaʔ > LTB *adi* 'shadow', *batu > *bittoh* 'stone', *Ratas (> *gatas) > *gita* 'milk', but not after other

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[3] Notwithstanding statements in the generalist phonetics literature (Ladefoged & Maddieson 1996: 80), these segments are unit phonemes, not consonant clusters (Blust 2006, 2016).

consonants, as with *mata > *mattəh* 'eye', *paʔa > *paʔəh* 'thigh', *kami > *kammeh* '1PL EXCL', *laki > *lakkeh* 'male', etc.

Miri differs from this pattern in targeting low vowels only in the last syllable, regardless of the distance to the trigger. In *adan > *aden* 'name', *tugal > *tugel* 'dibble stick' and *uban > *uben* 'grey hair', where the trigger is the onset of the final syllable, LVF appears to follow the same pattern as in LTB. However, in reflexes of words with an initial voiced obstruent and two low vowels, like *daʔan > *daʔen* 'branch' and *ʤalan > *ʤalen* 'path, road', the trigger targets a low vowel in the final syllable even though it immediately precedes a low vowel that is unaffected (cf. PNS *daʔan > LTB *diʔən* 'branch', *ʤalan > *ilan* 'path, road'). It has been suggested that this pattern might be dissimilatory, but in *baRu > *baruh* 'new', *daʔi > *daʔih* 'forehead' and a number of other examples, dissimilation is not an option.

Like some other languages, Miri reflects the PNS voiced aspirates as voiceless fricatives or stops, but fronts a following low vowel, which shows that these consonants were still voiced obstruents at the time of LVF: *əbʰaʔ > *feʔ* 'fresh water, river', *mədʰan > *masen* 'to faint, pass out', *əʤʰa > *seh* 'one', *pəgʰəl > *məkel* 'to sleep'. Finally, some words, such as *məkel,* were recorded only in their active verb forms with homorganic nasal substitution, rather than in their unaffixed nominal base form.

Two interrelated features of LVF in Miri distinguish it from this phenomenon in most other languages. The first, which has been mentioned already, is that a low vowel is fronted only in the last syllable (I recorded no suffixes, and hence no synchronic alternations between /a/ and /e/). As a result, trigger and target are often separated by a VC sequence. Where the consonant of such a sequence is a supraglottal voiceless stop or a nasal, it neutralises the effect of the preceding voiced obstruent. Thus, LVF is seen in PNS *baRa > *bare* 'ember', *busak > *buek* 'flower', *ʤalaʔ > *ʤələʔ* 'tongue', but not in *bituka > *batukah* 'intestines', *dəpa > *dəpah* 'fathom', *gatəl > *gatal* 'itchy', *bana > *banah* 'husband', *danaw 'lake' > *danaw* 'pond', *ʤamaʔ > *ʤamaʔ* 'dirty'. This second feature of LVF in Miri is particularly puzzling, since in Narum, its closest living relative, the fronting of last-syllable vowels may also be triggered at a distance, but there are no blocking consonants (thus *dəpa > *dəpeəh* 'fathom', *gatəl > *gatel* 'to itch, itchy', *danaw > *daniəw* 'lake', *ʤaməʔ > *ʤameʔ* 'dirty'). As a result, LVF in bases with a trigger + blocking consonant patterns like bases without a trigger in Miri, but like bases with a trigger in Narum, as will be shown below.

4.2 Vowel breaking: the major pattern

Many languages in Sarawak, particularly those on or near the coast, show a pattern of vowel breaking or diphthongisation in which *i, *u and occasionally *a (which was raised to /e/) developed a mid-central offglide before -*k* and -*ŋ*, but not -*g* (hence -*iək*, -*iəŋ*, -*ig*) and a mid-central onglide word-finally. Table I summarises variations in this pattern across ten language communities.

Proto-North Sarawak	*-ik	*-iŋ	*-uk	*-uŋ	*-ak	*-aŋ	*-i	*-u
Kiput	-iəʔ	-iə	-uəʔ	-uə	-ak	-aŋ	-əj	-əw
Balingian Melanau	-iək	-iəŋ	-uk	-u(ə)ŋ	-ak	-aŋ	-əj	-əw
Mukah Melanau	-iəʔ	-iəŋ	-uəʔ	-uəŋ	-eəʔ	-eəŋ	-əj	-əw
Dalat Melanau KT	-iək	-iəŋ	-uək	-uəŋ	-ak	-aŋ	-əj	-əw
Dalat Melanau KK	-eək	-eəŋ	-oʔ	-u	-iʔ	-i	-əj	-əw
Matu Melanau	-it	-in	-ok	-oŋ	-ak	-aŋ	-əj	-əw
Sarikei Melanau	-iəʔ	-in	-uəʔ	-uəŋ	-ak	-aŋ	-aj	-aw
Uma Juman Kayan	-iək	-iəŋ	-ok	-oŋ	-ak	-aŋ	-eʔ	-oʔ
Uma Bawang Kayan	-ik	-iŋ	-uk	-uŋ	-eək	-eəŋ	-eʔ	-oʔ
Long Wat Kenyah	-iək	-iəŋ	-uək	-uəŋ	-ak	-aŋ	-əj	-əw

Table I

Patterns of vowel breaking in languages of Sarawak (predictable glides
are omitted). KT (Kampung Teh) and KK (Kampung Kekan) are
two subdialects of Dalat Melanau. Adapted from Blust (2013: 655).

4.3 Vowel breaking in Miri

Miri differs from most of these languages in both positive and negative
respects. Specifically, vowel breaking occurs before some final consonants
other than velars, and is suspended in some cases where it would be
expected. Like most North Sarawak languages, Miri offers many chal-
lenges in its historical phonology, and perhaps the most puzzling of
these is a large set of examples in which high vowels in the final syllable
show no change of shape, neither breaking nor lowering.

The full range of reflexes is given in Table II. The diphthongs -*aj*/-*aw*
are written -*ai*/-*au* before a consonant, including the historically secondary
-*h*. Numbers represent instances of each type of change attested in the data
cited below: 0 = either no examples of this sequence were available in
reconstructed forms, or examples were available, but none showed this
change; postvocalic vowels and glides were not counted; palatals and /f/
do not occur as codas, and -*p* and -*m* are rare (the sole example of *-um
in my data is found in *məɲum* 'to drink').

