Sebirwa in Contact with Setswana:

A Natural Experiment in Learning an Unnatural Alternation

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The problem of the role of phonetic naturalness in phonological representation has been debated for decades. Our fieldwork on Sebirwa and Setswana has given us the opportunity to study the issue of phonetic naturalness in a situation of language contact, with some surprising findings. Setswana, which is spoken by about 4.5 million people throughout Botswana, has become well-known in the literature for "post-nasal devoicing," in which /b/ and /l/ become [p] and [t] after nasals, contra the expected, phonetically-grounded pattern of voicing in post-nasal position. Sebirwa, in contrast, has at most 15,000 speakers concentrated in the far eastern corner of the country. Although *Ethnologue* describes Sebirwa as "vigorous" we did not find this to be the case: it is in fact highly endangered. Sebirwa is being overwhelmed by Setswana, and in a process of "massive Tswananization" (Chebanne 2000), has borrowed some aspects of post-nasal devoicing. Our analysis, based on conversations and recordings of nine older adults in one village (Molalatau, Botswana), shows that the Sebirwa pattern is doubly unexpected: only /b/ devoices, not /d/ and /g/. We attribute the asymmetry to frequency effects from Setswana, where, due to a skewed voicing inventory, the majority of lexical items that exhibit the alternation have underlying /b/. We discuss the implications of this type of borrowing, both for the typology of alternations, and for patterns of language loss. While we sought out Sebirwa for its inherent phonological interest, not its endangered status, we found that the language contact situation itself gave rise to a situation where interesting theoretical questions could be posed. Further, having found ourselves in the midst of people speaking a highly endangered language, we were drawn as well into the problem of documentation.

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1. Background: Setswana and Sebirwa

Setswana and Sebirwa are both Bantu languages in the Sotho-Tswana (S30) group. The family tree is shown in Figure 1. While the exact family relationships among some of these langauges is a matter of debate (see Chebanne 2000), Sebirwa and Setswana are seen to be distant cousins. They are not quite mutually intelligible.

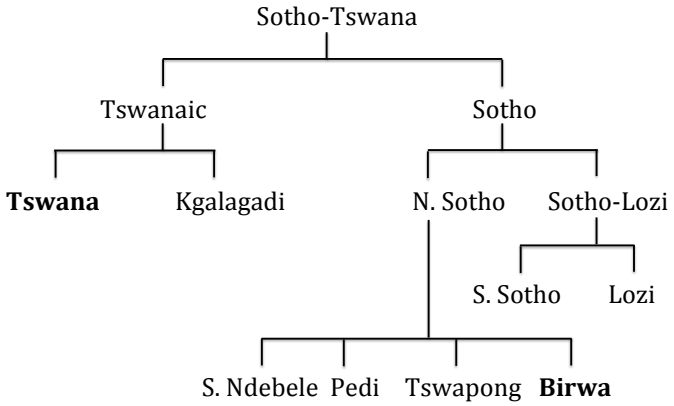

Figure 1. Sotho-Tswana family tree (glottolog.org). Because not all languages in the group use the Se- prefix (as do Setswana and Sebirwa), the prefix (which means "language") is left off in the figure.

Both languages are spoken in Botswana. The status of the two, however, is very different. Setswana is the national language of Botswana, with about 4.5 million native speakers (including those in neighboring South Africa and Zimbabwe). It is the first language of about 80% of the population of Botswana. While English is the official language of the government and of secondary education, and has a strong presence in media, business, and advertising (as does Afrikaans), Setswana is the predominant language in media and advertising, and is the language used in all primary schools across the country.

The 20% of citizens of Botswana who are not native speakers of Setswana are split among about 25 Khoesan and Bantu languages, among which is Sebirwa. Sebirwa has at most 15,000 speakers (see discussion below), clustered in the far eastern corner of the country where Botswana borders South Africa and Zimbabwe. The language is not written; it has no official status; it is not used in school. Thus all Birwa children learn Setswana from a very early age.

