

COMPLEX DIACHRONIES OF FINAL NASALIZATION IN AUSTRONESIAN AND DAKOTA

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MANUSCRIPT *as of* OCTOBER 19, 2023

ABSTRACT Final nasalization of voiced stops is phonetically unmotivated (i. e. not a consequence of universal articulatory or perceptual tendencies). As such, final nasalization has been deemed an impossible sound change. Nonetheless, Blust (2005, 2016) proposes that final nasalization took place in four Austronesian languages: Kayan-Murik, Berawan dialects, Kalabakan Murut, and Karo Batak. In this paper, we argue final nasalization in these languages is not a single sound change and reduce it to a combination of phonetically grounded changes. We demonstrate that in Austronesian, final nasalization involved four steps: (i) fricativization of voiced stops, (ii) devoicing of the fricatives, (iii) spontaneous nasalization before voiceless fricatives, and (iv) occlusion of the nasalized fricatives to nasal stops. Finally, we extend our account to final nasalization in Dakota (Siouan) and propose a new explanation for the development of the unnatural final voicing in the related Lakota language. Our results shed light on the role of phonetic naturalness in diachrony and synchrony. We maintain that while phonetically unnatural phonological processes may arise via a sequence of sound changes or analogical extension, regular sound changes are always natural and phonetically grounded.

1 INTRODUCTION

Final nasalization (henceforth FN) is a process whereby an oral segment becomes a nasal stop in the word-final position. In this paper, we use the term to refer specifically to the final nasalization of stops. Final nasalization (of stops) is phonetically unmotivated, i. e. it does not arise as a consequence of universal articulatory or perceptual tendencies. As such, final nasalization can be deemed an impossible sound change. In Steriade’s (2001) phonetically-grounded theory of phonology (*perceptibility map* or P-map), this intuition has been further enshrined by rendering final nasalization a synchronically impossible phonological process as well (p. 3).

Nonetheless, synchronic systems that repair the marked configuration of a voiced stop in the word-final position (*D#) with nasalization have been recently reported in Noon (Cangin) (Merrill, 2015) and a number of Austronesian languages (Blust, 2005, 2016). Merrill (2015) demonstrates that Noon’s final nasalization arose through a combination of sound changes. Specifically, Proto-Cangin prenasalized stops (*ND) denasalized intervocalically (> D / V _ V) and deoralized word-finally (> N / _ #). We discuss Merrill’s (2015) proposal in more detail in [Section 2](#).

Blust (2005, 2016) reports final nasalization in four Austronesian languages: Kayan-Murik, Berawan dialects, Kalabakan Murut, and Karo Batak. Yet, no traces of prenasalized stops

are found to explain it. As such, Blust (2005, 2016) concludes that final nasalization had to operate as a single sound change. Except for Blust's (2005, 2016) proposals, final nasalization has never been reported to operate as a single sound change.

We argue that final nasalization is not a single sound change in these reported cases and results from a combination of changes. In Section 4, we demonstrate that in Kayan-Murik (§4.1), Berawan (§4.2), and Kalabakan Murut (§4.3), final nasalization proceeded through a series of steps (1)¹ involving (i) the fricativization of voiced stops, (ii) devoicing of the fricatives, (iii) spontaneous nasalization before voiceless fricatives (plus at least partial voicing of the fricatives), and—finally—(iv) the occlusion of nasalized fricatives to nasal stops. This development is a subtype of the *blurring process*, as described in Beguš (2019, 2020).²

(1) FINAL NASALIZATION AS A SERIES OF CHANGES

$\frac{* - VD}{\text{o - proto}}$	$\frac{> * - VZ}{\text{i - fricativization}}$	$\frac{> * - VS}{\text{ii - devoicing}}$	$\frac{> * - \tilde{V}\tilde{S}}{\text{iii - nasalization}}$	$\frac{> - VN}{\text{iv - occlusion}}$
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Following Beguš (2019), we define natural sound changes as following the direction of *universal phonetic tendencies*, i. e. “phonetic pressures motivated by articulatory or perceptual mechanisms ... that passively operate in speech production cross-linguistically and result in typologically common phonological processes” (p. 691). For an overview of phonetic mechanisms, see Garrett and Johnson, 2013. According to this definition, each of the four changes in (1) is natural. We discuss the phonetic motivation for each of the changes in Section 3. By comparison, a single-change final nasalization as posited by Blust (2005, 2016) would be unmotivated because final nasalization does not reflect a universal phonetic tendency. Moreover, in Kayan-Murik (Beguš, 2019), Berawan (Beguš and Dąbkowski, 2023), and Kalabakan Murut, the fricativization stages are independently motivated by other diachronic developments and dialectal correspondences, further strengthening our proposal. We suggest that word-final nasalization in Karo Batak might have arisen via analogical extension (§4.4).

In Section 5, we extend our account to a set of correspondences in Sioux (Siouan). Lakota word-final voiced stops correspond to voiceless stops or nasals in related languages. We propose that word-final nasalization in Dakota proceeded through an intermediate stage of fricativization. Lakota word-final stop voicing proceeded through an interstage of preconsonantal and prepausal fricativization and occlusion.

By reducing final nasalization to a series of phonetically motivated sound changes, our results shed light on the role of phonetic naturalness in diachrony and synchrony. We maintain that while phonetically unnatural phonological processes (e. g. Beguš and Dąbkowski, 2023;

² Specifically, the development exemplifies the *blurring chain*, a subtype of the blurring process. In the blurring chain, at least three sound changes operate, schematically represented as (i) $B > C / X$; (ii) $C > D$, and (iii) $D > A$, ultimately resulting in $B > A / X$. The first change (fricativization) creates a complementary distribution. The next two changes (devoicing, nasalization) operate on the newly created fricatives. The last change (occlusion) blurs the original complementary distribution.

² The following natural class abbreviations have been used: C = (voiceless) consonant, D = voiced oral stop, G = voiced consonant, N = nasal stop, R = approximant, S = (voiceless) fricative, T = (voiceless) oral stop, V = vowel, \tilde{X} = nasalized segment, Z = voiced fricative.

Beguš, Nazarov, et al., 2022; Coetzee and Pretorius, 2010; Dąbkowski, 2023; Hyman, 2001; Merrill, 2015) may arise via a set of sound changes or analogical extension, regular sound changes are always natural and phonetically grounded.

2 FINAL NASALIZATION IN NOON

First, we summarize and discuss Merrill's (2015) findings on final nasalization in Noon (Cangin). While final nasalization in Noon does not result from the sequence of changes outlined in (1), Merrill's (2015) straightforward explanation provides a simple case study of final nasalization resulting from a combination of two natural sound changes. As such, it provides support to our central contention that sound changes are always phonetically grounded.

In Noon, underlyingly voiced stops are realized as nasals in the word-final position (2a)³ and pre-consonantly. Before vowels, e. g. when a root is suffixed with a vowel-initial suffix, the voiced stops surface faithfully (2b).

(2) VOICED STOPS IN NOON			(Merrill, 2015)	
a. NASALIZED WORD-FINALLY			b. FAITHFUL PREVOCALICALLY	
/paʃ/	[paŋ]	marry	/paʃ-ee/ (PST)	[paʃee]
/awaag/	[awaan]	open mouth	/awaag-ee/ (PST)	[awaagee]
/yʔib/	[yʔim]	chin	/yʔib-ii/ (PROX.DEF)	[yʔibii]
/nad/	[nan]	spider	/nad-ii/ (PROX.DEF)	[nadii]

Merrill (2015) demonstrates that final nasalization in Noon is a consequence of two sound changes. Voiced stops in Proto-Cangin were prenasalized. Word-finally, the oral part of prenasalized stops was lost, resulting in word-final nasal stops. Intervocally, on the other hand, prenasalized voiced stops develop into plain-voiced stops (3). The proposed development is substantiated by abundant evidence from neighboring dialects. For example, in Safen, the Proto-Cangin prenasalized stops are retained in all positions (3c).

(3) DEVELOPMENTS OF PROTO-CANGIN PRENASALIZED STOPS					(Merrill, 2015)
a. PROTO-CANGIN	*hang	*hamb	*pang	*yoond	
b. NORTHERN NOON	aŋ ~ ag-	am ~ ab-	paŋ ~ pag-	yoon ~ yood-	
c. SAFEN	and	amb	pang		
	be wide	hold	do, cook	learn	

The two sound changes of Noon result in a synchronic alternation between voiced stops intervocally and nasal stops word-finally, i. e. final nasalization. Voiced stops and nasals in Noon

³ The following glossing abbreviations have been used: AV = actor voice, DEF = definite, LV = locative voice, NPST = nonpast, OV = object voice, PROX = proximal, PST = past.

are allophonic; their alternation is exceptionless and fully general, so the final nasalization in Noon is fully productive (Merrill, 2015).^{4, 5}

While Noon shows synchronically active final nasalization, its origin resides in two sound changes: word-final “deplosion” (loss of the oral component of a prenasalized stop) and intervocalic denasalization. Both changes observed are natural, as both involve the simplification of a complex segment. Intervocalically, where voiced stops are easiest to produce, the oral component is retained and the nasal component is lost. Word-finally, where voiced stops are difficult to articulate, the oral component is lost and the nasal component is retained. The two changes yield a pattern of phonetically unmotivated word-final nasalization, but each change is by itself natural.

3 PHONETIC MOTIVATION FOR THE PROPOSED CHANGES

The development of final nasalization we propose for Kayan-Murik (§4.1), Berawan (§4.2), and Kalabakan Murut (§4.3) involves four consecutive changes: (i) fricativization of voiced stops, (ii) devoicing of the fricatives, (iii) spontaneous nasalization before voiceless fricatives (including at least partial voicing of the fricatives), and (iv) occlusion of the nasalized fricatives to nasal stops. This schematized development is repeated in (4). Here, we motivate each of the changes as phonetically grounded.