To summarise, lowering of high vowels in the last syllable occurs in 22
cases and breaking in 43, and there is no change in 45. Since 'no change'
means neither breaking nor lowering, there are 65 cases in which a last-syl-
lable high vowel either diphthongises or lowers, and 45 in which no change
occurs. The puzzle to be solved, then, is why there is no change in 45 of 110
etymologies, while either vowel breaking or lowering occurs in 65 others,
often in what appears to be the same environment. In short, at first glance
it appears to be impossible to predict when a high vowel undergoes a
change (breaking or lowering) or remains unchanged.

At face value, Table II shows a 65–45 split between high vowels in the final
syllable that underwent either breaking or lowering and those that remained

PNS Miri	i e	i aj	i i	u o	u aw	u u
*-p	0	0	0	0	0	0
*-t	0	5	0	3	0	4
*-k	1	0	0	4	0	7
*-ʔ	0	5	2	0	6	5
*-b	0	0	0	0	0	0
*-d	0	0	1	0	0	4
*-g	0	0	0	0	0	0
*-m	0	0	0	0	0	1
*-n	0	3	1	6	0	1
*-ŋ	2	0	1	1	0	3
*-s	0	3	0	0	1	0
*-l	0	0	0	2	0	1
*-R	0	0	0	3	0	1
*-Ø	0	9	5	0	11	8
	3	25	10	19	18	35

Table II
All reflexes of last-syllable high vowels in Miri, by frequency.

intact. However, when the voicing of preceding obstruents is taken into account, nearly every example falls into place. This is particularly surprising, since the trigger in LVF is a preceding voiced obstruent. With final-syllable high vowels rather than low vowels, on the other hand, a preceding voiced obstruent appears to act as a suppressor, preventing a process that would otherwise be much more general. In other words, last-syllable vowels are affected by an unobstructed preceding voiced stop in one of two ways: (i) *a > e (rarely *i*); (ii) *i/u fail to become -*aj*/-*aw* or -*e*/-*o*. What feature these two functions share is at first sight a mystery.

The most systematic way to present the relevant data is probably by citing developments in one environment at a time (reconstructions with a high vowel preceding a final labial or /g/ are rare, and are omitted here). Note that where glosses of reconstructions and reflexes differ, the former appears before a semicolon and the latter after it. A double asterisk here and elsewhere marks a form as irregular. In all environments, the sub-types are (i) no preceding voiced obstruent, (ii) a preceding voiced obstru-ent with an intervening blocking consonant and (iii) a preceding voiced obstruent without an intervening blocking consonant.

Finally, Narum examples are included for ease of comparison, but will not be discussed further.

4.3.1 Word-final high vowels

(2) a.

	PNS	Miri	Narum	
i.	*əsi	saih	saj	'flesh, meat'
	*kami	—	hamaj	'we (EXCL)'
	*laki	lakaih	lahaj	'male'
	*nupi	nupaih	nupaj	'dream'
	*paRi	faraih	paraj	'stingray'
	*pəlaki	falakaih	—	'hawk, eagle'
	*puki	fukaih	puhaj	'vagina'
	*punti	futaiʔ[4]	putaj	'banana'
	*tali	talaih	—	'rope'
	*taʔi	taʔaiʔ	taiʔ	'faeces'
ii.	*buɲi	**muɲih	uɲeəj	'a sound; to sound'
	*ʤəRami	—	ʤərameəj	'rice straw; rice shoots'
iii.	*bəli	fəlih	məneəj[5]	'to buy'
	*daʔi	daʔih	—	'forehead'
	*tadi	tadih	tadeəj	'younger sibling'
	*ubi	ubih	ubeəj	'yam; sweet potato'

b.

	PNS	Miri	Narum	
i.	*-ku	—	kaw	(1SG POSSESSOR)
	*ləmu	ləmauh	—	'fat'
	*liku	likauh	lihaw	'sink hole in river; river'
	*ɲilu	ma-ɲilauh	—	'rheumatic pain'
	*ɲiRu	ɲirauh	—	'winnowing basket'
	*paku	—	pahaw	'fern'
	*pəɲu	fəɲauh	pəɲoʔ	'green turtle'
	*siku	ikauh	ihaw	'elbow'
	*silu	ilauh	ilaw	'fingernail'
	*təlaʔu	talaʔauh	təlaʔaw	'barking deer'
	*təlu	təlauh	təlaw	'three'
	*tuʔu	—	tuʔeəw	'right side, truth'
ii.	*batu	batauh	bateəw	'stone'
	*kutu[6]	gutauh	guteəw	'head louse; louse'

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[4] With irregular final glottal stop in this and *taʔi > taʔaiʔ.

[5] Narum /l/ alternates with /n/ following a nasal, as in *hulet* 'skin', *m-unet* 'to skin', and *pulaut* 'latex', *m-unaut* 'to collect latex'.

[6] With sporadic change *kutu > *gutu in a language ancestral to at least Miri and Narum.

iii.

*abu	abuh	abeəw	'ashes'
*adu	—	adeəw	'much, many'
*baʔu	bau	biw	'odour, smell'
*baRu	baruh	bəreəw	'new'
*bubu	—	bubeəw	'bamboo fish trap'
*bulu	buluh	buleəw	'body hair; feathers'
*dalu	—	daleəw	'angry'
*kaju	adʒuh	hajeəw	'wood, tree'
*pədʰu	fəduh ~ fəsuʔ[7]	pəteəw	'gall, gall bladder'
*Ribu	ribuh	ribeəw	'thousand'
*təbʰu	təfuh	təfaw	'sugarcane'

The first difference to note between the languages in Table I and Miri is that vowel breaking in most languages of Sarawak changed *-i/u to -əj/ -əw, but in Miri these have become -ai/-au or -aj/-aw, with a low vowel diphthongal nucleus. However, Miri may have begun with *-i > -əj and *-u > -əw, since *a and *ə merged as /a/ in the final syllable: PNS *anak > anak 'child', *əpat > pat 'four', *nakan > nahan 'small jackfruit sp.', *ənəm > nam 'six', *gatəl > gatal 'to itch', *dʒəkət > dʒukat 'to burn fields'.[8]

