COMPLEX DIACHRONIES OF FINAL NASALIZATION IN AUSTRONESIAN AND DAKOTA

MAKSYMILIAN DĄBKOWSKI AND GAŠPER BEGUŠ
UNIVERSITY OF CALIFORNIA, BERKELEY
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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 stop becomes a nasal stop in the word-final position. Final nasalization is phonetically unmotivated, i. e. it does not arise as a consequence of universal articulatory or perceptual tendencies. As such, final nasalization has been 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 rending final nasalization a synchronically impossible phonological process as well.

Nonetheless, synchronic systems that repair *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.

(1) FINAL NASALIZATION AS A SERIES OF CHANGES

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

Each of the four changes is phonetically grounded (discussed in Section 3). 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 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 diachronic and synchrony. We maintain that while phonetically unnatural phonological processes (e. g. Beguš and Dąbkowski, 2023; 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). In Noon, underlyingly voiced stops are realized as nasals in the word-final position (2a)[2] and preconsonantally. Before vowels, e. g. when a root is suffixed with a vowel-initial suffix, the voiced stops surface faithfully (2b).

1 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, $\tilde{\text{X}}$ = nasalized segment, Z = voiced fricative.

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

(2) VOICED STOPS IN NOON (Merrill, 2015)

a. NASALIZED WORD-FINALLY

/*paj*/	[*paŋ*]	marry
/*awaag*/	[*awaaŋ*]	open mouth
/*yíib*/	[*yíim*]	chin
/*nad*/	[*nan*]	spider

b. FAITHFUL PREVOCALICALLY

/*paj-ee*/ (PST)	[*pajee*]
/*awaag-ee*/ (PST)	[*awaagee*]
/*yíib-ii*/ (PROX.DEF)	[*yíibii*]
/*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, resulting in word-final nasal stops. Intervocalically, 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 intervocalically and nasal stops word-finally, i. e. final nasalization. Voiced stops and nasal in Noon are allophonic; their alternation is exceptionless and fully general, so the final nasalization in Noon is fully productive (Merrill, 2015).

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

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).

(4) FINAL NASALIZATION AS A SERIES OF CHANGES

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

Here, we motivate each of the changes as phonetically grounded. 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 (Kaplan, 2010; Kirchner, 2001). 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.

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. In short, final fricative devoicing is very well motivated and commonly attested.

Step III involves spontaneous nasalization of voiceless fricatives. While spontaneous nasalization is generally rare typologically, the vicinity of voiceless fricatives constitutes the one environment where this development is phonetically grounded and well attested (Ohala and Ohala, 1993; Ohala and Busà, 1995). Ohala and Amador (1981) propose that vowels close to fricatives are "produced with a slightly open glottis via assimilation to the greater than-normal glottal opening" required by the fricatives and demonstrate that the spectral effects of fricatives are 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.

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. This makes nasal fricatives very articulatorily difficult. As such, their occlusion is an expected sound change.

In fact, nasalized fricatives have been argued to be very rare. In Scottish Gaelic, for example, phonologically nasal fricatives are implemented in various ways, including as nasal approximants (Warner et al., 2015). A subset of speakers feature both nasalization and frication. The exact details of nasal fricative articulation are not central to our claim. Their occlusion could have proceeded through an intermediate stage of approximantization since nasal approximants have also been shown to occlude. For example, the Standard Polish *ą* [ɔ̃w̃] is often realized as [ɔm] in Greater Poland (Baranowska and Kaźmierski, 2020; Dejna, 1981; Kaźmierski and Szlandrowicz, 2020; Stieber, 1973).

In sum, we propose that final nasalization in Austronesian and Siouan arose from a sequence of four sound changes. Our analyses are presented in the remaining part of the paper. Each of the proposed changes is natural, i. e. motivated by facts of speech production and perception.

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. 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.

Previous work on two of the four languages shows that intermediates 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.