(4) FINAL NASALIZATION AS A SERIES OF CHANGES

$\underbrace{* -VD}$	$\underbrace{> * -VZ}$	$\underbrace{> * -VS}$	$\underbrace{> * -\tilde{V}\S}$	$\underbrace{> -VN}$
o – proto	i – fricativization	ii – devoicing	iii – nasalization	iv – occlusion

3.1 Fricativization

Step I involves the fricativization of voiced stops. The articulation of voiced stops makes conflicting demands: On one hand, airflow must be maintained to produce voicing. On the other hand, the airflow must be obstructed to produce a stop. This competition means that voiced stops are often cross-linguistically avoided. Intervocalically, voiced stops are commonly lenited to fricatives (Beguš, 2018, 2019, 2020; Kaplan, 2010; Kirchner, 2001; Kümmel, 2007). Beguš (2020) counts about 47 cases of postvocalic fricativization of voiced stops based on approximately 294 languages surveyed in Kümmel (2007). We propose that in Kayan-Murik, Berawan dialects, and Kalabakan Murut, the fricativization of voiced stops was generalized to any postvocalic position, including word-finally. Evidence supporting this claim is presented in Section 4.

⁴ Merrill (t.a.) provides further evidence from other Cangin languages, and shows that Ndut-Paloor, as well as all dialects of Noon-Laalaa (except the Thiès dialect), have the same N~D alternation.

⁵ In Japanese, a similar phenomenon is found in coda positions (albeit not word-finally due to the languages’ phonotactic constraints). The Japanese D~N alternation, e. g. root-finally in *asob-u* ~ *ason-de* ‘play,’ goes back to a Proto-Japonic sequence of a nasal and a stop **asonpu* > **asombu* (Frellesvig, 2010). Notably, the Japanese case also arises from two sound changes affecting an earlier **mb*.

3.2 Devoicing

Step II involves (at least partial) word-final devoicing of voiced fricatives. Voiced fricatives, like voiced stops, are articulatorily difficult. Voicing requires the pressure in the oral cavity to be as low as possible, while frication requires it to be as high as possible (Ohala, 1983, 1997, 2006; Smith, 1997). Due to these opposing demands, maintaining voicing in fricatives is strenuous. Additionally, voicing in the word-final position is particularly dispreferred, making final devoicing one of the most common phonological processes across many language families (Beguš, 2020). In English, the devoicing of final fricatives is more common than the devoicing of final stops (Davidson, 2016), suggesting that voiced fricatives are particularly difficult to produce word-finally. In short, final fricative devoicing is very well attested and articulatory motivated.

3.3 Nasalization

Step III involves spontaneous nasalization of voiceless fricatives. While spontaneous nasalization (henceforth SN) is generally rare typologically, the vicinity of voiceless fricatives constitutes the one environment where this development is attested and phonetically grounded (other such environments include affricates and aspirated stops; Ohala and Ohala, 1993). Instances of spontaneous nasalization can be observed e. g. in Indo-Aryan (5) and Early Modern Breton borrowings from French (6).

(5) SN IN INDO-ARYAN		(Grierson, 1922; Ohala and Ohala, 1993 p. 240)			
i. SANSKRIT	<i>paḷṣa</i>	<i>akṣi</i>	<i>uččaka-</i>	<i>sarpa-</i>	
ii. MODERN HINDI	<i>pāṇk^ha</i>	<i>āk^h</i>	<i>ūčā</i>	<i>sāp</i>	
	side	eye	high	snake	
(6) SN IN EARLY MODERN BRETON (Jackson, 1967, p. 174; Ohala and Ohala, 1993, p. 240)					
i. FRENCH	<i>maçon</i>	<i>rosse</i>	<i>vis</i>		
ii. E MOD BRETON	<i>mañzonner</i>	<i>rouñçe(e)t</i>	<i>biñcz, biñs</i>		
	mason	horse	screw		

Ohala and Ohala (1992, 1993) propose a phonetically grounded explanation for the relationship between high airflow segments, such as fricatives, and perceived nasalization—voiceless fricatives require a greater glottal opening which ends up creating an acoustic effect similar to nasalization. Ohala and Ohala's (1993) explanation is reproduced verbatim in (7).

- (7) HIGH AIRFLOW SEGMENTS → PERCEIVED NASALIZATION (Ohala and Ohala, 1993, p. 240)
- i. "High airflow segments like voiceless fricatives and aspirated stops require for their production a greater than normal glottal opening (vis-à-vis comparable voiceless segments like voiceless unaspirated stops)."
 - ii. "This greater than normal glottal opening may spread via assimilation to the margins of adjacent vowels, even though these vowels may remain completely voiced."

- iii. “This slightly open glottis creates acoustic effects due to some coupling between the oral and the subglottal cavities that mimic the effects of coupling of the oral and nasal cavities, i. e., lowered amplitude and increased bandwidth of F₁.”
- iv. “Vowels that sound nasal to listeners, even though they are not physiologically nasal, can be reinterpreted and produced as nasal, thus precipitating a sound change.”

Ohala and Amador (1981) demonstrate that the spectral effects of fricatives are indeed similar to those of nasalization. Ohala and Amador (1981) and Ohala and Ohala (1992) show that speakers of English, Spanish, and Hindi judge fricative-adjacent vowels as significantly more nasal than vowels not adjacent to fricatives. Khattab, Al-Tamimi, and Alsiraih (2018) demonstrate that Iraqi Arabic pharyngeals exhibit various degrees of nasalization when combined with nasals and suggest that their variable realization may act as a precursor for sound change.

In particular, nasality shows a particularly strong connection to glottal articulation. The close affinity between the two classes of sounds has been dubbed *rhinoglottophilia* by Matisoff (1975). Ohala’s (1975) summary of its phonetic basis is given in (8).

- (8) PHONETICS OF RHINOGLOTTOPHILIA (Ohala, 1975, p. 303)
 “[*h*] may produce an effect on vowels that ‘mocks’ that of nasalization. Because of the open glottis during phonation accompanying an [*h*] (or breathy-voice), the spectrum of the vowel will be changed in the following ways: there will be upward shifting of the formants, especially F₁ ..., increased bandwidth of the formants, presence anti-resonances in the spectrum and an overall lowering of the amplitude of the vowel ... This is identical to the effect of nasalization on vowels. Articulatory re-interpretation may occur, i. e., actual nasalization may be produced on the vowel” (quoted in Blevins and Garrett, 1993, pp. 220–1).

The rhinoglottophilic connection between nasals and glottals is reflected in their frequent synchronic and diachronic connections. For example, Johnson et al. (2019) show that Thai non-high vowels spontaneously nasalize after the glottal consonants *h* and *ʔ*. Blevins and Garrett (1992, 1993) propose that Proto-Ponapeic geminates developed into Ponapean nasal-stop sequences through a stage of preaspiration (*T: > *hT > NT), demonstrating that spontaneous nasalization can give rise to a regular sound change (9).

- (9) RHINOGLOTTOPHILIA IN PONAPEAN (Blevins and Garrett, 1993, pp. 215–6)
- | | | |
|-----------------------|-------|----------|
| o. PRE-PROTO-PONAPEIC | *içça | *pap-pap |
| i. PROTO-PONAPEIC | *ihça | *pah-pap |
| ii. PRE-PONAPEAN | *inça | *pam-pap |
| iii. PONAPEAN | ñça | pam-pap |
| | blood | swimming |

While we propose that in Austronesian and Dakota, spontaneous nasalization was triggered by all voiceless fricatives (not only *h*), the phonetics of rhinoglottophilia is similar to that of other cases of spontaneous nasalization, lending strong indirect support to our account.

3.4 Occlusion

Step IV involves the occlusion of nasalized fricatives. Frication requires high oral air pressure while nasalization consists of lowering the velum and redirecting a part of the pulmonic airflow through the nasal cavity. Ohala (1975) and Ohala and Ohala (1993) suggest that the remaining oral air pressure might be too low to produce a nasal fricative. This makes nasal fricatives very articulatorily difficult (and typologically rare). As such, a change away from nasalized fricatives is to be expected.

The development from spontaneously nasalized fricatives to nasal stops might have proceeded along several different paths. First, nasalized fricatives could have developed into nasal stops as a single sound change, i. e. $\tilde{V}\tilde{S} > VN$. While we are not aware of any previously reported instances of this change, we speculate it might be due to the overall typological rarity of voiceless fricatives.

Second, the occlusion of nasalized fricatives might have itself involved a combination of two changes: fricative approximantization and approximant occlusion, i. e. $\tilde{V}\tilde{S} > \tilde{V}\tilde{R} > VN$. The change of a fricative into an approximant is very well attested, with many reports of unconditioned $\beta, v > w$; $\delta > l, r (> r)$; $j, \zeta > j$; and $\gamma > w$ (Kümmel, 2007, pp. 78–88).⁶ In the scenario at hand, the fricatives undergoing the change are at least partially nasalized. The aerodynamic difficulty involved in the production of nasalized fricatives (Ohala, 1975; Ohala and Ohala, 1993) makes their approximantization all the more likely. Indeed, one of the possible implementations of Scottish Gaelic phonologically nasal fricatives is as nasal approximants (Warner et al., 2015).⁷

In this scenario, the approximantization of nasal fricatives is then followed by the occlusion of nasal approximants. This again is a typologically attested change. For example, the Medieval Polish nasal vowel \tilde{a} (< Proto-Slavic $*\tilde{e}$ and $*\tilde{o}$) developed into the Standard Polish ɔw (and ɛw),⁸

⁶ The most frequent cases of fricative approximantization involve voiced fricatives. This is congruent with our proposal since the preceding (spontaneous) nasalization most likely gives results in at least partial voicing of the adjacent fricative. Nonetheless, the approximantization of voiceless fricatives is also attested, e. g. $*\phi > w$, $*\theta > w$, $*x > w / _ C$ (Old Armenian; Kümmel, 2007, p. 87); $*f > w / V _ C$ (Zaza, Gorani, Kurdish; Kümmel, 2007, p. 87); $*f > v / \# _$ (Proto-Finnish; Hakulinen, 1979); $*f > j$ (Marshallese; Hale, 2007, p. 89); $*s > *j / \#C_0V _ \#$ (Proto-Tocharian; Kümmel, 2007, p. 88); $\text{ʃ} > j / V _ \#$ (common Eastern Romance; Kümmel, 2007, p. 88); $\theta > l$ (Kurdish; Kümmel, 2007, p. 80); $*\text{ʃ} > j / _ T$ (central and south Sami; Kümmel, 2007, p. 88); $*t > l$ (Proto-Omoti; Ehret, 1995); and $*\text{ç} > j / (V) _ t$ and/or s (northwestern Italian, common Romance, common French, Franco-Provençal, Gascon, and others, the exact environment depending on the language; Kümmel, 2007, p. 88). Many of these changes are unconditioned or take place word-finally, postvocally, or before a consonant, i. e. in environments similar to the hypothesized cases of approximantization in Austronesian and Sioux.