The Setswana consonant inventory (Sengwato dialect, which is the closest to Sebirwa both in location and characteristics), is shown in Figure 2.

	bilabial	**alveolar**	**alv.pal.**	**velar**	**glottal**	**labicoronal**
stop	p p^h b	t t^h (d) t^w t^{hw}		k k^h k^w k^{hw}		
fricative	ɸ	s s^w	ʃ	x x^w	h	$\widehat{ɸʃ}$
affricate		$\widehat{ts}$ $\widehat{ts^h}$ $\widehat{ts^w}$ $\widehat{ts^{hw}}$	$\widehat{tʃ}$ $\widehat{tʃ^h}$ $\widehat{dʒ}$	$\widehat{kx^h}$ $\widehat{kx^{hw}}$		$\widehat{pʃ}$ $\widehat{pʃ^h}$ $\widehat{bʒ}$
flap						
nasal	m	n n^w	ɲ	ŋ $ŋ^w$		
approx.	(β)	r l r^w l^w				

Figure 2. Setswana consonant inventory, Sengwato dialect. Based on Gouskova et al. 2011 and subsequent fieldwork.

Note the many affricates and complex consonants, including rare labiocoronal doubly-articulated fricatives and affricates. For purposes of this chapter, our focus will be on the stop inventory. Voiceless aspirated and voiceless unaspirated (variably ejective) stops contrast at the bilabial, alveolar, and velar places. The distribution of voiced stops, however, is skewed, as exemplified in (1).

(1) Skewed distribution of voiced stops in Setswana

- /b/ contrasts with /p/ and /pʰ/
  bala *read*
  pala *refuse*
  pʰaɲa *slap*

- [d] occurs, but only as an allophone of /l/ before high vowels

lapa	*get tired*	*dapa
lepa	*observe*	*depa
lopa	*ask for something*	*dopa
dupa	*diagnose*	*lupa
dipa	*refuse to move*	*lipa

  xo-bol-a *to rot*
  bod-ile *rotted*

- [g] does not occur. Orthographic "g" is pronounced [x].

The Sebirwa inventory is shown in Figure 3.

	bilabial	alveolar	alv.pal.	velar	glottal	labicoronal
stop	p pʰ b bʲ	t tʰ d tʲ tʰʲ dʷ		k kʰ g kʷ gʷ		
fricative	ɸ	s z sʲ zʷ	ʃ		h	ɸ͡ʃ
affricate		t͡s d͡z d͡zʷ	t͡ʃ t͡ʃʰ d͡ʒ			p͡ʃ p͡ʃʰ b͡ʒ
flap		ɺ				
nasal	m	n nʲ nʷ	ɲ	ŋ ŋʷ		
approx.		r l lʷ lʲ				

Figure 3. Sebirwa consonant inventory. Based on Chebanne (2000), modified by subsequent fieldwork.

Like Setswana, Sebirwa has many complex consonants and the rare labiocoronals, which is what first brought the language to our attention. Unlike in Setswana, voicing is fully contrastive for obstruents, as exemplifed in (2). /d/ is a separate phoneme, not an allophone of /l/. Both /d/ and /l/ occur in all vowel environments.

(2) Even distribution of voiced stops in Sebirwa

bala *count*
pala *fail*
dada *bind*
tadʒa *fill*
gada *stitch*
kala *weigh*

luma *bite* (compare Setswana [duma])

This combination of factors makes the language contact between Sebirwa and Setswana a fascinating laboratory for theoretical linguistics. The languages are related and similar, with many cognate vocabulary items, yet their phonological systems differ in crucial respects. Because Setswana is culturally and numerically dominant, its influence on Sebirwa is large. Yet because of the systemic differences, borrowing from Setswana to Sebirwa is not straightforward. In this chapter, we will examine how the "unnatural" alternation of post-nasal devoicing arose within the skewed system of Setswana, discuss data on its conemporary status, and then examine how post-nasal devoicing has been borrowed into Sebirwa, with surprising results. We will also discuss how two theoretical linguists became drawn into the problem of language documentation.

2. The problem of unnatural phonology

It is a given that documentary linguists are concerned with the description of all language varieties, especially those with small numbers of speakers and no written records. As linguists trained in the theoretical perspective, however, we sought out data on Setswana and Sebirwa not because of their status as thriving or endangered, but because

we were seeking to learn more about a question of linguistic theory: what is the role of phonetic naturalness in phonological alternations?