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 (5). Proto-Kayan-Murik (PKM) final *-*b* and *-*d* (5a) correspond to Uma Bawang and Long Atip -*m* and -*n* (5b-c). In Uma Juman (UJ), the PKM word-final *-*b* fricativizes to -*v* and *-*d* lenites to -*r* (5d). While the data is limited, Blust (2016) observes that Murik seems to have devoiced PKM *-*b*, but nasalized PKM *-*d* (5e).

(5) WORD-FINAL DEVELOPMENTS OF PROTO-KAYAN-MURIK VOICED STOPS (Blust, 2016)

a.	PROTO-KM	**kələb*	**añud*
b.	UMA BAWANG	*kələm*	*añun*
c.	LONG ATIP	*kələm*	*añun*
d.	UMA JUMAN	*kələv*	*añur*
e.	MURIK	*kələp*	*añun*
		tortoise	adrift

Word-initially, the voiced stops *d- and *b- do not undergo any changes in Uma Juman, Uma Bawang, or Long Atip. In 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 (6).

(6) SUMMARY OF KM DEVELOPMENTS (Blust, 2005, p. 259; Blust, 2013; Blust, 2016)

a.	PROTO-KM	**b-*	**-b-*	**-b*	**d-*	**-d-*	**-d*
b.	UB & LGA	*b-*	*-v-*	*-m*	*d-*	*-r-*	*-n*
c.	UMA JUMAN	*b-*	*-v-*	*-v*	*d-*	*-r-*	*-r*
d.	MURIK	*b-*	*-b-*	*-p*	*l-*	*-r-*	*-t*

Additionally, Murik also shows phonetically unnatural post-nasal devoicing, whereby Proto-Kayan-Murik voiced stops devoice after nasal consonants (6).

(7) MURIK POST-NASAL DEVOICING (Blust, 2005, pp. 259–262, Blust, 2013, p. 668)

a.	PROTO-KM	**kelembit*	**lindem*	**nɟi*	**tuŋgan*
b.	MURIK	*kələmpit*	*lintəm*	*ncçi*	*tuŋkan*
		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 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. Beguš (2019) refers to a combination of sound changes which fit the description as the *blurring process*. The blurring process schema is restated in (8). For more on the mechanics and subtypes of the blurring process, see e. g. Beguš (2018, 2019, 2020, 2022), Beguš and Dąbkowski (2023), and Beguš, Nazarov, et al. (2022).

(8) BLURRING PROCESS (Beguš, 2018; Beguš, 2019, p. 735)

i. A set of segments enters complementary distribution.

ii. A sound change occurs that operates on the changed/unchanged subset of those segments.

iii. Another sound change occurs that blurs the original complementary distribution.

The operation of the blurring process in Murik is summarized in (9). First, voiced stops **b* and **d* fricativize to **β* and **ð* if not directly preceded by a nasal. Second, all the remaining (i. e. post-nasal) voiced stops devoice. Word-initial and intervocalic **ð* lenites to *l-* and *-r-* respectively. Finally, **β* occludes to *b*. This combination of sound changes in the Murik blurring process 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.

(9) BLURRING PROCESS IN MURIK (Beguš, 2019, pp. 725–726)

o.	PRE-PKM	*b-	*V*b*V	*N*b*-	*d-	*V*d*V	*N*d*-
i.	PROTO-KM	*β-	*-β-	*-b-	*ð-	*-ð-	*-d-
ii.	PROTO-KM	*β-	*-β-	*-p-	*ð-	*-ð-	*-d-
iii.	MURIK	b-	-b-	-p-	l-	-r-	-t-

Evidence for this trajectory of development 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 like to develop into *l* and *r* through an interstage with **ð* (Beguš, 2019).

We extend Beguš's (2019) argument to propose that Long Atip and Uma Bawang underwent a similar fricativization. Unlike in Murik however, the Uma Bawang and Long Atip 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 (5d): 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 devoice, 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 (10).