⁷ Other attested realizations include “nasalization of $[\tilde{h}]$, nasalization on the preceding vowel,” as well as “sequential frication and nasalization” (Warner et al., 2015).

⁸ Additionally, the latter component of the Polish nasal diphthongs assimilates with respect to the place of articulation of the following obstruent, giving rise to a number of conditioned allophones.

following a conditioned split). The diphthongized \mathfrak{w} further developed into \mathfrak{m} in Greater Poland (Baranowska and Kaźmierski, 2020; Dejna, 1981; Kaźmierski and Szlandrowicz, 2020; Stieber, 1966, 1973). In A'ingae, nasal stops in the coda position nasalized the preceding vowel and underwent deletion. Additionally, most instances of \mathfrak{n} and some instances of \mathfrak{m} go back to sequences of $*\mathfrak{n}\mathfrak{j}$ and $*\mathfrak{n}\mathfrak{v}$ (Sanker and AnderBois, t.a.). Regardless of the relative ordering of the two changes, A'ingae developments testify to the occlusion of nasalized approximants: $*\mathfrak{V}\mathfrak{n}\mathfrak{j}$ ($> * \tilde{\mathfrak{V}}\mathfrak{j}$) $> \tilde{\mathfrak{V}}\mathfrak{j}$; $*\mathfrak{V}\mathfrak{n}\mathfrak{v}$ ($> * \tilde{\mathfrak{V}}\mathfrak{v}$) $> \tilde{\mathfrak{V}}\mathfrak{m}$. In Samoyed and in Lappish, word-initial $*\mathfrak{j}$ - became \mathfrak{j} - if a nasal consonant is present later in the word, i. e. $*\mathfrak{j}$ - $> \mathfrak{j}$ - / # _ VN (Collinder, 1960, p. 63; Kümmel, 2007, p. 159; Mikola, 1988, 228f). In Kamassian, $*\mathfrak{w}$ - changed into \mathfrak{m} - in the same environment, i. e. $*\mathfrak{w}$ - $> \mathfrak{m}$ - / # _ VN (Collinder, 1960, p. 66; Kümmel, 2007, p. 159; Mikola, 1988, 228f). Both changes presumably resulted from nasal spreading with nasalized approximants as the intermediate stage, i. e. $*\mathfrak{j}$ - $> * \tilde{\mathfrak{j}}$ - $> \mathfrak{j}$ - and $*\mathfrak{w}$ - $> * \tilde{\mathfrak{w}}$ - $> \mathfrak{m}$ -.

Finally, the step of occlusion might have proceeded as follows: (i) the spontaneously nasalized vowel unpacks into an oral vowel followed by a nasal stop, (ii) the postnasal fricative hardens to a stop, (iii) the resulting stop is ultimately deleted. This sequence of changes can be schematized as $\tilde{\mathfrak{V}}\tilde{\mathfrak{S}} > \mathfrak{V}\mathfrak{N}\mathfrak{S} > \mathfrak{V}\mathfrak{N}\mathfrak{D} > \mathfrak{V}\mathfrak{N}$. The unpacking is attested in the development of Portuguese nasal vowels into sequences of oral vowels followed by a nasal stop in Portuguese-based creoles. E. g., in Casamancese Creole (Biagui and Quint, 2013), $k\tilde{o}'tar > konta$ 'tell' (p. 42), $\tilde{u} > un$ 'one' (p. 43), $'s\tilde{i}ku > sin'ku$ 'five' (p. 43). In Papamientu (Birmingham, Jr., 1970), $\mathfrak{z}\tilde{a}'tar > \mathfrak{z}arnta$ 'eat' (p. 6), $t\tilde{e}'b\tilde{e}\tilde{j} > tar'mbe$ 'also, too' (p. 6), $'b\tilde{o} > b\tilde{o}\eta$ 'good' (p. 34). (Yet another example is the previously discussed development of the Medieval Polish \tilde{a} into the Greater Poland Polish \mathfrak{m} .) The latter sequence of fricative hardening followed by stop deletion is, among others, a familiar development from German, e. g. Germanic $*tan\theta > Old\ High\ German\ zand > German\ Zahn$ 'tooth.'

In sum, we propose that final nasalization in Austronesian and Siouan arose from a sequence of sound changes which are natural, i. e. motivated by facts of speech production and perception. First, voiced stops underwent fricativization. Second, the fricatives devoiced. Third, voiced fricatives triggered spontaneous nasalization. Finally, fricatives in the vicinity of nasalization occluded to nasal stops. Nasal occlusion might have involved an intermediate approximantization, proceeded via post-nasal hardening, or consisted of a single sound change. Our accounts are compatible with any of the three scenarios. As such, we remain agnostic about the possible incremental changes involved in the final step.

4 FINAL NASALIZATION IN AUSTRONESIAN

Now we present the details of our account of final nasalization in four Austronesian languages: Kayan-Murik, Berawan dialects, Kalabakan Murut, and Karo Batak. A previous account of the data has been proposed by Blust (2005, 2016), who argues that final nasalization took place as a single sound change, without any intervening steps. We take a different stance. While it is true that final voiced stops in proto-languages of the four languages with final nasalization correspond to observed final nasals (as presented in Blust, 2016), reflexes of voiced stops in other positions suggest that additional steps were involved in the development of final nasalization.

Beguš's (2019) and Beguš and Dąbkowski's (2023) work on two of the four languages shows that intermediate stages of fricativization are independently necessary to account for the phonologically unnatural developments. Beguš (2019) demonstrates that Murik post-nasal devoicing proceeded through a change of voiced stops to voiced fricatives. Beguš and Dąbkowski (2023) show that Berawan intervocalic devoicing involves a similar step of fricativization. Our account builds on their findings and provides additional language-internal and dialectal data supporting the claim that stop fricativization preceded final nasalization. Beguš (2019) and Beguš and Dąbkowski (2023) also argue that the occlusion of fricatives back to stops is independently attested in both Berawan and Murik, which bears high resemblance to the occlusion of nasalized fricatives in the present case.

4.1 *Kayan-Murik*

Let us first take a look at the Kayan-Murik (KM) data. Kayan-Murik (or Kayanic) is a branch of Austronesian languages spoken in Borneo, Indonesia, and Malaysia. Blust (2016) reports (at least) two dialects to have undergone final nasalization: Uma Bawang (UB) and Long Atip (LgA) dialects of Kayan (10). Proto-Kayan-Murik (PKM) final **-b* and **-d* (10a) correspond to Uma Bawang and Long Atip *-m* and *-n* (10b-c). In Uma Juman (UJ), the PKM word-final **-b* fricativizes to *-v* and **-d* lenites to *-r* (10d). While the data is limited, Blust (2016) observes that Murik seems to have devoiced PKM **-b*, but nasalized PKM **-d* (10e).

(10)	WORD-FINAL DEVELOPMENTS OF PROTO-KAYAN-MURIK VOICED STOPS			(Blust, 2016)
a.	PROTO-KM	<i>*kələb</i>	<i>*aŋud</i>	
b.	UMA BAWANG	<i>kələm</i>	<i>aŋun</i>	
c.	LONG ATIP	<i>kələm</i>	<i>aŋun</i>	
d.	UMA JUMAN	<i>kələv</i>	<i>aŋur</i>	
e.	MURIK	<i>kələp</i>	<i>aŋun</i>	
		tortoise	adrift	

Word-initially, the voiced stops **d-* and **b-* do not undergo any changes in Uma Juman, Uma Bawang, or Long Atip. Word-internally, **-d-* lenites to *-r-* in all four languages. Crucially, Uma Juman intervocalic **-b-* fricativizes to *-v-*. In Murik, word-initial **d-* lenites to *l-*; Murik non-final **b* does not change. These developments are summarized in (11).

(11)	SUMMARY OF KM DEVELOPMENTS	(Blust, 2005, p. 259; Blust, 2013; Blust, 2016)					
a.	PROTO-KM	<i>*b-</i>	<i>*-b-</i>	<i>*-b</i>	<i>*d-</i>	<i>*-d-</i>	<i>*-d</i>
b.	UB & LGA	<i>b-</i>	<i>-v-</i>	<i>-m</i>	<i>d-</i>	<i>-r-</i>	<i>-n</i>
c.	UMA JUMAN	<i>b-</i>	<i>-v-</i>	<i>-v</i>	<i>d-</i>	<i>-r-</i>	<i>-r</i>
d.	MURIK	<i>b-</i>	<i>-b-</i>	<i>-p</i>	<i>l-</i>	<i>-r-</i>	<i>-n</i>

Additionally, Murik also shows phonetically unnatural post-nasal devoicing (henceforth PND), whereby Proto-Kayan-Murik voiced stops devoice after nasal consonants (11).