The second difference to note is that, while Miri followed a common Sarawak pattern in adding -h after final vowels, it also added -h after both historically derived and inherited word-final diphthongs, as in the above examples and *anaj > anaih 'termite', *m-ataj > mataih 'to die; dead', *sapaw > apauh 'roof', *takaw > nakauh 'to steal' (next to *danaw 'lake' > danaw 'pond', *laŋaw > laŋaw 'housefly', *tapaj > tapaj 'fermented rice', etc., which are unchanged). Aspirate addition appears to have been regular after derived diphthongs from earlier word-final high vowels, but is sporadic after original final diphthongs. In words that ended in *-is or *-us (see (7) below) it appears that vowel breaking preceded loss of the final consonant, since otherwise these words would have ended in a vowel at the time of diphthongisation, and, as already noted, words that earlier ended in *-i/-u seem invariably to have resulted in -aih/-auh.[9]

What is most noteworthy in these examples is the difference between the reflex of word-final high vowels in subtype (iii), where a preceding voiced obstruent occurs without an intervening blocking consonant (fəlih, daʔih, tadih, ubih, abuh, etc.), as against subtypes (i) (no preceding voiced obstruent) and (ii) (preceding voiced obstruent with blocking consonant). I will return to this point below.

[7] Expected **fəsuh.

[8] With penultimate /u/ from umlaut in active voice verbs (Blust 1997a).

[9] Vowel breaking does not appear to have taken place in words that already had a vowel sequence, as with *dʒauʔ > dʒauʔ (not **dʒaauʔ) 'far', *Rait > rait (not **raait) 'sand' and *sai (not **saaih) 'who?'. Where a vowel sequence developed secondarily, as in *asu > au (not **aauh) 'dog', neither vowel breaking nor aspirate addition occurred.

4.3.2 *Vowels preceding word-final* *ʔ

(3) a.
	PNS	Miri	Narum	
i.	*piliʔ	milaiʔ	pilaiʔ	'to choose'
	*putiʔ	futaiʔ	putaiʔ	'white'
	*titiʔ	titaiʔ	titaiʔ	'female breast'
	*uliʔ	m-ulaiʔ	m-unaiʔ	'turn around, go back'
ii.	*ʤaniʔ	ʤanaiʔ	sanæʔ	'near'
iii.	*abiʔ	abiʔ	—	'finished'
	*ləbʰiʔ	ləfiʔ	lumbaiʔ	'lie down to sleep'
	*pədʰiʔ	—	pətiʔ	'smarting; painful'

b.
	PNS	Miri	Narum	
i.	*ikuʔ	ihauʔ	ihauʔ[10]	'tail'
	*lasuʔ	lauʔ	laoʔ	'hot (as water)'
	*ɲatuʔ	ɲatauh[11]	—	'fruit tree, *Palaquium* sp.'
	*pəkuʔ	**fəkuʔ	pəkuʔ	'nape of the neck'
	*pənuʔ	fənauʔ	pənauʔ	'full'
	*puluʔ	**fuluʔ	pulauʔ	'ten'
	*pusuʔ	—	pauʔ	'heart of banana'
	*təkuʔ	təkauʔ	təkoʔ	'hook'
ii.	*bunuʔ	bunauʔ	—	'to kill'
iii.	*buluʔ	buluʔ	buluʔ	'bamboo (generic)'
	*əbʰuʔ	fuʔ	foʔ	'below, underneath'
	*tuʤuʔ	tuʤuʔ	tuʤuʔ	'seven; hand'

The pattern of breaking of high vowels before word-final glottal stop does not differ markedly from that of word-final high vowels. Although there are fewer examples, categories (i) and (ii) clearly pattern alike, showing the transformation of high vowels into diphthongs, while category (iii) preserves the high vowels intact.

4.3.3 *Vowels preceding word-final* *t

(4) a.
	PNS	Miri	Narum	
i.	*gərit	garait	—	'a scratch'
	*kəlit	—	kaleət	'cave bat'
	*kulit	ulait	huleət	'skin'
	*lampit	lapait	lapait	'rattan mat'
	*laɲit	laɲait	laɲait	'sky'
	*paʔit	—	paʔeət	'bitter'
	*sakit	sahait	sahait	'painful'

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[10] Presumably from a doublet of the better-attested *ikuR that is also found in e.g. Iban *ikoʔ* 'tail'.

[11] With unexplained word-final *-h*.

b.   *PNS*   *Miri*   *Narum*

　　i. *əput   —   paut   'puff; blowpipe'
　　　*ətut   —   tot   'fart'
　　　*pulut   fulot   pulaut   'breadfruit sap; latex'
　　　*Ramut   ramot   ramaut   'root'
　　　*siŋut   siŋot   siŋot   'snout, beak; nose'
　　ii. *bukut   **bukut   bukut   'a punch'
　　iii. *abut   —   abot   'bottom, posterior'
　　　*bubʰut   bufut   bufut   'crow pheasant'
　　　*puʤut   fuʤut   —   'to pick (fruit)'
　　　*sabut   sabut   sabot   'coconut husk'

The pattern of breaking before word-final /t/ differs in an important particular from the preceding sets of examples, in that *i diphthongises, while *u lowers. Again, there are relatively few examples, although the pattern is consistent. No examples of *-it with a preceding voiced obstruent in the word were recorded, and (4b.ii) is irregular, since the medial voiceless stop should have blocked the suppression of lowering seen in (4b.iii).