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

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

UB & LGA: **kələɸ* > **kələ̃ɸ̃* > *kələm*
**kələb* > **kələβ* >
UMA JUMAN: *kələv*

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

UB & LGA: **añuθ* > **añũθ̃* > *añun*
**añud* > **añuð* >
UMA JUMAN: *añur*

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

(11a) correspond to nasal stops in the Berawan dialects of Long Terawan (11b), Batu Belah (11c), and Long Jegan (11d).

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

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

Intervocalically, 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 (12). The developments of voiced stops in all positions are summarized in (13).

(12) DEVELOPMENTS OF PMP VOICED STOPS ELSEWHERE (Blust, 2013; Burkhardt, 2014)

a.	PROTO-MP	**bibi*	**bəlibiəw*	**bigiu*	**gigun*	**dibiən*
b.	BATU BELAH	*biki*	*bəlikiw*	*bikiw*	*gikuŋ*	*dikin*
		edge	rat	typhoon	cloud	parent-in-law

(13) SUMMARY OF BERAWAN DEVELOPMENTS

a.	PROTO-MP	**b-*	**-b-*	**-b*	**d-*	**-d-*	**-d*	**g-*	**-g-*
b.	BERAWAN	*b-*	*-k-*	*-m*	*d-*	*-r-*	*-n*	*g-*	*-k-*

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 the blurring process (14).

(14) BLURRING PROCESS IN BERAWAN (Beguš and Dąbkowski, 2023)

o.	PROTO-MP	**b-*	**-b-*		**d-*	**-d-*		**g-*	**-g-*
i.	PRE-BERAWAN	**b-*	**-β-*		**d-*	**-ð-*		**g-*	**-ɣ-*
ii.	PRE-BERAWAN	**b-*	**-ɸ-*		**d-*	**-r-*		**g-*	**-x-*
iii.	PRE-BERAWAN	**b-*	**-x-*		**d-*	**-r-*		**g-*	**-x-*
iv.	BERAWAN	*b-*	*-k-*		*d-*	*-r-*		*g-*	*-k-*

First (14i), voiced stops fricativize intervocalically. Second (14ii), **ð* lenites to **r*, while the other voiced fricatives devoice unconditionally. Third (14iii), the labial fricative **ɸ* velarizes to **x*. The velarization of labial fricatives is topologically attested (Kümmel, 2007) and phonetically motivated (because non-strident fricatives are perceptually confusable; Redford and Diehl, 1999). Finally (14iv), the remaining **x* occludes to *k*.

There are several pieces of evidence that 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). Third, unless an interstage of intervocalic fricativization is postulated, the changes of devoicing and velarization cannot be ordered. Ordering devoicing before velarization incorrectly predicts the velarization of Pre-Berawan *p > $^{\times}k$. Ordering velarization before devoicing incorrectly predicts the velarization of Pre-Berawan word-initial *b- > $^{\times}g$-. 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 (14ii). Finally, word-final fricatives nasalize[3] and occlude, yielding apparent word-final nasalization. This development in Long Terawan is exemplified in (15).

(15) Developments of Pre-Berawan word-final voiced stops in Long Terawan

a. Development of Pre-Berawan *-*b*

cab > *caβ* > *caɸ* > *cãɸ̃* > *cam*

b. Development of Pre-Berawan *-*d*

tumid > *tumið* > *tumiθ* > *tumĩθ̃* > *tumin*

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 devoicing (Beguš, 2019). In Berawan, fricativization explains the unusual devoicing of stops between vowels (Beguš and Dąbkowski, 2023). In one additional language—Kalabakan Murut—

3 In Berawan, only 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.

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 (16). Proto-Murutic (PMur) final voiced stops *-*b*, *-*d*, and *-*g* (16a) develop to *-m*, *-n*, and *-ŋ* (16b). Notably, Proto-Murutic *-*b*-, *-*d*-, and *-*g*- yield *-b*-, *-r*-, and *-h*- intervocalically at morpheme boundaries when followed by a vowel-initial prefix (16c). Word-initially, voiced stops do not change. The Kalabakan Murut developments are summarized in (17).