- (12) MURIK POST-NASAL DEVOICING (Blust, 2005, pp. 259–262, Blust, 2013, p. 668)
- | | | | | |
|-------------|------------------|----------------|-------------|----------------|
| a. PROTO-KM | <i>*kelembit</i> | <i>*lindem</i> | <i>*ɲji</i> | <i>*tungan</i> |
| b. MURIK | <i>kələmpit</i> | <i>lintəm</i> | <i>ncçi</i> | <i>tujkan</i> |
| | shield | dark | one | dibble stick |

The development of unnatural post-nasal devoicing in Murik and twelve other languages receives extensive treatment in Beguš (2019), who demonstrates that post-nasal devoicing always arises from a sequence of (at least) three changes, in the course of which (i) a set of segments enters complementary distribution, (ii) a sound change occurs that operates on the changed or unchanged subset of those segments, (iii) another sound change occurs that blurs the original complementary distribution. Beguš (2019) refers to a combination of sound changes that fit that description as the *blurring process*. Changes involved in the post-nasal devoicing in Murik are summarized in (13). For more on the mechanics and subtypes of the blurring process, see e. g. Beguš (2018, 2019, 2020, 2022) and Beguš, Nazarov, et al. (2022).

- (13) DEVELOPMENT OF PND IN MURIK (based on Beguš, 2019, pp. 725–726)
- | | | | | | | |
|--------------|------------|-------------|-------------|------------|-------------|-------------|
| o. PRE-PKM | <i>*b-</i> | <i>*VbV</i> | <i>*Nb-</i> | <i>*d-</i> | <i>*VdV</i> | <i>*Nd-</i> |
| i. PROTO-KM | <i>*β-</i> | <i>*-β-</i> | <i>*-b-</i> | <i>*ð-</i> | <i>*-ð-</i> | <i>*-d-</i> |
| ii. PROTO-KM | <i>*β-</i> | <i>*-β-</i> | <i>*-p-</i> | <i>*ð-</i> | <i>*-ð-</i> | <i>*-t-</i> |
| iv. MURIK | <i>b-</i> | <i>-b-</i> | <i>-p-</i> | <i>l-</i> | <i>-r-</i> | <i>-t-</i> |

First (13i), voiced stops **b* and **d* fricativize to **β* and **ð* if not directly preceded by a nasal. Second (13ii), all the remaining (i. e. post-nasal) voiced stops devoice. Finally (13iii), word-initial and intervocalic **ð* lenites to *l-* and *-r-* respectively,⁹ and **β* occludes to *b*. This combination of sound changes in Murik gives rise to the appearance of unnatural post-nasal devoicing. However, due to the preceding fricativization (**b, *d > *β, *ð*) in other positions, the devoicing of stops was unconditioned (and hence phonetically natural) at the time of its actuation.

Evidence for the proposed trajectory of development (13) comes from the reflexes of Pre-PKM **d*. The alveolar stop lenites word-initially and intervocalically but devoices post-nasally, suggesting a stage of complementary distribution. The lenited reflexes point to a stage of fricativization since **d* is likely to develop into *l* and *r* through an interstage with **ð* (Beguš, 2019).

We extend Beguš's (2019) argument to propose that Uma Bawang and Long Atip underwent a similar fricativization. Unlike in Murik however, the UB and LgA voiced stops develop into voiced fricatives in all post-vocalic positions, including word-finally. This reconstruction is supported by evidence from the closely related dialect of Uma Juman. Uma Juman lacks final nasalization, but voiced stops develop into voiced fricatives in all post-vocalic positions, including word-finally (10d): PKM **-b* develops into **-β > -v* and PKM **-d* develops into *-r*, likely through an interstage with **-ð*. In Uma Bawang and Long Atip, the word-final fricatives de-

⁹ Alternatively, **-d-* might have lenited to *-r-* without the intermediate stage of **-ð-*, since *d > r* is a common sound change in its own right. Either trajectory attests to the intervocalic lenition of voiced stops.

voice, creating a precondition for spontaneous nasalization. Finally, nasalized fricative occlude to nasal stops. The developments of PKM word-final **-b* and **-d* are exemplified in (14).¹⁰

(14) DEVELOPMENTS OF PKM WORD-FINAL VOICED STOPS IN UB, LGA, AND UJ

a. DEVELOPMENTS OF PROTO-KAYAN-MURIK **-b*

UB & LGA:	<i>*kələb</i>	>	<i>*kələβ</i>	>	<i>*kələ̃β</i>	>	<i>kələm</i>
	<i>*kələb</i>	>	<i>*kələβ</i>	>			
UMA JUMAN:				>	<i>kələv</i>		

b. DEVELOPMENTS OF PROTO-KAYAN-MURIK **-d*

UB & LGA:	<i>*aṇuθ</i>	>	<i>*aṇũθ̃</i>	>	<i>aṇun</i>
	<i>*aṇud</i>	>	<i>*aṇuð</i>	>	
UMA JUMAN:				>	<i>aṇur</i>

In sum, we propose that final nasalization in Uma Bawang and Long Atip proceeded through the interstage of fricativization. Fricativization is independently motivated by the facts of Murik post-nasal devoicing and synchronically attested in the closely related Uma Juman.

4.2 Berawan

The second language with reported final nasalization that shows independent evidence of fricativization of voiced stops is Berawan. Berawan is a group of closely related dialects spoken in the Malaysian state of Sarawak. Proto-Malayo-Polynesian (PMP) word-final voiced stops (15a) correspond to nasal stops in the Berawan dialects of Long Terawan (15b), Batu Belah (15c), and Long Jegan (15d).

(15) WORD-FINAL DEVELOPMENTS OF PROTO-MALAYO-POLYNESIAN VOICED STOPS (Blust, 2016)

a. PROTO-MP	<i>*asəb</i>	<i>*tumid</i>
b. LONG TERAWAN	<i>cam</i>	<i>tumin</i>
c. BATU BELAH	<i>cam</i>	<i>tumin</i>
d. LONG JEGAN	<i>cam</i>	<i>tomən</i>
	<i>smoke</i>	<i>heel</i>

¹⁰ Proto-Malayo-Polynesian (PMP) did not have phonemic non-strident fricatives (except for **h*) (Blust, 2013), and we have no reasons to believe that the immediate ancestors of Kayan-Murik (discussed in this section), Berawan (§4.2), Kalabakan Murut (§4.3), or Karo Batak had the non-strident phonemic fricatives either (§4.4). As such, the stages of fricativization and devoicing did not result in any mergers with **β*, **ð*, **ɣ*, or **ϕ*, **θ*, **x*. Proto-Malayo-Polynesian had two fricatives **s* and **h* (Blust, 2013). The alveolar fricative **s* does not trigger spontaneous nasalization. However, **s* is a sibilant. Sibilants have a higher amplitude and pitch than non-sibilant fricatives. As a consequence, sibilants and non-sibilants are often found to pattern differently. Our discussion of Austronesian fricatives is restricted to the non-sibilant ones, to the exclusion of the **s*. Finally, PMP had the non-strident glottal fricative **h* (Blust, 2013). In most Malayo-Polynesian languages, word-final **-h* has been lost (Blust, Trussel, and Smith, 2023). The PMP word-final **-h* does not have nasal reflexes, suggesting that it had been lost in the daughter languages before the sequence of changes in (4) took place.

Intervocally, the Berawan voiced stops undergo other unusual developments. The Proto-Malayo-Polynesian **-g-* devoices to *-k-*; **-b-* also devoices and velarizes to *-k-*. PMP **-d-* does not devoice, but rather lenites to *-r-*. Word-initially, the three voiced stops do not undergo any changes. Some of these developments are exemplified in (16). The developments of voiced stops in all positions are summarized in (17).

- (16) DEVELOPMENTS OF PMP VOICED STOPS ELSEWHERE (Blust, 2013; Burkhardt, 2014)
- | | | | | | |
|---------------|--------------|------------------|---------------|---------------|----------------|
| a. PROTO-MP | <i>*bibi</i> | <i>*bɔlibiaw</i> | <i>*bigiu</i> | <i>*gigun</i> | <i>*dibian</i> |
| b. BATU BELAH | <i>biki</i> | <i>bɔlikiw</i> | <i>bikiw</i> | <i>gikuŋ</i> | <i>dikin</i> |
| | edge | rat | typhoon | cloud | parent-in-law |
- (17) SUMMARY OF BERAUAN DEVELOPMENTS (based on Blust, 2016; Burkhardt, 2014, p. 273)
- | | | | | | | | | | |
|-------------|------------|-------------|------------|------------|-------------|------------|------------|-------------|------------|
| a. PROTO-MP | <i>*b-</i> | <i>*-b-</i> | <i>*-b</i> | <i>*d-</i> | <i>*-d-</i> | <i>*-d</i> | <i>*g-</i> | <i>*-g-</i> | <i>*-g</i> |
| b. BERAUAN | <i>b-</i> | <i>-k-</i> | <i>-m</i> | <i>d-</i> | <i>-r-</i> | <i>-n</i> | <i>g-</i> | <i>-k-</i> | <i>-ŋ</i> |

The phonetically unnatural intervocalic devoicing receives treatment in Beguš and Dąbkowski (2023), who propose that like the post-nasal devoicing in Murik, Berawan's intervocalic devoicing is also the outcome of a sequence of sound changes (the blurring process) (18).