The question has a long history in the phonological literature, with the pendulum swinging between an emphasis on naturalness (finding an articulatory or acoustic grounding, or explanation, for every phonological fact) and unnaturalness (pointing out that there are limits to what phonetics can explain, and that a phonology independent of phonetics works just fine). So, to take just a few examples, Trubetskoy (1939) emphasized the role of markedness/naturalness in phonological systems, while Hjemslev (1953) argued that phonology must be free of phonetic content. Donegan & Stampe (1979) proposed the theory of "Natural Phonology," and Anderson (1981) countered with "Why Phonology Isn't Natural." Prince & Smolensky (1993/2004) required universal constraints grounded in phonetic principles, while Hale and Reiss (2000) insisted on "substance-free phonology." Browman and Goldstein (1986) proposed "Articulatory Phonology," in which all phonological patterns are explained solely in terms of articulatory gestures, and Blevins (2006) proposed "Evolutionary Phonology," in which all phonological patterns are explained in terms of historical change, and markedness/naturalness plays no role in synchronic alternations.

This back-and-forth in the literature shows both that the majority of synchronic phonological alternations are phonetically natural, and that unnatural alternations also exist. One way of incorporating both types of alternation is through the idea of "telescoping" (Anderson 1981, Hyman 2001, Blevins 2006). A language may undergo a series of natural changes, but when only the endpoints are considered without the intervening steps, the naturalness is obscured. The canonical example is the unnatural

alternation foot/feet in English: there is no phonetic reason to change [ʊ] to [i]. But when one realizes that the Old English plural was /-i/, and that the Old English pair [fo:t/fo:ti] went through a series of perfectly natural historical changes including umlaut [fo:t/fœ:ti], simplification [fo:t/fe:ti]; closed syllable shortening [fot/fe:ti], final vowel deletion [fot/fe:t] , and system-wide upward shift [fʊt/fijt], the alternation makes sense.

But is a singular/plural pair like foot/feet really part of the phonology, or is it just the morphological remnant of what was once phonology? After all, English speakers no longer make new plurals on the foot/feet pattern. A proponent of phonological naturalness might concede that telescoping gives rise to unnatural alternations, but would argue that these alternations are destined not to last as productive phonology. One hypothesis for why they might not last is that humans have an innate "learning bias" that favors the acquisition of natural alternations (Wilson 2006). When a learner is exposed to an unnatural alternation, the learner either fails to acquire it at all, or learns it imperfectly and changes it to something more phonetically transparent, and thus unnatural alternations die a natural death.

To test for the existence of such a learning bias, linguists may set up artificial learning experiments (e.g., Wilson 2006, Do 2013, White 2013). The experimenter devises one mini-grammar that contains an unnatural alternation (such as unmotivated vowel change) and another mini-grammar that contains a natural alternation (such as vowel assimilation), and tests whether adult subjects exposed to the data learn one grammar better or faster than the other. Thus far, data from these experiments do show an advantage for natural alternations, but the experimental paradigm has drawbacks. It is very difficult to set up two alternations that are matched in everything but naturalness;

interference from the subjects' native language is hard to overcome; the subjects are all adults (who might or might not learn like children); and experimental time constraints mean that the grammars are by necessity fragmentary and the time of exposure very short.

This is where Setswana and Sebirwa come in. The situation of language contact between dominant Setswana and surrounded Sebirwa has created experimental conditions just right for testing for a learning bias. Setswana has become well-known for having an unnatural rule of post-nasal devoicing. What happens when Sebirwa speakers are exposed to it?

3. Post-nasal devoicing in Setswana.

Hyman (2001), in an article titled "The Limits of Phonetic Determinism in Phonology" described post-nasal devoicing in Setswana as an example of historical telescoping. Phonetically, post-nasal position favors voicing (Hayes 1999): as the velum closes, the strong vocal fold vibration during the nasal is hard to turn off and tends to continue into a following stop. Thus, cross-linguistically (as argued by Pater 1996), sequences of nasal plus voiceless stops are avoided. Yet Setswana, it seems, goes out of its way to *create* nasal plus voiceless stop sequences, turning the phonetically natural nasal plus voiced stop sequence in /m+bata/to the phonetically *un*natural [mpata] l*ook for me*. Meanwhile, underlying voiceless stops remain unchanged. Some further Setswana examples are shown in (3) and (4).