(16) DEVELOPMENTS OF PROTO-MURUTIC VOICED STOPS (Blust, 2016)

a.	PMURUTIC	**takub*	**takod*	**ipag*
b.	MKAL _ #	*an-akum* (AV.NPST)	*an-akon* (AV.NPST)	*aŋ-ipaŋ* (AV.NPST)
c.	MKAL V _ -V	*takub-on* (OV.NPST)	*tokor-on* (OV.NPST)	*ipah-in* (LV.NPST)
		catch	climb tree	call

(17) SUMMARY OF KALABAKAN MURUT DEVELOPMENTS (based on Blust, 2016)

a.	PMURUTIC	**b-*	**-b-*	**-b*	**d-*	**-d-*	**-d*	**g-*	**-g-*	**-g*
b.	MKAL	*b-*	*-b-*	*-m*	*d-*	*-r-*	*-n*	*g-*	*-h-*	*-ŋ*

To account for the Kalabakan Murut reflexes, we propose that—like in Kayan Murin and Berawan—the Proto-Murutic voiced stops (18) fricativize word-medially and finally, i. e. in all post-vocalic positions (18i). The reflexes of Proto-Murutic **d* and **g* point directly to this interstage. Intervocalically, **d* > **ð* lenites to *r*. The velar fricative **g* > **ɣ* unconditionally devoices to **x*. The other fricatives devoice word-finally (18ii). Word-final fricatives spontaneously nasalize (18iii). At last, fricatives occlude, yielding word-final nasal stops (18iv). 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.

(18) KALABAKAN MURUT DEVELOPMENTS STEP-BY-STEP

o.	PMURUTIC	**b-*	**-b-*	**-b*	**d-*	**-d-*	**-d*	**g-*	**-g-*	**-g*
i.	PRE-MKAL	**b-*	**-β-*	**-β*	**d-*	**-ð-*	**-ð*	**g-*	**-ɣ-*	**-ɣ*
ii.	PRE-MKAL	**b-*	**-β-*	**-ɸ*	**d-*	**-r-*	**-θ*	**g-*	**-x-*	**-x*
iii.	PRE-MKAL	**b-*	**-β-*	**-$\tilde{\underset{\smile}{\phi}}$*	**d-*	**-r-*	**-$\tilde{\theta}$*	**g-*	**-x-*	**-$\tilde{x}$*
iv.	MKAL	*b-*	*-b-*	*-m*	*d-*	*-r-*	*-n*	*g-*	*-h-*	*-ŋ*

This proposed sequence of developments yield the synchronic alternation between final *-m*, *-n*, and *-ŋ* (16b) and medial *-b*-, *-r*-, and *-h*- (16c), which directly points to an interstage with frication, e. g. *aŋ-ipaŋ* ~ *ipah-in* or *an-akon* ~ *tokor-or*.

The reconstruction of the stages of fricativization (18i) and word-final devoicing (18ii) 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 *lijoɣ*). In Murut Tagol (MTag), the fricative further debuccalizes to *-h* (> MTag *lijoh*). The Kalabakan Murut cognate shows word-final nasalization (> MKal *lijoŋ*). The developments of the Proto-Murutic voiced stops in the word-final position are illustrated in (19).