- (18) INTERVOCALIC DEVOICING IN BERAUAN (Beguš and Dąbkowski, 2023)
- | | | | | | | |
|------------------|------------|-------------|------------|-------------|------------|-------------|
| o. PROTO-MP | <i>*b-</i> | <i>*-b-</i> | <i>*d-</i> | <i>*-d-</i> | <i>*g-</i> | <i>*-g-</i> |
| i. PRE-BERAUAN | <i>*b-</i> | <i>*-β-</i> | <i>*d-</i> | <i>*-ð-</i> | <i>*g-</i> | <i>*-ɣ-</i> |
| ii. PRE-BERAUAN | <i>*b-</i> | <i>*-ϕ-</i> | <i>*d-</i> | <i>*-r-</i> | <i>*g-</i> | <i>*-x-</i> |
| iii. PRE-BERAUAN | <i>*b-</i> | <i>*-x-</i> | <i>*d-</i> | <i>*-r-</i> | <i>*g-</i> | <i>*-x-</i> |
| iv. BERAUAN | <i>b-</i> | <i>-k-</i> | <i>d-</i> | <i>-r-</i> | <i>g-</i> | <i>-k-</i> |

First (18i), voiced stops fricativize intervocally. Second (18ii), **ð* lenites to **r*,¹¹ while the other voiced fricatives devoice unconditionally. Third (18iii), the labial fricative **ϕ* velarizes to **x*. The velarization of labial fricatives is typologically attested (Kümmel, 2007, p. 222) and phonetically motivated (because non-strident fricatives are perceptually confusable; Redford and Diehl, 1999). Finally (18iv), the remaining **x* occludes to *k*. The unconditioned change of **x > k* has been reported e. g. from Proto-Tacanan to Cavineña (Key, 1968). A similar change of **x > k^h* has been reported from Proto-Tai to several Tai languages (Li, 1977).

Several pieces of evidence support Beguš and Dąbkowski's (2023) reconstruction. First, the lenition of **-d-* to *-r-* likely went through an intermediate step of **-ð-*, pointing to a stage of fricativization. Second, the velarization of labial fricatives is more common than velarization of labial stops (Kümmel, 2007, pp. 221–2). Third, unless an interstage of intervocalic fricativization is postulated, the changes of devoicing and velarization cannot be ordered. Ordering

11 As in Murik, **-d-* might have lenited to *-r-* without the intermediate stage of **-ð-*. Positing the intermediate stage of **-ð-* allows for parallel treatment of all three series of stops. On the other hand, a direct change of **-d- > -r-* helps explain why **-d-* does not devoice, while the other Proto-Malayo-Polynesian stops-turned-fricatives do. Either trajectory attests to the postvocalic lenition of voiced stops.

devoicing before velarization incorrectly predicts the velarization of Pre-Berawan $*p > *k$. Ordering velarization before devoicing incorrectly predicts the velarization of Pre-Berawan word-initial $*b- > *g-$. The only way out of the ordering paradox is to say that the velarization of stops (an already unusual change) occurred only intervocalically. This is highly implausible since the place of articulation of stops is best articulatorily cued specifically between vowels. For a full exposition of the argument, see Beguš and Dąbkowski (2023).

We extend Beguš and Dąbkowski's (2023) analysis in proposing that—similarly to Kayan-Murik—Berawan fricativization takes place in all post-vocalic positions, including word-finally. Next, we reconstruct that the fricatives devoice. Note that the unconditioned devoicing of fricatives in Berawan is independently motivated in the account of Berawan's intervocalic devoicing (18ii). Finally, word-final fricatives nasalize and occlude, yielding apparent word-final nasalization. This development in Long Terawan is exemplified in (19).¹²

(19) DEVELOPMENTS OF PRE-BERAWAN WORD-FINAL VOICED STOPS IN LONG TERAWAN

a. DEVELOPMENT OF PRE-BERAWAN $*-b$

$*cab > *ca\beta > *ca\phi > *c\tilde{a}\tilde{\phi} > cam$

b. DEVELOPMENT OF PRE-BERAWAN $*-d$

$*tumid > *tumi\delta > *tumi\theta > *tumi\tilde{\theta} > tumin$

In Berawan, only the word-final voiceless fricatives trigger spontaneous nasalization. This may be the case because articulatory cues in the final position are the weakest. This is to say, word-final fricatives and adjacent vowels are most readily misperceived as nasalized (due to the mechanism proposed by Ohala and Amador, 1981). Alternatively, Berawan devoicing might have taken place in two steps, separated by spontaneous nasalization. First, word-final fricatives devoice. Second, voiceless fricatives nasalize. Lastly, all other fricatives devoice. Due to a lack of additional evidence, we do not take a strong stance on why only word-final fricatives nasalize in Berawan.

In sum, we propose that final nasalization in Berawan arose through the intermediate stage of voiced stop fricativization. The interstage of fricativization is motivated independently by the facts of Berawan intervocalic devoicing.

4.3 *Kalabakan Murut*

In two out of four reported languages with final nasalization, a stage of voiced stop fricativization must be reconstructed for reasons completely independent of final nasalization. In Kayan-Murik, the interstage of fricativization accounts for phonetically unnatural post-nasal

¹² If $*-d$ had lenited to $*-r$ as a single sound change, as discussed in the preceding footnotes, the word-final $-n$ could have developed from $*-r$ directly, without the stages of fricativization and spontaneous nasalization. Nonetheless, this explanation does not extend to the other series, still necessitating an incremental approach with a sequence of step-wise changes.

devoicing (Beguš, 2019). In Berawan, fricativization explains the unusual devoicing of stops between vowels (Beguš and Dąbkowski, 2023). In one additional language—Kalabakan Murut—there exists strong internal and dialectal evidence that final nasalization arises through an interstage with fricativization as well.

Kalabakan Murut (MKal) is a language of the Sabahan branch of Austronesian spoken in Malaysia. Blust (2016) reports that Kalabakan Murut underwent final nasalization (20). Proto-Murutic (PMur) final voiced stops **b*, **d*, and **g* (20a) develop to *-m*, *-n*, and *-ŋ* (20b). Notably, Proto-Murutic **b-*, **d-*, and **g-* yield *-b-*, *-r-*, and *-h-* intervocally at morpheme boundaries when followed by a vowel-initial prefix (20c). Word-initially, voiced stops do not change. The Kalabakan Murut developments are summarized in (21).

(20)	DEVELOPMENTS OF PROTO-MURUTIC VOICED STOPS			(Blust, 2016)
a.	PMURUTIC	<i>*takub</i>	<i>*takod</i>	<i>*ipag</i>
b.	MKAL _ #	<i>an-akum</i> (AV.NPST)	<i>an-akon</i> (AV.NPST)	<i>aŋ-ipaŋ</i> (AV.NPST)
c.	MKAL V _ -V	<i>takub-on</i> (OV.NPST)	<i>tokor-on</i> (OV.NPST)	<i>ipah-in</i> (LV.NPST)
		catch	climb tree	call
(21)	SUMMARY OF KALABAKAN MURUT DEVELOPMENTS			(based on Blust, 2016)
a.	PMURUTIC	<i>*b-</i> <i>*-b-</i> <i>*-b</i>	<i>*d-</i> <i>*-d-</i> <i>*-d</i>	<i>*g-</i> <i>*-g-</i> <i>*-g</i>
b.	MKAL	<i>b-</i> <i>-b-</i> <i>-m</i>	<i>d-</i> <i>-r-</i> <i>-n</i>	<i>g-</i> <i>-h-</i> <i>-ŋ</i>

To account for the Kalabakan Murut reflexes, we propose that—like in Kayan-Murik and Berawan—the Proto-Murutic voiced stops (22) fricativize word-medially and finally, i. e. in all post-vocalic positions (22i). The reflexes of Proto-Murutic **d* and **g* point directly to this interstage. Intervocally, **d* > **ð* lenites to *r*. The velar fricative **g* > **ɣ* unconditionally devoices to **x*. The other fricatives devoice word-finally (22ii). Word-final fricatives spontaneously nasalize (22iii). At last, fricatives occlude, yielding word-final nasal stops (22iv). In Karo Batak (discussed briefly in §4.4), the voiceless velar fricative *x* is word-finally in free variation with voiceless glottal fricative *h* (Woollams, 1996), pointing to an ongoing sound change *x* > *h*. We propose that this debuccalization takes place in Kalabakan Murut as well.

(22)	KALABAKAN MURUT DEVELOPMENTS STEP-BY-STEP		
o.	PMURUTIC	<i>*b-</i> <i>*-b-</i> <i>*-b</i>	<i>*d-</i> <i>*-d-</i> <i>*-d</i> <i>*g-</i> <i>*-g-</i> <i>*-g</i>
i.	PRE-MKAL	<i>*b-</i> <i>*-β-</i> <i>*-β</i>	<i>*d-</i> <i>*-ð-</i> <i>*-ð</i> <i>*g-</i> <i>*-ɣ-</i> <i>*-ɣ</i>
ii.	PRE-MKAL	<i>*b-</i> <i>*-β-</i> <i>*-φ</i>	<i>*d-</i> <i>*-r-</i> <i>*-θ</i> <i>*g-</i> <i>*-x-</i> <i>*-x</i>
iii.	PRE-MKAL	<i>*b-</i> <i>*-β-</i> <i>*-φ̃</i>	<i>*d-</i> <i>*-r-</i> <i>*-θ̃</i> <i>*g-</i> <i>*-x-</i> <i>*-x̃</i>
iv.	MKAL	<i>b-</i> <i>-b-</i> <i>-m</i>	<i>d-</i> <i>-r-</i> <i>-n</i> <i>g-</i> <i>-h-</i> <i>-ŋ</i>

This proposed sequence of developments yield the synchronic alternation between final *-m*, *-n*, and *-ŋ* (20b) and medial *-b-*, *-r-*, and *-h-* (20c), which directly points to an interstage with frication, e. g. *aŋ-ipaŋ* ~ *ipah-in* or *an-akon* ~ *tokor-on*.

In Kalabakan Murut, only the word-final $*-x$ spontaneously nasalized, even though the Proto-Murutic word medial $*-g-$ had also fricativized to $*-x-$. It is possible that, like in Berawan, only the final fricatives triggered spontaneous nasalization because articulatory cues in the final position are least robust (i. e. word-final fricatives and adjacent vowels are most readily misperceived as nasalized). This scenario is particularly plausible if the velar fricative had debuccalized before nasalizing, i. e. $*-x > *-h > *-h̃$. Word-finally, the realization of h is very weak, which may have further precipitated reinterpreting the glottal fricative cues as nasal.