(3) Setswana voiced stops devoice in post-nasal position

bala	*read*	mpala	*read me*
bata	*look for*	mpata	*look for me*
disa	*guard*	ntisa	*guard me*
duba	*knead*	ntuba	*knead me*

(4) Setswana voiceless stops remain unchanged in post-nasal position

pala	*refuse*	mpala	*refuse me*
pata	*accompany*	mpata	*accompany me*
tisa	*bring*	ntisa	*bring me*
tuba	*wish harm on*	ntuba	*wish harm on me*
kala	*weigh*	ŋkala	*weigh me*
p^haŋa	*slap*	mp^haŋa	*slap me*
t^hala	*draw a line*	nt^halela	*draw a line for me*
k^hat^{h}a	*cut*	ŋk^hat^{h}a	*cut me*

Hyman (2001:163) argues that this unnatural alternation arose through telescoping. At one stage of its history, Proto-Tswana had no voiced stops: Proto-Bantu /*b, *d, *g/ were lenited to sonorants /*β, *l, *ɣ/. In post-nasal position, these voiced sonorants, and all other continuant consonants, "hardened" into stops. (Post-nasal hardening, phonetically grounded in the articulatory difficulty of quickly switching from nasal airflow to fricative airflow, is widely attested, as in English "warm[p]th"). Because voiced stops were not present in the inventory, however, in the process of becoming stops the sonorants also devoiced. Some example alternations are given in (5).

(5) Proto-Tswana post-nasal hardening

mβ → mp
nl → nt
ŋɣ → ŋk
mɸ → mp^h
nr → nt^h
ŋx → ŋk^{xh}

After this alternation was established, the voiced sonorants underwent additional sound change. /*ɣ/ dropped out entirely: thus Setswana has no voiced velar obstruent. /*l/ developed a stop allophone before high vowels: thus [d] in Setswana occurs only before [i] and [u], as in (1). Crucially, [*β] changed (back) to [b]. As a result of these further sound

changes, contemporary Setswana (6) is left with not only phonetically natural post-nasal hardening, but also phonetically unnatural post-nasal devoicing. The old β~mp alternation became b~mp, and the old li~nti alternation became di~nti.

(6) Post-nasal alternations in contemporary Setswana

ɸula	*shoot*	mpʰula	*shoot me*
supa	*point at*	ntsʰupa	*point at me*
ʃapa	*hit*	ɲtʃʰapa	*hit me*
rata	*love*	ntʰata	*love me*
lata	*follow*	ntata	*follow me*
bata	*look for*	mpata	*look for me*
disa	*guard*	ntisa	*guard me*

Hyman (2001) uses this and other examples to argue against a "phonetic determinism" that requires all phonological alternations to be phonetically natural.

The Setswana data is hardly the only evidence in the debate over phonetic naturalness, but it turns out that contemporary Setswana is far from a clear case of unnatural post-nasal devoicing. In previous work (Boyer & Zsiga 2013), we reported on acoustic and perceptual data from fieldwork with Setswana speakers in different areas of Botswana. Perceptual experiments show that the post-nasal alternation is indeed categorical: Setswana listeners can not distinguish between [mpata] *look for me* (from/bata/ *look for*) and [mpata] *accompany me* (from/pata/ *accompany*). Yet speakers often hesitated or stumbled over their productions, seeming unsure of whether they should devoice or not, even in relatively frequent words. Of 20 speakers who participated in an experiment testing nonce words, only 7 consistently extended the alternation to the nonce words, and in general the alternation does not extend to loan words (for example, [ndɔdʒa], *avoid me*). This evidence suggests that the alternation is becoming more morphologized

rather than productive phonology (as predicted by the learning bias hypothesis). Further, our acoustic evidence leads us to conclude that the alternation is still better understood as (phonetically-natural) fortition rather than (phonetically-unnatural) devoicing. In initial position (Figure 4, from Boyer & Zsiga 2013), voiced and voiceless stops are distinguished by presence/absense of prevoicing. In post-nasal position, however (Figure 5), all stops, whether underlyingly voiced or voiceless, do in fact show long perseverative voicing from the nasal into the stop closure. On average, 77% of the oral closure is voiced. There is, however, a strong voiceless burst on release, as seen in the example spectrogram in Figure 6. The stop in Figure 6 is by no means devoiced, but the strong burst indicates that it is *fortis*. Our Setswana speakers unanimously identified this word as [mpala], indicating that stop closure voicing is a less important perceptual cue than acoustic events at release.