(19) Developments of Proto-Murutic word-final voiced stops

a. Development of PMur *-*b* in Kalabakan Murut

*takub > *takuβ > *takuɸ > *takũɸ̃ > (*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 > *lijoɣ* > *lijox > *lijõx̃ > *lijoŋ*

MTag: *lijox > *lijõx̃ > *lijoŋ*

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 well-motivated (§3). We propose that the fricatives devoice word-finally (if they are not already devoiced as in Berawan). Next, word-final syllables nasalize (VS > ṼS̃) due to the perceptual similarity between fricative-adjacent and nasalized vowels (Ohala 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) (20a) word-final voiced stops devoice in Southern Batak, including Toba Batak (TB) (20b), but nasalize in Northern Batak, including Karo Batak (KB) (20c). However, in Karo Batak, no direct evidence for an interstage with frication exists.

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

a.	PROTO-BATAK	**tərəb*	**alud*	**dələg*
b.	TOBA BATAK		*alut*	*dolok*
c.	KARO BATAK	*tərəm*	*alun*	*dələŋ*
		mass of people	massage	mountain
d.	KB AFFIXED	*kə-tərəm-ən*	*ŋ-alun-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, which would distinguish Karo Batak from the other languages discussed above (21).

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

o.	PROTO-BATAK	**tərəb*	**alud*	**dələg*
i.	KARO BATAK	*tərəm*	*alun*	*dələŋ*

Second, Karo Batak FN could have arisen from the same combination of sound changes as in the other Austronesian languages (22). In this familiar scenario, post-vocalic stops fricativize (22i), devoice word-finally (22ii), spontaneously nasalize (22iii), and lastly occlude (22iv).

(22) HYPOTHESIS TWO: KB FINAL NASALIZATION VIA THE BLURRING PROCESS

o.	PROTO-BATAK	**tərəb*	**alud*	**dələg*
i.	PRE-KB	**tərəβ*	**aluð*	**dələɣ*
ii.	PRE-KB	**tərəɸ*	**aluθ*	**dələx*
iii.	PRE-KB	**tərə̃ɸ̃*	**alũθ̃*	**dələ̃x̃*
iv.	KARO BATAK	*tərəm*	*alun*	*dələŋ*

In other places of articulation, KB fricatives undergo occlusion without devoicing or nasalization. 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 **β* (< **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.

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 (20d). For example, PB **tərəb* 'mass of people' yields KB *tərəm*, but when the stop appears in a non-final position, it also surfaces as a nasal, e. g. *kə-tərəm-ən* 'receive many guests at once.' This stands in contrast with Kalabakan Murut which preserves a synchronic alternation (16b-c), e. g. *aŋ-ipaŋ* ~ *ipah-in* or *an-akon* ~ *tokor-or*.

While by itself, this piece of evidence does not necessarily mean nasalization has to be analogical, evidence from the related Toba Batak suggests points to a stage which could have been its precursor (Blust, 2013). Toba Batak has a sandhi phenomenon whereby word-final nasal (23a) and oral voiced stops merge to oral stops before word-initial stops (23b-c).

(23) SANDHI IN TOBA BATAK (Blust, 2013, p. 250)

a. *minum*	b. *minub* (*bir*)	c. *minup* (*purik*)
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 (24). The analogically extended form is marked with wavy underline.

(24) HYPOTHESIS THREE: KB FN BY ANALOGY (based on Adelaar, 1981; Blust, 2016)

o.	PROTO-BATAK	**tanem* D-	:	**tanem*	::	**tərəb* D-	:	**tərəb*
i.	PRE-KB	**tane*D D-	:	**tanem*	::	**tərə*D D-	:	**tərəm*
				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.

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 is a result of the blurring process 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 (25a) 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 (25b) and forms with apocope of final vowels (25c) or in a variety of morphophonological environments where the final vowel is dropped, such as reduplication (25d) 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).