4.3.4 *Vowels preceding word-final *d*

(5) a.   *PNS*   *Miri*   *Narum*

　　i. *kuɲid   —   uɲit   'turmeric'
　　　*tumid   tumid ~ tumit   tumait   'heel'
b.   *PNS*   *Miri*   *Narum*

　　i. *alud   alud   alaut   'boat'
　　　*ətud   —   taut   'knee'
　　　*likud   lihud ~ lihut   ihaut   'back (anat.)'
　　　*tulud   tulud   tulaut   'to fly'
　　　*ubud   —   ubut   'palm shoots'
　　　*uʔud   uʔut   —   'upriver'

No examples of *-id or *-ud with a preceding voiced obstruent were recorded, but even given this limitation, a clearly divergent pattern is seen in the (i) set here, namely that high vowels are unchanged. Since there are five examples that conform to this pattern, and no exceptions, it seems reasonable to hypothesise that vowel breaking in Miri is suppressed not only when there is an unblocked voiced obstruent earlier in the word, but also when a final-syllable high vowel immediately precedes a stop that is, or was historically, voiced (Miri appears to be undergoing final devoicing, but the process was not yet complete at the time my data were recorded). Although this is not a condition for LVF, the available evidence leaves us at liberty to assume that voiced obstruents suppressed vowel breaking or lowering whether they preceded or *followed* a high vowel. If this condition is accepted as plausible, then these apparent exceptions can be seen as a

subtype of the general principle that a preceding voiced obstruent suppresses vowel lowering.[12]

4.3.5 *Vowels preceding word-final* *n

(6) a.

	PNS	Miri	Narum	
i.	*masin	masain	məsain	'salty; salty, sweet'
	*lamin	**amin	amain	'longhouse room; house'
	*ulin	f-ulain	ulain	'rudder; back of boat'
	*utin	utain	utain	'penis'

b.

	PNS	Miri	Narum	
i.	*luŋun	—	luŋaun	'coffin'
	*puʔun	fuʔon	puʔaun	'base of a tree'
	*talun	talon	təlaun	'fallow land; forest'
	*taʔun	taʔon	taʔaun	'year'
	*tənun	tanon	—	'weaving'
	*ulun	ulon	ulaun	'life (cf. *ʤəmulun)'
ii.	*ʤəmulun	ʤamulon	ʤəmunaun	'slave; person'
iii.	*daʔun	daʔun	dəʔon	'leaf'

Examples of *-in* were recorded only for subtype (i), but even so it is clear that *i and *u in this set pattern as they do before word-final /t/, namely with breaking of *i and lowering of *u. Although the (ii) and (iii) sets for *-un contain only one example each, these are consistent with the wider pattern in which a high vowel remains intact in set (iii).

4.3.6 *Vowels preceding word-final* *s

(7) a.

	PNS	Miri	Narum	
i.	*ma-nipis	ma-lifaj	mə-lipaj	'thin (materials)'
	*taŋis	taŋaj	taŋaj	'to weep, cry'
ii.	*bətis	bətaj	bəti	'calf of leg'

b.

	PNS	Miri	Narum	
i.	*Ratus	rataw	rataw	'hundred'

Examples of *-is and *-us are limited, and in every case *s has disappeared. Since -*h* is not found after any diphthong that resulted from loss of *-s, it is tempting to see the order of changes as (i) vowel breaking, (ii) addition of -*h*, (iii) loss of *-s. However, Narum has also lost final *s, but without adding -*h*, and as already noted, inherited *-aj and *-aw sometimes added -*h* and sometimes did not, leaving the matter in limbo.

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[12] I am indebted to Erik Thomas for pointing out to me that the vowel-raising effect of voiced obstruents is known to be bidirectional, as noted for example in Lisker (1986).

4.3.7 *Vowels preceding word-final* *l *and* *R

(8) a.	*PNS*	*Miri*	*Narum*	
i.	*tukul	tukol	tukaul	'hammer'
	*tumpul	**tupul	tupul	'dull, blunt'
ii.	*bakul	bakol	bakul	'type of basket'
b.	*PNS*	*Miri*	*Narum*	
i.	*apuR	apor	apaur	'chalk, lime'
	*iluR	iror	—	'spittle, saliva'
iii.	*bəsuR	**besor	bəsur	'full after eating'
	*sambuR	amur	—	'to sow, scatter seed'

Neither of these sets offers a clear picture of how high vowels developed preceding final liquids, in part because of apparent irregularities and in part because no examples of *-il or *-iR were recorded. It is possible that the Miri reflex of *sambuR is /amᵇur/, with a postploded medial nasal, since these segments are well attested in Narum (Blust 1997b).

4.3.8 *Vowels preceding word-final* *k

(9) a.	*PNS*	*Miri*	*Narum*	
i.	*itik	—	itaik	'duck, *Anas* sp.'
iii.	*burik	**burek	—	'speckled'
b.	*PNS*	*Miri*	*Narum*	
i.	*manuk	manok	manauk	'bird'
	*pi(ŋ)kuk	—	pihok	'to bend, bent'
	*pukpuk	mupok	pupok	'to pound, beat; to hit'
	*Rusuk	—	rauk	'ribcage; chest'
	*tukuk	tukok	—	'to peck'
ii.	*batuk	batok	batuk	'nape; neck'
iii.	*abuk	abuk	abuk	'dust'
	*bədʰuk	bəsuk	bətuək	'short-tailed macaque'
	*bubʰuk	bufuk	bufok	'wood weevil'
	*buRuk	buruk	burok	'rotten'
	*əbʰuk	fuk	fauk	'head hair'
	*kuduk	—	huduk	'to sit'
	*lubuk	lubuk	—	'submarine cavern; lake'
	*mabuk	mabuk	mabuək	'drunk'

Type (9a) is poorly represented, but (9b) provides valuable information. Here, where most languages of Sarawak show vowel breaking with a mid-central offglide, Miri has vowel lowering (shared with Matu Melanau and Uma Juman Kayan). Most importantly, there is complete agreement in

the four examples of sets (9b.i) and (9b.ii) in showing high vowel lowering, and the seven examples of set (9b.iii) in showing suppression of lowering.

4.3.9 *Vowels preceding word-final *ŋ*

(10) a.	*PNS*	*Miri*	*Narum*	
i.	*kəsiŋ	ŋəseŋ	ŋəseəŋ	'to laugh'
	*puliŋ	fuleŋ	—	'turn around'
iii.	*bəluʔiŋ	—	bəluʔiəŋ	'scythe, weeding tool'
	*giliŋ	—	giliŋ	'to roll, roll over something'
	*kabiŋ	abiŋ	abiŋ	'left side'
b.	*PNS*	*Miri*	*Narum*	
i.	*əluŋ	—	lauŋ	'mouth of a river'
	*əsuŋ	—	sauŋ	'rice mortar'
	*munuŋ	munoŋ	munauŋ	'upper lip; mouth'
	*utuŋ	**utuŋ	—	'extremity, tip'
ii.	*bətuŋ	—	bətuəŋ	'bamboo sp.'
iii.	*gəRuŋ	gəruŋ	gəroŋ	'thunder'
	*nibuŋ	nibuŋ	nibuəŋ	'nibong palm'
	*sabuŋ	—	sabuəŋ	'cockfight'
	*uʤuŋ	—	uʤuəŋ	'above'

Although there are fewer known cases of high vowels preceding a final velar nasal than preceding final *k, the pattern is reasonably clear, namely that high vowels lower in this environment unless preceded by an unblocked voiced obstruent. These patterns are summarised for ready reference in Table III, which is more fine-grained than Table II, in recognising subtypes (i)–(iii).