The reconstruction of the stages of fricativization (22i) and word-final devoicing (22ii) is further supported by data from closely related dialects (Lobel, 2013). In Murut Paluan (MPal) and Murut Timugon (MTim), the Proto-Greater Murutic (PGMur) voiced velar stop $*-g$ develops word-finally into the voiced velar fricative $-ɣ$ (e. g. PGMur $*liʔog$ ‘neck’ > MPal, MTim *lijoy*). In Murut Tagol (MTag), the fricative further debuccalizes to $-h$ (> MTag *lijoh*). The Kalabakan Murut cognate shows word-final nasalization (> MKal *lijon*). The developments of the Proto-Murutic voiced stops in the word-final position are illustrated in (23).

(23) DEVELOPMENTS OF PROTO-MURUTIC WORD-FINAL VOICED STOPS

a. DEVELOPMENT OF PMUR $*-b$ IN KALABAKAN MURUT

$*takub > *takuβ > *takuϕ > *takũϕ > (t)akum$

b. DEVELOPMENT OF PMUR $*-d$ IN KALABAKAN MURUT

$*takod > *takoð > *takoθ > *takõθ̃ > (t)akon$

c. DEVELOPMENTS OF PGMUR $*-g$ IN MKAL, PAL, TIM, & TAG (based on Lobel, 2013)

MKAL:		$*lijox > lijoh$
MPAL, TIM:	$*liʔog > lijoy$	$>$
MTag:		$*lijox > *lijõx̃ > lijon$

In sum, three out of the four Austronesian languages with final nasalization reported in Blust (2016) show strong evidence for an interstage in which voiced stops develop into fricatives. In two of these (Kayan-Murik and Berawan), the evidence for a stage with fricativization is independent of final nasalization data. In Kalabakan Murut, word-final nasals still alternate with an approximant r ($< *ð$) and a voiceless fricative h ($< *x < *ɣ$), pointing directly to a stage of fricativization. Thus, the three Austronesian languages—we argue—had a stage of word-final voiced stops surfacing as fricatives, which is precisely the environment where spontaneous nasalization is phonetically motivated (§3). We propose that the fricatives devoice word-finally (if not already devoiced as in Berawan). Next, word-final rimes nasalize ($VS > V\tilde{S}$) due to the perceptual similarity between fricative-adjacent and nasalized vowels (Ohalá and Amador, 1981). Finally, the nasalized fricatives occlude to nasal stops.

In Noon (§2), final nasalization arose from prenasalized stops ($*ND$) denasalizing intervocalically ($> D / V _ V$) and deoralizing word-finally ($> N / _ \#$) (Merrill, 2015). Thus, in total,

in four out of the five languages with reported final nasalization, the phenomenon has been shown to have a complex diachrony.

4.4 Karo Batak

Finally, we turn to discuss the case of Karo Batak, a Northern Batak language spoken by the Karo people in North Sumatra. Blust (2016) reports that Proto-Batak (PB) (24a) word-final voiced stops devoice in Southern Batak (SB), including Toba Batak (TB) (24b), but nasalize in Northern Batak (NB), including Karo Batak (KB) (24c). However, in Karo Batak, no direct evidence for an interstage with frication exists.

(24) WORD-FINAL DEVELOPMENTS OF PROTO-BATAK VOICED STOPS (Blust, 2016)

a. PROTO-BATAK	<i>*təɾəb</i>	<i>*alud</i>	<i>*dələg</i>
b. TOBA BATAK		<i>alut</i>	<i>dolok</i>
c. KARO BATAK	<i>təɾəm</i>	<i>alun</i>	<i>dələŋ</i>
	mass of people	massage	mountain
d. KB AFFIXED	<i>kə-təɾəm-ən</i>	<i>ŋ-alun-i</i>	
	receive many guests at once	to massage	

There are three possible explanations for final nasalization in Karo Batak. First, final nasalization in Karo Batak could have resulted from a single sound change (25) (as proposed by Blust, 2016), which would distinguish Karo Batak from the other languages discussed above, where evidence for intermediate stages is present.

(25) HYPOTHESIS ONE: KB FINAL NASALIZATION AS A SINGLE SOUND CHANGE

o. PROTO-BATAK	<i>*təɾəb</i>	<i>*alud</i>	<i>*dələg</i>
i. KARO BATAK	<i>təɾəm</i>	<i>alun</i>	<i>dələŋ</i>

Second, Karo Batak FN could have arisen from the same combination of sound changes as in the other Austronesian languages (26). In this familiar scenario, post-vocalic stops fricativize (26i), devoice word-finally (26ii), spontaneously nasalize (26iii), and lastly occlude (26iv).

(26) HYPOTHESIS TWO: KB FINAL NASALIZATION VIA A SERIES OF CHANGES

o. PROTO-BATAK	<i>*təɾəb</i>	<i>*alud</i>	<i>*dələg</i>
i. PRE-KB	<i>*təɾəβ</i>	<i>*aluð</i>	<i>*dələɣ</i>
ii. PRE-KB	<i>*təɾəɸ</i>	<i>*aluθ</i>	<i>*dələx</i>
iii. PRE-KB	<i>*təɾəɸ̃</i>	<i>*aluθ̃</i>	<i>*dələɣ̃</i>
iv. KARO BATAK	<i>təɾəm</i>	<i>alun</i>	<i>dələŋ</i>

In other positions, KB fricatives undergo occlusion without devoicing or nasalization, i. e. **-b- > *-β- > -b-*, **-d- > *-ð- > -d-*, and **-g- > *-ɣ- > -g-*. We reconstruct this sequence of

sound changes in Berawan, Kalabakan Murut, and Murik as well. For example, in Murik and Kalabakan Murut, the intervocalic labial fricative $*\beta$ ($< *b$) occludes back to b . In Berawan, occlusion occurs in the velar series ($*b, *g > *x > k$). What distinguishes Karo Batak from the other languages is that in KB, fricatives occlude in all places of articulation, blurring the evidence for the initial development of frication.

While we are unaware of direct evidence for the sequence of changes outlined above, languages closely related to Karo Batak exhibit spontaneous nasalization of fricatives, which is precisely the step we are proposing in the history of Karo Batak's final nasalization. These developments further support our incremental scenario. For example, NB *picat* 'to squeeze sth., to massage breasts' corresponds to TB, Simalungun *pisat* and Angkola Mandailing (AnMa) *piñat* (Adelaar, 1981, p. 15). The AnMa *mañabia*, *manabia* is a borrowing from Sanskrit *vāyavya* (Adelaar, 1981, p. 16). Sanskrit *lakṣa* 'hundred thousand' has been borrowed into NB as *laksa* 'ten thousand' and becomes TB *laso* and in AnMa *laño* (Adelaar, 1981, p. 15). These examples reveal the directionality of change—in AnMa, fricatives (and approximants) have undergone spontaneous nasalization.

Finally, Karo Batak final nasalization could also have resulted from analogical extension. While the Proto-Batak final voiced stops $*-b$, $*-d$, and $*-g$ correspond to Karo Batak $-m$, $-n$, and $-ŋ$, these nasalized final stops do not alternate (24d). For example, PB $*tərab$ 'mass of people' yields KB *təram*, but when the stop appears in a non-final position, it also surfaces as a nasal, e. g. *kə-təram-ən* 'receive many guests at once.' This stands in contrast with Kalabakan Murut which preserves a synchronic alternation (20b-c), e. g. *aŋ-ipaŋ* ~ *ipah-in* or *an-akon* ~ *tokor-on*.

While by itself, this piece of evidence does not necessarily mean nasalization has to be analogical, evidence from the related Toba Batak points to a stage which could have been its precursor. Toba Batak has a sandhi phenomenon whereby word-final nasal (27a) and oral voiced stops merge to oral stops before word-initial stops (27b-c).

- (27) SANDHI IN TOBA BATAK (Blust, 2013, p. 250)
- | | | |
|-----------------|-----------------------|-------------------------|
| a. <i>minum</i> | b. <i>minub (bir)</i> | c. <i>minup (purik)</i> |
| to drink | to drink (beer) | to drink (rice water) |

If the same sandhi phenomenon was a stage in Karo Batak, the word-final nasal variant could have arisen via generalization. In this scenario, $*N D-$ and $*-D D-$ both merge to $*-D D-$ in sandhi. Then, nasal articulation gets analogically extended from the sandhi merger position. This hypothesis is illustrated in (28). The analogically extended form is marked with wavy underline.

- (28) HYPOTHESIS THREE: KB FN BY ANALOGY (based on Adelaar, 1981; Blust, 2016)
- | | | | | | | | |
|----------------|-------------|---|----------|----|-------------|---|----------------------------|
| o. PROTO-BATAK | $*tanem D-$ | : | $*tanem$ | :: | $*tərab D-$ | : | $*tərab$ |
| i. PRE-KB | $*taneD D-$ | : | $*tanem$ | :: | $*təraD D-$ | : | <u>$*təram$</u> |
| | | | to bury | | | | mass of people |

In sum, it is difficult to assess which of the three scenarios actually gave rise to final nasalization in KB. Nonetheless, given the evidence from related languages and the plausibility of analogical extension, it is likely that Karo Batak FN did not arise from a single sound change.

Finally, while we propose that the sequence of sound changes in (4) took place in three (or four) Austronesian languages, we note that sequence (4) is not shared by their common ancestor. We also do not have any evidence suggesting that final nasalization is an areal feature. As such, we consider final nasalization to be an independent development in each of the four Austronesian languages in question.