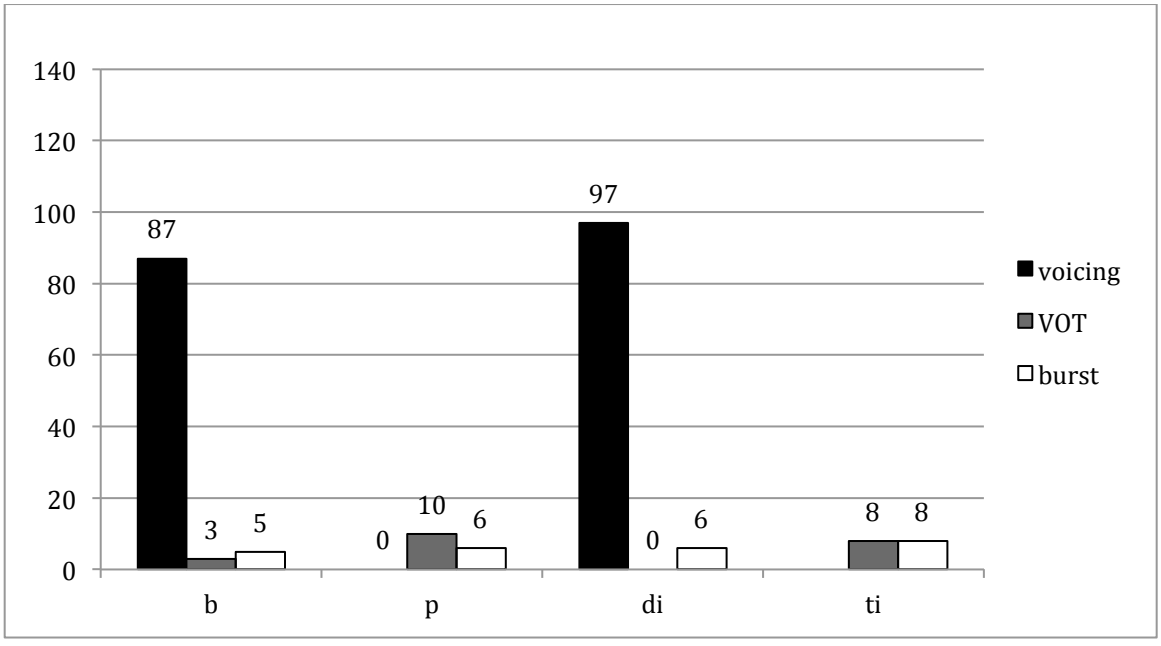

Figure 4. Duration (ms) of voicing, VOT, and burst for stops in word-initial position in Setswana. From Boyer & Zsiga 2103.