With regard to the patterns in Table III, it is clear that subtype (i) is the most robustly attested, since it does not require a voiced obstruent earlier in the word, and so includes a wide range of other possibilities. Under this condition, 60 examples show either breaking or lowering of a last-syllable high vowel, and five do not. Subtype (iii) is the second most robustly attested pattern, with 33 supporting examples and two counterexamples, since here all that is required is a voiced obstruent earlier in the word, without an intervening blocking consonant. The rarest pattern is subtype (ii), which requires both a voiced obstruent earlier in the word and an intervening blocking consonant that neutralises its effect, thus making it like subtype (i); here we have eight supporting examples and two counterexamples, suggesting that breaking consonants function less consistently than voiced obstruents. In total, there are 101 supporting cases and nine contrary ones, for a predictability rating of nearly 92%. This shows that there is a rather consistent pattern in which an unblocked preceding voiced obstruent suppresses the breaking or lowering of last-syllable high vowels in Miri reflexes of Proto-North Sarawak.

PNS	(i)	(ii)	(iii)
*-i	-aih (9–0)	-aih (0–1)	-ih (5–0)
*-u	-auh (9–0)	-auh (2–0)	-uh (8–0)
*-iʔ	-aiʔ (4–0)	-aiʔ (1–0)	-iʔ (2–0)
*-uʔ	-auʔ (5–2)	-auʔ (1–0)	-uʔ (3–0)
*-it	-ait (5–0)	—	—
*-ut	-ot (3–0)	-ut (0–1)	-ut (3–0)
*-id	-id (1–0)	—	—
*-ud	-ud (4–0)	—	—
*-in	-ain (3–1)	—	—
*-un	-on (5–0)	-on (1–0)	-un (1–0)
*-is	-aj (2–0)	-aj (1–0)	—
*-us	-aw (1–0)	—	—
*-ul	-ol (1–1)	-ol (1–0)	—
*-uR	-or (2–0)	—	-ur (1–1)
*-ik	—	—	-ek (0–1)
*-uk	-ok (3–0)	-ok (1–0)	-uk (7–0)
*-iŋ	-eŋ (2–0)	—	-iŋ (1–0)
*-uŋ	-oŋ (1–1)	—	-uŋ (2–0)

Table III
Patterns of vowel breaking and suppression in Miri. The
first number in parentheses is the number of supporting
examples; the second the number of contrary examples.

The contrary cases fall into three categories: five under subtype (i), in which vowel breaking or lowering is expected, but does not occur (*fəkuʔ*, *fuluʔ*, *amin*, *tupul*, *utuŋ*), two under subtype (ii), in which a voiced obstruent is found earlier in the word, but its suppressive effect on vowel breaking or lowering should have been neutralised by a blocking consonant (*buɲi > muɲih*, *bukut*), and two under subtype (iii), in which an unobstructed voiced obstruent is found earlier in the word, but vowel breaking or lowering still occurs (*bəsor*, *burek*). Two of these may be Malay loans (*tupul*, from Malay *tumpul* 'dull, blunt', and *burek*, from Malay *burek* 'speckled'), and one may be an Iban loan (*muɲih*, possibly from Iban *muɲi* 'make a sound'), but the others appear to be native, and their irregularity is unexplained. The only other qualification that might be made is that /s/, which is rare in medial position, may function as a blocking consonant in *bəsor*, like the voiceless stops.

The recognition that a general process of high vowel breaking or lowering is usually suppressed in Miri if an unblocked voiced obstruent is found earlier in the word is certainly significant in itself, but its significance is magnified enormously when it is recognised that low vowels in the final syllable are fronted under the same condition, since, at least initially,

these phenomena appear unrelated. The two processes can be compared side-by-side, as in (11).

(11) *Condition (a)*
   If there is no preceding voiced obstruent, *a is unchanged, and *i and *u diphthongise word-finally and preceding some final consonants. This can be called the default, or 'unmarked' condition.

Low vowel fronting	*High vowel backing*
*anak > *anak* 'child'	*laki 'male' > *lakaih* 'male'
*paʔa 'thigh' > *faʔa* 'lower leg'	*paRi > *faraih* 'stingray'
*tulaŋ > *tulaŋ* 'bone'	*tali > *talaih* 'rope'
	*ɲiRu > *ɲirauh* 'basket'
	*siku > *ikauh* 'elbow'
	*təlu > *təlauh ~ təloh* 'three'

   Condition (b)
   If there is a preceding voiced obstruent, but its effect on following vowels is neutralised by an intervening blocking consonant, the default condition still applies.

Low vowel fronting	*High vowel backing*
*bituka > *batukah* 'intestines'	*bətis > *bətaj* 'calf of the leg'
*dəpa > *dəpah* 'fathom'	*ʤaniʔ > *ʤanaiʔ* 'near'
*gatəl > *gatal* 'to itch, be itchy'	*batu > *batauh* 'stone'
*bana > *banah* 'husband'	*batuk 'nape' > *batok* 'neck'
*baŋaw > *baŋaw* 'white heron'	*bunuʔ > *bunauʔ ~ bunoʔ* 'to kill'
*ʤaməʔ > *ʤamaʔ* 'dirty'	*ʤəmulun > *ʤamulon* 'person'

   Condition (c)
   If there is a preceding voiced obstruent and its effect on following vowels is not neutralised by an intervening blocking consonant, low vowels in the last syllable are raised and fronted, and high vowels in this environment fail to diphthongise or lower

Low vowel fronting	*High vowel backing*
*bəRat > *bəret* 'heavy'	*daʔi > *daʔih* 'forehead'
*daja > *daʤih* 'inland, upriver'	*tadi > *tadih* 'younger sibling'
*ʤəlaʔ > *ʤəleʔ* 'tongue'	*ubi > *ubih* 'yam'
	*baRu > *baruh* 'new'
	*daʔun > *daʔun* 'leaf'
	*sabut > *sabut* 'coconut husk'
	*təbʰu > *təfuh* 'sugarcane'

When first recognised, a correlation of this detail and robustness in the conditioning of what appear to be distinct phonological processes is startling. However, as will be seen below, much of what makes this correlation surprising is the way in which it has been conceptualised (or misconceptualised), due to statistical biases in the original data sample. Before

examining a possible phonetic explanation for these facts in Miri it will repay our efforts to first briefly examine the behaviour of loanwords.