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

a.	MEDIAL CODA	*ób.tu*	*-kel*	*ka.ȟlóg.ʼo.štaŋ.pi*
		to be among	kind of	vest
b.	MEDIAL ONSET	*tó.pa*	*na.pó.tA*	*šó.kA*
c.	APOCOPE	*tób*	*na.pól*	*šog*
d.	REDUPLICATION	*tob.tó.pa*	*na.pól.potA*	*šog.šó.kA*
		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 illuminated by comparative data which suggest that Lakota's final voicing is in fact a result of three sound changes—i. e. a *blurring process* (Beguš, 2018, 2019; Beguš and Dąbkowski, 2023; Beguš, Nazarov, et al., 2022). Previous accounts which posit a complex history for Lakota final voicing include Rankin (2001) and Rood (2016), who reconstruct Lakota voiced stops as going back to nasals. We propose an alternative path of development, with voiced stops arising from the occlusion of voiced fricatives.

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* (26a) yields variously *r* (26b), *l* (26c), *d* (26d), *n* (26e), or *t* (26f).

(26) REFLEXES OF PROTO-SIOUAN **R* (Rankin, Carter, Jones, et al., 2015)

a.	PROTO-SIOUAN	**Ráhe*	**RásE*	**aRé•*	**Roksí*	**i-Ró•te*
b.	HIDATSA		*(á•)raci*	*are•´, aré•*	*rohcÉ*	*ro•tiška, no•tiška*
c.	LAKOTA	*lá*	*lazáta*	*ilé*	*(a)lóksoha*	*loté*
d.	DAKOTA	*da*	*dazáta*	*idé*	*doksí*	*doté*
e.	OMAHA-PONCA	*(wa)na*	*(a)nazatta*	*ine*	*nosi*	*nó•de*
f.	QUAPAW	*(wa)ttá*		*téde, idé*	*tosí*	*tótte*
		beg	behind, in back	burn	armpit	throat

In the labial series, Rankin, Carter, and Jones (1998) reconstruct another obstruent resonant **W* (27a), which yields *w* (27b), *b* (27c), *m* (27d), or *p* (27e).[4] 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 [β̞] and [ð̞]. We concur with their proposal.[5]

4 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).

5 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.

(27) REFLEXES OF PROTO-SIOUAN *W (Rankin, Carter, Jones, et al., 2015)

a.	PROTO-MS-VALLEY	*Wa-	*Wá•su	*Wá•ɣE	*Wé•	*Wi•
b.	LAKOTA	*wa-*	*wasú*	*wáɣačhą*	*wétu*	*wí*
c.	CHIWERE	*ba-*	*ba•θú*	*bá•xʔe*	*béhu*	*bí, bi•, (m)pí•*
d.	OMAHA-PONCA	*má-*	*másі*	*máʔa*	*me*	*mi*
e.	QUAPAW	*pa-*	*pási*	*báxʔa, páxʔa*	*pe*	*mi*
		cutting instrumental	hail	poplar, cottonwood	spring	sun

We propose that Lakota final voicing arose through an intermediate step of fricativization (28). First, voiceless stops **p*, **t*, **k* fricativize and voice to obstruent resonants in the coda position, where articulation is generally weakened (28i). (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*], [ɣ], 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* (28ii).

(28) DEVELOPMENT OF LAKOTA VOICING IN MEDIAL CODAS

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

We propose that coda voicing in the word-final position results from the same mechanism of pre-consonantal lenition (29i) and occlusion (29ii) across word boundaries. Then, the voiced realization of stops is extended to all positions, including utterance-finally (29iii).

(29) DEVELOPMENT OF LAKOTA VOICING IN FINAL CODAS

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

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 (30). 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).

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

a.	PROTO-MS-VALLEY	*wRé	*wRó•ke
b.	LAKOTA	blé	blokétu, blokéhą
		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 (31).

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

a.	MEDIAL ONSET	nape	topa	watopa	waniča	yuta	kuya
b.	APOCOPE	nam	tom	watom	wanin	yun	kun
		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 (32i), preconsonantal coda stops fricativize to *W and *R. (This stage is common to both Lakota and Dakota.) Second (32ii), the Dakota obstruent sonorants devoice. Third (32iii), voiceless fricatives create a precondition for spontaneous nasalization. Finally (32iv), nasalized fricatives occlude. The developments of the Pre-Proto-Sioux *top C- are illustrated in (33).