It has been often observed that related languages tend to undergo the same changes independently of each other (Bowern, 2015). While we do not have a definitive answer as to why, we speculate that cases of similar developments across related but non-interacting languages might be due to information-theoretic (Cohen Priva, 2017), phonological (Fruehwald, 2013) or phonetic (Ohala and Ohala, 1993) precursors already present in the mother language, which constitute preconditions favoring certain pathways of change.

5 FINAL VOICING AND NASALIZATION IN SIOUX

Finally, we turn to two related word-final developments in Lakota and Dakota, two varieties of Sioux (Siouan). In Lakota, Proto-Siouan voiceless stops undergo phonetically unnatural final voicing. In Dakota, they develop word-finally into nasals. We propose that the Lakota final voicing results from a combination of changes with an interstage of fricativization in weak positions. In Dakota, the fricativization is a precursor to spontaneous nasalization.

Lakota is a Mississippi Valley Siouan language spoken mainly in North and South Dakota. Lakota voiceless /p/, /t/, and /k/ voice to [b], [l], and [g] in codas. In addition to voicing, the coronal /t/ also develops into the sonorant [l]. Lakota coda voicing is a static phonotactic restriction (29a) as well as an active phonological alternation. As an active alternation, it can be observed, for example, between vowel-final citation forms where the medial stop syllabifies as an onset (29b) and forms with apocope of final vowels (29c) or in a variety of morphophonological environments where the final vowel is dropped, such as reduplication (29d) and compounding (Blevins, Egurtzegi, and Ullrich, 2020; Riggs, 1893; Rood, 2016). The process of coda voicing occurs in native Siouan words as well as recent borrowings, testifying to its productivity (Blevins, Egurtzegi, and Ullrich, 2020).

(29) LAKOTA STOP VOICING IN CODAS (Blevins, Egurtzegi, and Ullrich, 2020, pp. 301, 303)

a. CODA	<i>ób.tu</i>	<i>-kel</i>	<i>ka.ħlóg.ʔo.štəŋ.pi</i>
	to be among	kind of	vest
b. MEDIAL ONSET	<i>tó.pa</i>	<i>na.pó.tA</i>	<i>šó.kA</i>
c. APOCOPE	<i>tób</i>	<i>na.pól</i>	<i>šog</i>
d. REDUPLICATION	<i>tob.tó.pa</i>	<i>na.pól.potA</i>	<i>šog.šó.kA</i>
	four	to wear sth. out with the feet	to be thick

On the surface, coda voicing is an unnatural alternation. Nonetheless, its origin be can be illuminated by comparative data which suggest that Lakota's final voicing is in fact a result of three sound changes. Previous accounts which posit a complex history for Lakota final voicing include Rankin (2001) and Rood (2016), who reconstruct Lakota's voiced stops as going back to nasals. We propose an alternative path of development, with voiced stops arising from the occlusion of voiced fricatives. We argue that our reconstruction better captures the variety of outcomes in the individual daughter languages.

First, consider the alveolar coda reflex *-l*. The Lakota *l* goes back to the Proto-Siouan “obstruent resonant” **R* (Rankin, Carter, and Jones, 1998; Rankin, Carter, Jones, et al., 2015). In the daughter languages, **R* (30a) yields variously *r* (30b), *l* (30c), *d* (30d), *n* (30e), or *t* (30f).

(30) REFLEXES OF PROTO-SIOUAN * <i>R</i>		(Rankin, Carter, Jones, et al., 2015)			
a. PROTO-SIOUAN	* <i>Ráhe</i>	* <i>RásE</i>	* <i>aRé•</i>	* <i>Roksí</i>	* <i>i-Ró•te</i>
b. HIDATSA		(á•) <i>raci</i>	<i>are•', aré•</i>	<i>rohčÉ</i>	<i>ro•tiška, no•tiška</i>
c. LAKOTA	<i>lá</i>	<i>lazáta</i>	<i>ilé</i>	(a) <i>lóksohq</i>	<i>loté</i>
d. DAKOTA	<i>da</i>	<i>dazáta</i>	<i>idé</i>	<i>doksí</i>	<i>doté</i>
e. OMAHA-PONCA	(<i>wa</i>) <i>na</i>	(a) <i>nazatta</i>	<i>ine</i>	<i>nosi</i>	<i>nó•de</i>
f. QUAPAW	(<i>wa</i>) <i>ttá</i>		<i>téde, idé</i>	<i>tosí</i>	<i>tótte</i>
	beg	behind, in back	burn	armpit	throat

In the labial series, Rankin, Carter, and Jones (1998) reconstruct another obstruent resonant **W* (31a), which yields *w* (31b), *b* (31c), *m* (31d), or *p* (31e).¹³ The phonetic status of **W* and **R* is unclear. Rankin, Carter, and Jones (1998) categorize them as “obstruent resonants,” which we identify with voiced fricatives of high sonority, plausibly [*β*] and [*ð*]. We concur with their proposal.¹⁴

(31) REFLEXES OF PROTO-SIOUAN * <i>W</i>		(Rankin, Carter, Jones, et al., 2015)			
a. PROTO-MS-VALLEY	* <i>Wa-</i>	* <i>Wá•su</i>	* <i>Wá•yE</i>	* <i>Wé•</i>	* <i>Wi•</i>
b. LAKOTA	<i>wa-</i>	<i>wasú</i>	<i>wáyačhq</i>	<i>wétu</i>	<i>wí</i>
c. CHIWERE	<i>ba-</i>	<i>ba•θú</i>	<i>bá•x?e</i>	<i>béhu</i>	<i>bí, bi•, (m)pí•</i>
d. OMAHA-PONCA	<i>má-</i>	<i>mási</i>	<i>má?a</i>	<i>me</i>	<i>mi</i>
e. QUAPAW	<i>pa-</i>	<i>pási</i>	<i>báx?a, páx?a</i>	<i>pe</i>	<i>mi</i>
	cutting instrumental	hail	poplar, cottonwood	spring	sun

¹³ For comparison, the Proto-Siouan regular approximant **r* usually yields *r*, *l*, *n*, *ð*, or *y*, and the regular approximant **w* yields *w* or *m* in most daughter languages (Rankin, Carter, and Jones, 1998).

¹⁴ Rankin, Carter, Jones, et al. (2015) suggest that **R* might be, at least in some cases, traced back to an epenthetic glide (p. 746). Most instances of **W* derive from sequences of **w-w*, arising from medial vowel syncope (< **wV-w*) (p. 135). As such, **W* and **R* may ultimately go back to glides, which later underwent fortition.

We propose that Lakota final voicing arose through an intermediate step of fricativization (32). First, voiceless stops **p*, **t*, **k* fricativize and voice to obstruent resonants in the coda position, where articulation is generally weakened (32i). (We reconstruct an additional obstruent resonant **G* in the velar series.) Such a development is phonetically motivated and has a parallel in the development of Spanish voiceless stops that have various realization syllable-finally. For example, the Spanish /*k*/ can be realized as [x], [χ], or [g] before a stop like /*t*/ (Quilis, 1993). From here, coda **W* and **G* develop into *b* and *g*. The alveolar **R* undergoes its regular development into *l* (32ii).

(32) DEVELOPMENT OF LAKOTA VOICING IN MEDIAL CODAS

o. PRE-PROTO-SIOUX	<i>*top.tó.pa</i>	<i>*na.pót.potA</i>	<i>*šok.šó.kA</i>
i. PROTO-SIOUX	<i>*toW.tó.pa</i>	<i>*na.póR.potA</i>	<i>*šoG.šó.kA</i>
ii. LAKOTA	<i>tob.tó.pa</i>	<i>na.pól.potA</i>	<i>šog.šó.kA</i>

We propose that coda voicing in the word-final position results from the same mechanism of pre-consonantal lenition (33i) and occlusion (33ii) across word boundaries. Then, the voiced realization of stops is extended to all positions, including utterance-finally (33iii).

(33) DEVELOPMENT OF LAKOTA VOICING IN FINAL CODAS

o. PRE-PROTO-SIOUX	<i>*tóp C-</i>	<i>*na.pót C-</i>	<i>*šók C-</i>
i. PROTO-SIOUX	<i>*tóW C-</i>	<i>*na.póR C-</i>	<i>*šoG C-</i>
ii. PRE-LAKOTA	<i>*tób C-</i>	<i>*na.pól C-</i>	<i>*šóg C-</i>
iii. LAKOTA	<i>tób</i>	<i>na.pól</i>	<i>šóg</i>

Our reconstruction is supported by independent language-internal and dialectal evidence. First, bilabial sonorants in Lakota are known to occlude to *b* in pre-consonantal positions (34). Additionally, comparative evidence shows that velar voiceless stops (**k*) also fricativize in clusters. For example, Proto-Dakota **kri* ‘arrive here’ yields Dakota *hdi* and Lakota *glí* (Rankin, Carter, Jones, et al., 2015).

(34) PRE-CONSONANTAL OCCLUSION OF **w* IN LAKOTA (Rankin, Carter, Jones, et al., 2015)

a. PROTO-MS-VALLEY	<i>*wRé</i>	<i>*wRó•ke</i>
b. LAKOTA	<i>blé</i>	<i>blokétu, blokéhq</i>
	lake, water	summer

Finally, we turn to Dakota, a Sioux dialect closely related to Lakota. In Dakota, the cognates of Lakota word-final voiced stops are nasal stops (Riggs, 1893). This is to say, the Lakota coda-voicing corresponds to Dakota’s final nasalization (35).