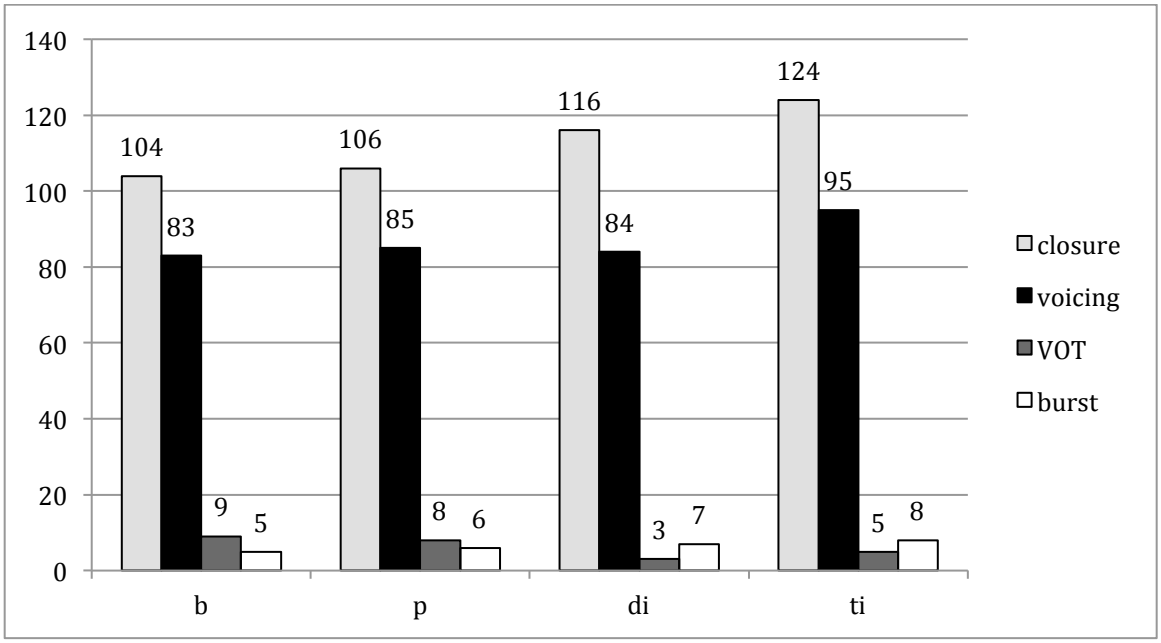

Figure 5. Duration (ms) of closure, voicing, VOT, and burst for stops in post-nasal position in Setswana. From Boyer & Zsiga 2103.

ʊ m b/p a l a

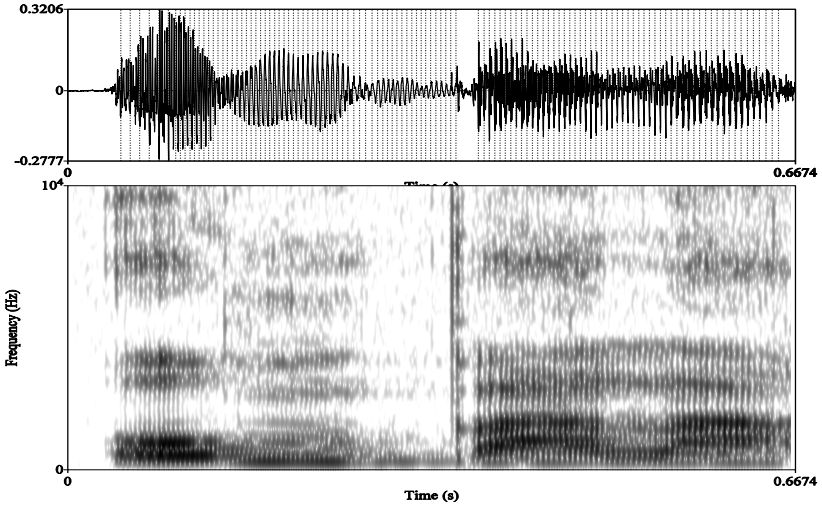

Figure 6. Spectrogram of an example utterance in Setswana: "she reads me" from /n + bala/ showing fortition but not phonetic devoicing.

Taken together, the evidence indicates that Setswana post-nasal devoicing is not the best example of a phonologically-productive but unnatural alternation. Evidence from nonce words and loan words suggests that it is not fully productive, and the phonetic evidence suggests phonetically natural foritition rather than phonetically unnatural devoicing.

Sebirwa is a different story.

4. The status of Sebirwa

Previous work on Sebirwa has been mostly sociolinguistic and ethnographic, including the studies listed in (7):

(7) Previous work on Sebirwa
- Batibo and Seloma (2006): "Sebirwa and Setswapong as distinct linguistic and cultural entities."
- Chebanne and Nyati-Ramahobo (2003): "Language knowledge and language use in Botswana."
- Batibo, Mathangwane, and Tsonope (2003): "A study of third language teaching in Botswana"
- Hasselbring, Segatlhe & Munch (2000): "A Sociolinguistic survey of the languages of Botswana."

Three of the four works in (7) are broad surveys that include Sebirwa but do not focus on it, and none of them describe the structure or phonology of the language. The one phonological study of Sebirwa that we know of is Chebanne (2000): "The Sebirwa Language: A synchronic and diachronic account." Chebanne's work is based on data elicited from 10 speakers, all older than 75 years. It includes a short phonological description, a tentative inventory, and some historical notes. Chebanne notes the presence of the labiocoronals (which, as mentioned above, is what first drew our attention to the language). He also notes that the lenition of Proto-Bantu /*b, *d, *g/ that took place in

Setswana did *not* take place in Sebirwa. Thus the full inventory of voiced stops is preserved in Sebirwa, and because the requirement for post-nasal fortition never arose for these segments, post-nasal devoicing did not develop. He states clearly (p. 193): "[T]he voiced plosives are not altered by the presence of a nasal." Yet Chebanne notes that there was variation and disagreement among his speakers in terms of vocabulary and pronunciation (though he doesn't mention post-nasal devoicing as an area of disagreement). He emphasizes a "massive Tswananization" (p. 194) that has taken place in Sebirwa in the last 100 or so years, accelerated in the generation just younger than his informants, which was the first to attend Setswana schools. The Sebirwa spoken by people younger than 65, he states, is "almost Sengwato" (p. 194).