(32) DEVELOPMENT OF LAKOTA FINAL NASALIZATION

o.	PRE-PROTO-SIOUX	*top C-	*yut C-
i.	PROTO-SIOUX	*toW C-	*yuR C-
ii.	PRE-DAKOTA	*toW̥ C-	*yuR̥ C-
iii.	PRE-DAKOTA	*tõW̥̃ C-	*yũR̥̃ C-
iv.	DAKOTA	tom C-	yun C-

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

DAKOTA: *toW̥ C- > *tõW̥̃ C- > tom C-

*top C- > *toW C- >

LAKOTA: *tob C- > tob

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; Kalabankan Murut, §4.3; Dakota, §5),

final nasalization is convincingly 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 (34).

(34) FINAL NASALIZATION AS A SERIES OF CHANGES

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

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 convincingly demonstrated to have a complex history. In the last case (Karo Batak, §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 richly attested (e. g. 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 phonetically motivated sound changes (Blevins, 2004, 2007, 2008, 2013; Hyman, 1976; Ohala, 1981, 1983) and provide evidence for the operation of the *blurring process* (Beguš, 2018, 2019; Beguš and Dąbkowski, 2023; Beguš, Nazarov, et al., 2022), whereby later sound changes "blur" an earlier complementary distribution. We also propose a new explanation for the development of unnatural final voicing in Lakota.

Our study focuses on word-final nasalization. Nonetheless, nothing in our account precludes the same sequence of changes from taking place elsewhere. Other cases where nasal stops plausibly developed along a path similar to (34) include the word onsets in Gã (Kwa) and codas in Bribri (Chibchan). According to Zimmermann (1858, p. 10), the Old Gã voiced bilabial stop **b* yields *m* in many words, e. g. **bi* 'young one' > Gã *mi*. Other developments of Old Gã **b* include the glide **w* (e. g. **ba* 'to come' > **wa* > *a*). In the related Ewe, Gã *b* sometimes corresponds to *v*, e. g. Gã *bi* 'child,' Ewe *vi*. Finally, the Old Gã voiceless bilabial stop **p* develops into a Gã fricative *f*, e. g.**pia, *po, *pe* > Gã *fia, fo, fe*. All these developments suggest that the nasalization of Old Gã **b* to Gã *m* likely proceeded through an interstage of fricativization with **β*.

In Bribri (Chibchan), the voiced bilabial stop /*b*/ is realized as a nasal [*m*] in the coda position, e. g./*ǰéb*/ [*ǰém*] '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. /*dîddǐ*/ [*dîndǐ*] 'sharp' (p. 112–113). The voiceless velar stops /*k*/ is realized as a nasal [*ŋ*] before voiced stops, e. g. /*tkôkdò*/ [*t͡k̂ˣôŋdò*] '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. /*iûdkè*/ [*iûrkè*] 'it flies,'

/*uôkìd*/ [*wôkìr*] 'head' (p. 112–3). The lenition to [*r*] suggests an earlier stage of fricativization with **ð*. In many related languages, Proto-Chibchan (PCh) stops are realized as fricatives. For example, the PCh **p* and **b* become Térraba *ɸ* 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* < **ɣ*) (p. 230).

We demonstrate that the development of final nasalization in several Austronesian languages (§4) and Dakota (§5) (as well as plausibly Gã and 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*/, /*dž*/, and /*g*/ are realized as preglottalized nasals [*ʔm*], [*ʔn*], [*ʔñ*], and [*ʔŋ*] in codas (Willett, 1991, p. 13), e. g. *ˈkai.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 proceeds demonstrably 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. The intermediate stages we posit are independently motivated by dialectal correspondences, language-internal developments, and typological plausibility. 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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