(35) DAKOTA STOP VOICING IN CODA POSITION (Riggs, 1893, pp. 9–10)

a. MEDIAL ONSET	<i>nape</i>	<i>topa</i>	<i>watopa</i>	<i>waniča</i>	<i>yuta</i>	<i>kuya</i>
b. APOCOPE	<i>nam</i>	<i>tom</i>	<i>watom</i>	<i>wanin</i>	<i>yun</i>	<i>kun</i>
	hand	four	to row	none	to eat	below

We propose that the Dakota final nasalization arose through an interstage with fricativization, in a way that closely parallels Austronesian (§4). First (36i), preconsonantal coda stops fricativize to *W and *R. (This stage is common to both Lakota and Dakota.) Second (36ii), the Dakota obstruent sonorants devoice. Third (36iii), voiceless fricatives create a precondition for spontaneous nasalization. Finally (36iv), nasalized fricatives occlude. The developments of the Pre-Proto-Sioux **top* C- are illustrated in (37).

(36) DEVELOPMENT OF LAKOTA FINAL NASALIZATION

o. PRE-PROTO-SIOUX	* <i>top</i> C-	* <i>yut</i> C-
i. PROTO-SIOUX	* <i>toW</i> C-	* <i>yuR</i> C-
ii. PRE-DAKOTA	* <i>toW̥</i> C-	* <i>yuR̥</i> C-
iii. PRE-DAKOTA	* <i>tōW̥</i> C-	* <i>yūR̥</i> C-
iv. DAKOTA	<i>tom</i> C-	<i>yun</i> C-

(37) DEVELOPMENTS OF PRE-PROTO-SIOUX *-*p* C-

DAKOTA:		* <i>toW̥</i> C-	>	* <i>tōW̥</i> C-	>	<i>tom</i> C-
	* <i>top</i> C-	>	* <i>toW</i> C-	>		
LAKOTA:				* <i>tob</i> C-	>	<i>tob</i>

In sum, we discussed phonetically unnatural developments in two closely related branches of Sioux. In Lakota, coda stops undergo voicing. In Dakota, word-final stops undergo nasalization. We demonstrated that in both languages, the unusual developments are best understood as arising from a combination of several natural sound changes.

6 DISCUSSION AND CONCLUSIONS

In conclusion, we investigated six cases of phonetically unmotivated word-final nasalization. In four of them (Kayan-Murik, §4.1; Berawan, §4.2; Kalabank Murut, §4.3; Dakota, §5), final nasalization is plausibly shown to arise from a sequence of four sound changes: (i) fricativization of voiced stops, (ii) devoicing of the fricatives, (iii) spontaneous nasalization before voiceless fricatives, and (iv) occlusion of the nasalized fricatives to nasal stops (38).

(38) FINAL NASALIZATION AS A SERIES OF CHANGES

*-VD	>	*-VZ	>	*-VS	>	*-V̥Ṣ̥	>	-VN
o – proto	i – fricativization	ii – devoicing	iii – nasalization	iv – occlusion				

Each of the changes is articulatorily or perceptually grounded, i. e. phonetically natural. The interstages of fricativization (and devoicing in Berawan) are supported by independent

language-internal or dialectal evidence. In five of the six cases (including Noon, §2), final nasalization is plausibly demonstrated to have a complex history. In the last case (KB, §4.4), final nasalization likely arises from a combination of sound changes or by analogical extension.

Our findings bear on the division of labor and the role of phonetic naturalness in diachrony and synchrony. While unnatural phonological processes are attested (e.g. Beguš, 2020, 2022; Beguš and Dąbkowski, 2023; Beguš, Nazarov, et al., 2022; Coetzee and Pretorius, 2010; Dąbkowski, 2023; Hyman, 2001; Merrill, 2015), we maintain that the sound changes are always grounded in the realities of language production and perception. As such, our findings lend support to the long-held assumption that synchronic phonological processes are phonologizations of natural sound changes (Blevins, 2004, 2007, 2008, 2013; Hyman, 1976; Ohala, 1981, 1983). We also propose a new explanation for the development of unnatural final voicing in Lakota. Cumulatively, these cases suggest that Beguš's (2019) *blurring process* framework, which derives phonological processes from specific sequences of sound changes, can be useful for understanding unnatural alternations.

While we focus mainly on Austronesian and Sioux, there is suggestive evidence that the proposed sequence of changes took place in other languages as well. In Hueyapan Nahuatl (Southern Uto-Aztecan), the bilabial fricative β (< Classic Nahuatl w) is realized as h word-finally after (historically) short vowels, but as η after (historically) long vowels (Pharao Hansen, 2018). For example, β alternates with h in *kioβi* 'it rains' ~ *o:gioh* 'it rained,' where the preceding vowel is short (p. 3), but with η in *tela:βi* 'it rains heavily' ~ *o:telaη* 'it rained heavily,' where the preceding vowel is long (p. 4). We propose that β developed into h and η through an interstage with the voiceless bilabial fricative $*\phi$. After short vowels, the voiceless fricative debuccalized to h . After long vowels, the fricative additionally nasalized to η . Our proposal is supported by dialectal data. E.g., *nofta:gaβ* 'my man/husband' is realized by some speakers from Atlahuilco as *nofta:gaφ* (p. 7), directly testifying to the stage of final devoicing.

We apply our incremental sound change explanation to word-final nasalization, but nothing in our account precludes the same sequence of changes from taking place word-internally. Another case where nasal stops plausibly developed along a path similar to (38) includes codas in Bribri (Chibchan). In Bribri, the voiced bilabial stop $/b/$ is realized as a nasal $[m]$ in the coda position, e.g. */jéb/* [*jém*] 'espavel (type of tree),' */bâbbă/* [*bâmbă*] 'hot' (Constenla, 1981, p. 112). The voiced dental stop $/d/$ is realized as a nasal $[n]$ before voiced consonants, e.g. */diddi/* [*dîndî*] 'sharp' (p. 112–113). The voiceless velar stops $/k/$ is realized as a nasal $[ŋ]$ before voiced stops, e.g. */tkôkdò/* [*tḱḱḱôŋdò*] 'to sit' (p. 112). Language-internal and dialectal evidence both point to a stage of development with fricatives. For example, the Bribri $/d/$ is realized as a voiced alveolar tap or trill $[r]$ before voiceless consonants and pause, e.g. */iûdkê/* [*iûrkê*] 'it flies,' */uôkid/* [*wôkir*] 'head' (p. 112–3). The lenition to $[r]$ suggests an earlier stage of fricativization with $*\delta$. In many related languages, Proto-Chibchan (PCh) stops are realized as fricatives. For example, the PCh $*p$ and $*b$ become Tèrraba ϕ in word-initial position (p. 219, 221). PCh $*b$ becomes Muisca β (p. 222). PCh $*d$ becomes s in Boruca intervocalically before an oral vowel, and in Muisca before oral vowels in non-morpheme-final position (p. 225–6). PCh $*g$ becomes Cabécar $/h/$ before i and u (presumably via an interstage with $*x$ < $*\gamma$) (p. 230).

We suggest that the development of final nasalization in several Austronesian languages (§4), Dakota (§5), and plausibly Hueyapan Nahuatl as well as Bribri, proceeded through an interstage with fricativization. Nonetheless, other pathways have also been attested. In Noon (§2), for example, final nasalization developed from the deoralization of prenasalized stops. A third trajectory—different yet—is suggested by Southeastern Tepehuan (Uto-Aztecan). In Tepehuan, voiced stops (and an affricate) /b/, /d/, /dʒ/, and /g/ are realized as preglottalized nasals [ʔm], [ʔn], [ʔñ], and [ʔŋ] in codas (Willett, 1991, p. 13), e.g. *'kai.baʔ* ‘it will ripen’ but *kaiʔm* ‘it (has) ripened’ (p. 17). We suggest that a likely course of events involved, first, the preglottalization of coda stops (*-VD > *-VʔD), and second, post-glottal nasalization (> -VʔN). Both changes are well motivated—the glottalization of coda stops is independently attested, and so is spontaneous nasalization in the vicinity of glottals (*rhinoglottophilia* in Matisoff, 1975). Thus, while many a pathway may lead to the phonetically unmotivated word- (or syllable-)final nasalization, each of them can be explained as proceeding through a series of phonetically grounded steps.

Finally, we address Blust’s (2005, 2023) argument from parsimony against “incremental” historical accounts. Blust (2005, 2023) proposes that a number of phonetically unmotivated developments result from single unnatural sound changes, and opposes positing series of natural changes which lead to an unnatural development. Blust (2005, 2023) motivates his stance primarily with the principle of economy—he sees the intermediate stages as an unmotivated departure from theoretical simplicity. We believe that Blust’s (2005, 2023) argument is unfounded on both empirical and theoretical grounds.

First, Occam’s razor, or the principle of theoretical economy, is used to decide between two empirically equivalent accounts. Otherwise, empirical adequacy always trumps parsimony. (For a discussion of the application of Occam’s razor in linguistics, see Joseph and Janda, 2003 and Klausenburger, 2014.) The intermediate stages we posit are independently motivated by dialectal correspondences and language-internal developments. As such, the interstages are not arbitrary. Since our proposal makes sense of a greater number of interrelated facts, it has a stronger empirical standing than a single-change account. This is to say, the incremental account would be preferable even if it were less parsimonious.

Second, even if there were no empirical upsides to our account, a proposal that succeeds at reducing an unnatural development to a combination of phonetically motivated sound changes would still be preferable. While it is true that an incremental account postulates a number of additional sound changes for each development, Blust’s (2005, 2023) theory allows completely *unnatural* changes. In doing so, Blust (2005, 2023) radically expands the total set of feasible sound changes, challenging several centuries of linguistic scholarship. Accepting Blust’s (2005, 2023) proposal would be tantamount to accepting a vastly more powerful theory of language change, where arguments from phonetics and typology become less influential. Thus, we conclude, our incremental account of final nasalization is preferable to a single-change account on both empirical and theoretical grounds.

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ACKNOWLEDGEMENTS We would like to express our sincere gratitude to Alex Elias for drawing our attention to the examples of nasal unpacking in Portuguese-based creoles and to Katie Russell for feedback on a previous version of this paper. Our research has been partly funded by the Georgia Lee Fellowship in the Society of Hellman Fellows to Gašper Beguš.