It is unclear how many speakers of Sebirwa there are. Chebanne (2000) suggests 20,000 speakers in Botswana, South Africa and Zimbabwe combined. Batibo et al. (2003) cite 2001 census as counting 12,500 Sebirwa speakers in Botswana, but note that it is likely that census data conflates language and ethnicity. Ethnologue (2013) estimates 15,000 speakers in Botswana, and lists Sebirwa as "vigorous: unstandardized and in vigorous use among all generations." This turned out not to be the case.

The surveys cited in (7) indicate that the Sebirwa-speaking area comprises the eastern corner of Botswana and adjacent areas of Zimbabwe and South Africa, roughly the area of the large circle in Figure 7, and centered on the town of Bobonong in Botswana. We visited Bobonong in July 2012, seeking speakers to record for our phonetic study of the Sebirwa language. Our goal, as stated above, was to document the consonant system, in order to compare it to Setswana, and thus to investigate theoretical questions of what is "natural" and "unnatural" in alternations (post-nasal devoicing/fortition, [l] ~ [d]) and

inventories (doubly-articulated fricatives). In Bobonong, however, while we found many people who proudly identified as ethnic Babirwa, we found no-one willing to represent him- or herself as an actual Sebirwa speaker: "They're all further east, out in the villages," we were told, or "My grandmother spoke Sebirwa but I don't." One speaker, using code-switched Setswana and Sebirwa told us:

Nna ha ke bue Sebirwa. Le ka bua le bakgekolo, ke bona ba se itseng.

I don't speak Sebirwa, but you can talk to the elderly, they are the ones who know it.

Most of the words in the sentence are Setswana, except for the Sebirwa form of the negative (/ha/ rather than /xa/) and "bakgekolo", the Sebirwa term for the elderly.

We travelled east, to the village of Molalatau (essentially the easternmost town in Botswana, before one reaches the safari areas on the South African border), where village leaders assured us "real" Sebirwa was spoken. Our estimate of the actual Sebirwa-speaking area is shown by the smaller circle in Figure 7, though this is just based on local report, not any systematic sampling.