5 Loanwords

It was noted earlier that nearly all coastal languages of Sarawak have borrowed fairly heavily from Brunei Malay during the six and a half centuries since the establishment of the Brunei sultanate in 1368, and Miri is no exception. What emerges with some clarity from this data is that LVF occurs in many Malay loans, as seen in (12).

(12) *Miri*   *Malay*

Miri	Malay	
ages	agas	'sandfly'
bareŋ	baraŋ	'things, belongings'
barʤeh	bəkərʤa	'work'
base	batʃa	'to read' (< Sanskrit)
baweŋ	bawaŋ	'onion'
bajer	bajar	'to pay'
buʤeŋ	buʤaŋ	'bachelor'
fager	pagar	'fence'
faʤer	faʤar	'dawn' (< Arabic)
gager	gəgar	'to shake'
gaʤeh	gaʤah	'elephant' (< Sanskrit)
galeŋ	gəlaŋ	'bracelet'
gamer	gambar	'picture'
gule	gula	'sugar'
ʤawep	ʤawab	'answer' (< Arabic)
ʤaweʔ	ʤawa	'Java'
kaʤeŋ	kaʤaŋ	'nipa leaf screen'
karbew	kərbau	'water buffalo, carabao'
labeh-labeh	laba-laba	'spider'
rabeh	mə-raba	'to grope in the dark'
rəgeh	harga	'price'
sabep	səbab	'because' (< Arabic)
sader	sadar	'conscious'
subeʔ	tʃoba	'to try; please'
tabageh	təmbaga	'copper' (< Sanskrit)
taʤew	taʤaw	'Chinese jar'
timek	tembak	'to shoot, fire a weapon'
timeŋ	timbaŋ	'to weigh'

By contrast, high vowel breaking (HVB) is almost totally absent in known or likely Malay loanwords in Miri, as shown in (13). The expected forms are given in parentheses.

(13) *Miri*   *Malay*

alun	(alon)	alun	'wave at sea'
aʔin	(aʔain)	kain	'cloth, clothing'
gupul	(gupol)	kumpul	'to gather, collect'
masiŋ	(maseŋ)	masiŋ-masiŋ	'other; singly, each alone'
ɲariŋ	(ɲareŋ)	ɲariŋ	'shrill'
pakuʔ	(pakauʔ)	paku	'nail'
pikir	(piker)	pikir	'to think' (< Arabic)
rasun	(rason)	ratʃun	'poison'
sarmin	(sarmain)	tʃərmin	'mirror'
sutuŋ	(sutoŋ)	sutoŋ ~ sotoŋ	'cuttlefish'
timun	(timon)	timun	'cucumber'
tulin	(tulain)	tulin	'tell the truth; pure'

Because high vowels are commonly lowered before word-final velars in Standard Malay and various Malay dialects, the significance of Miri *uneŋ*, Malay *kuniŋ* 'yellow' or Miri *useŋ*, Malay *kutʃiŋ* 'cat' is difficult to assess. The only unambiguous example of HVB in a word that almost certainly is a Malay loan is Miri *lakauʔ* 'profit in business', Malay *laku* 'having value, selling well'. The presence of a final glottal stop in both *lakauʔ* and *pakuʔ* points to Brunei Malay as the most likely source of these loans.

This rather striking difference in the application of LVF or HVB to known or likely loanwords suggests that HVB occurred before the beginning of large-scale borrowing from Malay, while LVF occurred after many Malay loans had entered the language, and were treated like part of the native vocabulary.

6 Distributional evidence for an implied phonetic motivation

There is no question that both LVF and HVB in Miri are conditioned in an unusual way, but the major challenge they present is how to explain why they are conditioned in the *same* way. At first there seems to be no connection between the fronting of low vowels and the breaking or lowering of high vowels. Add to this that both innovations can be conditioned at a distance, and share a set of blocking consonants that neutralise these phonological processes in seemingly opposite ways (blocking an active process with /a/, and blocking the suppression of an active process with /i u/), and the mystery deepens.

Faced with such data, it would be easy to conclude that there is no phonetic basis for either of these processes in Miri. However, the fact that LVF has a discontinuous distribution in northern Sarawak (Blust 2000), and has also been reported over a largely continuous area in northeast Luzon (Reid 1991, Himes 2002, Lobel 2010, 2013, Robinson & Lobel 2013: 136–137), clearly implies that at least this change must be driven by some universal

phonetic mechanism, and, given the similar patterning of high vowel break-
ing, we have little choice but to conclude that the two phonological processes
must share a common phonetic cause. For most sound changes that are
phonetically motivated, the mechanism that lies behind them is readily rec-
ognisable. What makes this problem difficult is that the phonetic mechanism
that unites LVF and HVB as different expressions of a single targeted
outcome is not immediately apparent.

7 Is low vowel fronting really fronting?

It now seems likely that the principal reason for this lack of phonetic trans-
parency is that the problem has been framed in a way that obscures the
relationship between its parts. After all, what connection can the fronting
of low vowels and the breaking or lowering of high vowels possibly have?

The change of *a to /e/ or /i/ when a voiced obstruent is found earlier in
the word was called 'low vowel fronting' in Blust (2000), since if this was a
raising process there is no clear reason why *a did not sometimes raise to a
back or central vowel, or why the schwa is never raised to a high central
vowel, but this is unattested in any of the nine North Sarawak languages
known to have undergone this change, as shown in (14).

(14) *Miri*   *a > e (rarely i)
     Narum   *a > iə or eə, with roughly equal probability
     Dali'   *a > i, e (Ray 1913)
     Lelak   *a > i, iə (Ray 1913)
     Kiput   *a > i, iə, əj (Blust 2000, 2002)
     Lemeting   *a > i, iə (Ray 1913)
     Belait   *a > i, less commonly e (Blust 2000)
     Berawan   *a > i (Blust 2000)
     Sa'ban   *a > i, iə, əj, e (Blust 2000, 2001)

In addition, Berawan was treated as one language, although there are
dialect differences in how this innovation is realised. *a > i is found in
Long Terawan Berawan, for which the best data is available, but *a > æ
in the Long Jegan dialect suggests that the effect of a preceding voiced
obstruent is to front a low vowel, with raising as an incidental by-
product. However, it now appears that the essential feature of LVF is
raising, and this recognition enables us to connect the otherwise mysteri-
ous identical conditioning of LVF and HVB in Miri in a phonetically
plausible way.

To start with LVF, if we consider a wider set of languages with similar
processes of change to low vowels following voiced obstruents, it becomes
clear that the North Sarawak languages, for whatever reason, have not used
the full range of potential options. A number of languages on the Pacific
coast of Luzon and neighbouring inland areas, as well as several non-stan-
dard Malay dialects, also show changes to *a only after a voiced obstruent.
Although this was noted in Blust (2000: 306ff), recourse to non-front

options was not fully appreciated, and the number of such cases has continued to increase since 2000 as more data has become available. The full range of conditioned changes to *a following a voiced obstruent can now be stated as in (15).

(15) a. *Casiguran Dumagat (Pacific coast, Luzon)*
Although it is not fully regular, *a often became *i* in an unaccented initial syllable and *e* in a final syllable if there was a voiced stop earlier in the word: *balu > *bilo* 'widow', *daRaq > *digeʔ* 'blood', *daRat (> *dagat) > *diget* 'sea', *kaRat > *kaget* 'to bite', *quzan > *uden* 'rain', *tuba > *tube* 'croton plant' (Healey 1974: xxii, xxiv).

   b. *Arta (Sierra Madre range, northeast Luzon)*
*a > *i* in both penultimate and final syllables after a voiced stop (Reid 1989: 55–56).

   c. *Alta (Sierra Madre range, northeast Luzon)*
'In Southern Alta, *a is typically raised and fronted to [e] following voiced obstruents in inherited forms. In Northern Alta, it is typically raised to [ɨ], but apparently only following voiced obstruents in initial syllables containing short vowels. A number of cases are found in both languages where *a is also reflected as [a] in these environments' (Reid 1991: 272).

   d. *Ilongot (Sierra Madre range, northeast Luzon)*
In all dialects, *a > *i* after a voiced stop (Himes 1998: 137).

   e. *Umiray Dumaget (Pacific coast, Luzon)*
*a > *e*, or less commonly *i* immediately after a voiced stop or a glide (Himes 2002: 278). In some dialects of both Umiray Dumaget and Bontok, which are geographically separated and genetically quite distinct, a low vowel after a voiced stop is unchanged, but the stop is palatalised, as in *batu > *bjato* 'stone' (reported for an unspecified Umiray Dumaget community of Risal province).

   f. *Dupaningan Agta (northeast Luzon)*
*a > *e* after a voiced stop (Robinson 2008).

   g. *Manide (southeast Luzon)*
*a > *e* in the first syllable (*ˈbabuj > *beˈbij* 'pig', *baqəˈRu > *beʔˈgi* 'new', *daˈtəŋ > *deˈtuŋ* 'to arrive', *huaʤi (> *waʤi) > *wediʔ* 'younger sibling'), *a > *u* in the last syllable (*kaˈRat > *kaˈgut* 'to bite', *ˈquban > *ˈubun* 'grey hair', *sia ([sija]) > *hiˈju* (3SG NOM) and *u > *i* in either syllable (*ˈbulan > *ˈbilan* 'moon', *buˈqaja > *biˈuju* 'crocodile', *ˈtaRuq > *ˈtagiʔ* 'to hide'). The fronting of *u must have preceded the change of *a to *u* in the last syllable. Each of these changes is conditioned by an earlier voiced stop or glide, including automatic transitional glides (Lobel 2010).

Both Lobel (2013) and Robinson & Lobel (2013: 138) follow Blust (2000) in using the term 'low vowel fronting' for innovations that affect *a only after a

voiced obstruent, since these usually result in a front vowel outcome. However, as seen above, in both Northern Alta and Ilongot, two languages that are not closely related, the outcome is a high central vowel, and in Manide, which is not in proximity with or closely related to either of the foregoing languages, *a has become either *e* or *u* after voiced obstruents.

Blust (2000), after describing and attempting to explain the data in the North Sarawak languages, notes several of these Philippine cases, and in addition states that 'Collins (1993, 1998) and Jaludin (2000) have drawn attention to vocalic effects after voiced obstruents in several Malay dialects spoken on or near Borneo, where the process seems clearly to be one of raising rather than fronting' (2000: 307). These cases are given in (16).

(16) a. *Kutai Malay* (*eastern Borneo*)
     *a merges with schwa following the voiced obstruents *b*, *d*, *dʒ* and *g*, but otherwise remains unchanged (Collins 1993).
   b. *Natuna Malay* (*Natuna archipelago, South China Sea*)
     Under the same conditions '*a is raised and backed to *o* in the Serasan and Sedanau dialects, and raised and fronted to *e* in the Bunguran Timur dialect' (Collins 1998).
   c. *Sambas Malay* (*southwest Borneo*)
     *a > *o* after voiced obstruents (Marabuan village).

Although their discussion is very brief, Sneddon & Usup (1986: 414–415) draw attention to similar phenomena in the Gorontalic languages of northern Sulawesi. Their data sample in Table IV shows reflexes of Proto-Malayo-Polynesian *a after a voiced stop.

Proto-Malayo-Polynesian		Proto-Gorontalic	Buol	Kaidi-pang	Goron-talo
*a	>	*o	41	48	11
*a	>	*e	—	—	12
*a	>	*a	6	5	21

Table IV
Reflexes of Proto-Malayo-Polynesian *a after a voiced stop.

In addition, they state (1986: 414) that Proto-Gorontalic '*o became *u* following a voiced stop. This change occurred in all languages except Bnt [Bintauna] but was not entirely regular in any language.'

For ready reference, these changes are summarised under (17), where rare reflexes appear in parentheses, and alternatives of roughly equal frequency are separated by '/' (nearly all changes in the Gorontalic languages can apparently be captured by developments in Gorontalo and Buol).

(17) a. *Miri*   *a > e (i)
        Narum   *a > iə / eə
        Dali'   *a > i / e
        Lelak   *a > i / iə
        Kiput   *a > i / iə / əj
        Lemeting   *a > i / iə
        Belait   *a > i (e)
        Berawan   *a > i
        Sa'ban   *a > i / iə / əj / e
    b. *Dumagat (Casiguran)*   *a > i / e
        Arta   *a > i
        Alta (Northern)   *a > ɨ
        Alta (Southern)   *a > e
        Ilongot   *a > e / i
        Dumaget (Umiray)   *a > i
        Agta (Dupaningan)   *a > e
        Manide   *a > e / u, *u > i
    c. *Malay (Kutai)*   *a > ə
        Malay (Natuna: Bunguran Timur)   *a > e
        Malay (Natuna: Serasan, Sedanau)   *a > o
        Malay (Sambas)   *a > o
    d. *Gorontalo*   *a > e / o / u
        Buol   *a > o / u

As can be seen, most languages for which this type of change has been reported favour a front vowel outcome, but outside the North Sarawak group, where this is the only attested outcome, about half of all languages show raising of *a to a central or back vowel. Given this broader perspective, the changes that have previously been subsumed under the label LVF can now be stated as a special case of low vowel raising. Most importantly, once we change our perspective in this way, certain other observations acquire a significance they previously did not have.

8 The clinching argument

For Casiguran Dumagat, Healey (1974) not only describes low vowel raising, but also observes that in the final syllable high vowels lower to *e* and *o* if the immediately preceding consonant is not a voiced stop (18a), but remain unchanged after a voiced stop (18b).

(18) a. * ataŋis > *saŋet* 'to cry, weep'   b. *qujiŋ > *ugiŋ* 'charcoal'
        *kulit > *kulet* 'skin'   *kaRi > *kagi* 'to say, tell'
        *buliq > *bule* 'buttocks'   *diRus > *digus* 'to bathe'
        *batu > *bito* 'stone'   *qabu > *abu* 'ashes'
        *danum > *dinom* 'water'   *tiduʀ > *tidug* 'to sleep'
        *Ramut > *gimot* 'root'   *zaRum > *digum* 'needle'

Likewise, as shown above, Sneddon & Usup (1986) found that a mid-back vowel from any source often raises to /u/ when following a voiced obstruent in Buol and some other Gorontalic languages of northern Sulawesi. Although it might not be immediately obvious, these changes share the same complex conditioning as Miri, as shown in (19) for Casiguran Dumagat, where the first column gives the default reflexes, and the second gives reflexes if there is a voiced obstruent earlier in the word.

(19)   *Casigaran Dumagat*   *Miri*

*a	a	i / e	a	e
*i̥	e	i	aj / e	i
*u	o	u	aw / o	u

There is a previously overlooked unity to these changes: regardless of differences in other details of their history, every language raises *a after a preceding voiced obstruent, and in several of them a high vowel which would otherwise lower remains high under the same condition. In Casiguran Dumagat vowel lowering is straightforward, while in Miri it takes two forms: *i/u > *e/o* before certain consonants, and *i/u > *ai/au*, *aj/aw* before other consonants, or word-finally. This was initially a distraction, since vowel breaking in Miri appeared to be a variation on the common patterns in Table I, but the larger constellation of changes affecting final-syllable vowels in this language shows that what has previously been called 'low vowel fronting' is actually low vowel raising, and what initially appeared to be high vowel breaking is actually high vowel lowering. That *i/u > *aj/aw* is essentially a lowering process is clear because breaking and lowering are in complementary distribution, as shown in §4.3.[13]

9 Conclusion

What at first appears to be an arbitrary condition in Miri (and other languages) turns out on further analysis to be a product of favoured phonetic outcomes that are driven by inherent airflow conflicts in voiced obstruents: the blocking of an egressive airstream raises air pressure above the glottis, which lowers the larynx, and so lengthens the pharyngeal cavity. Since the first formant is a back cavity resonance, and the primary acoustic correlate of vowel height, it favours the perception of following vowels as higher than their default values, either by raising a low vowel or suppressing the lowering of a high vowel. In Miri, this

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[13] It may not be out of place here to also note that in the Great Vowel Shift of English tense front vowels raised at every height until they could raise no more, and then lowered through diphthongisation to avoid merger. As noted by Labov (1994: 37ff), such processes are more widespread than is often appreciated. Although his discussion relates specifically to chain shifts, the principle that diphthongisation or breaking of a high vowel is a variant of lowering is arguably more general.

process is obscured by vowel breaking in certain environments, but this can be seen as a type of lowering, as it appears to be in other languages.

Finally, while the proposal advanced here helps to explain a challenging sound change, it does not succeed in eliminating all odd conditions. Among those that remain unexplained are: (i) why do some languages (such as Miri or Sa'ban) have blocking consonants, while others that may be closely related (such as Narum) do not?; (ii) why in Miri (but not in most other languages) does low vowel raising skip over a closer target to affect one in the final syllable?; (iii) why does Miri use vowel breaking as a surrogate for lowering in word-final position, before a final glottal stop, and only with *i (but not *u) before final coronals? And, to extend the questions beyond Miri: (iv) why, in Gorontalo, does an otherwise general process of low vowel raising to /e/ produce /o/ when the vowel of the next syllable is high (whether it is back or front)?; (v) why in Manide does *a raise to /e/ after a voiced obstruent in the first syllable, but to /u/ under the same condition in the last syllable?; and (vi) why in Manide do back vowels front after a voiced obstruent? (Lobel 2010: 491).

Questions like these remind us that, despite our successes in some areas of phonology, many other areas resist phonetic explanation, and will no doubt continue to challenge linguists for years to come.

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