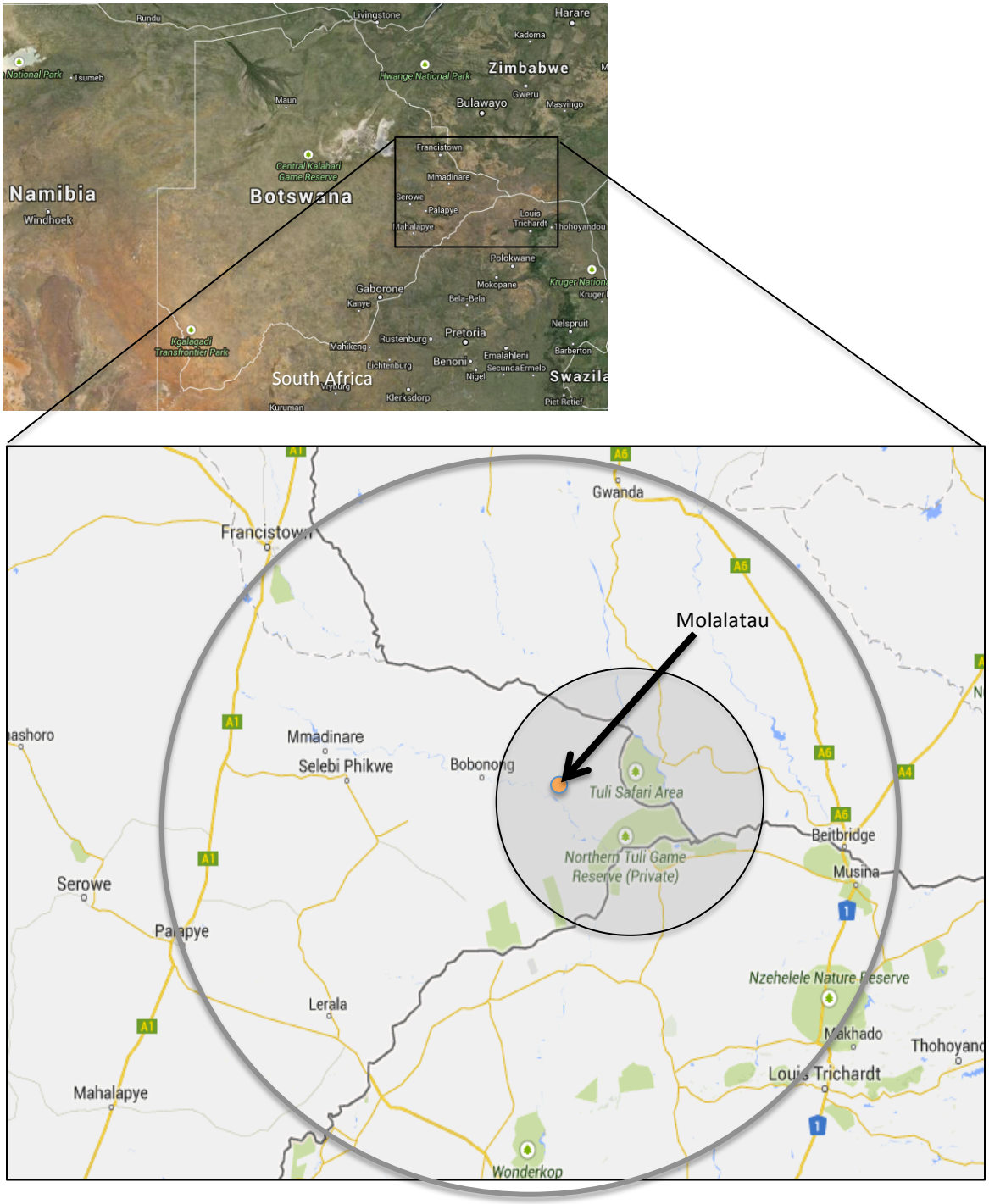

Figure 7. The Sebirwa-speaking area. Large circle indicates the area suggested by the literature, the small circle the area suggested by our fieldwork. The location of Molalatau, the village where our study was conducted, is indicated.

Molalatau is a farming community with a population of about 2,400 (Botswana 2011 census). It has an elementary and secondary school, library, clinic, and *kgotla* (town

hall/community center). The people of Molalatau identify as ethnic Babirwa, and many community leaders we spoke to showed a great interest in language revitalization. Some attempts at creating an orthography had been made, but the project was never finished. Nonetheless, even in Molalatau, Sebirwa was not spoken in most homes, except by and to the elderly. We found no-one under the age of 50 willing to self-identify as a Sebirwa speaker. Since adults of child-bearing age are not speaking Sebirwa, children are not learning the language at all.

We collected data over one week in Molalatau, subsequently analyzed over the next months at Georgetown University. With guidance from community leaders, we identified 9 speakers (1 male, 8 female), 50 to 80 years old, who were willing to participate in recording sessions, which took place at the local secondary school.

Before we began our planned phonetic experiment, it was clear that we had a responsibility to just get the Sebirwa language recorded. So we asked each of our participants to spend 10 to 20 minutes just talking, particularly about their lives and the Birwa culture. One woman told about her wedding, and the marriage customs of 50 years ago. A village elder recited as many proverbs as he could think of. Another man talked about farming and cattle. One of our oldest participants sang her favorite songs.

These recordings have all been transcribed in IPA, with glosses in both Setswana and English. For now, the Molalatau community leaders have asked that we simply make the recordings available on CD at the village library. Our hope is to be able to make return trips, to work with Birwa leaders in using these materials to create an orthography and then reading materials based on the stories.

Having done what little we felt we could in the direction of documentation, we turned to the more structured collection of phonetic data.

5. Phonetic data: Post-nasal devoicing in Sebirwa

We began by working with speakers to create and then check a word list illustrating the Sebirwa inventory. Immediately we found (as did Chebanne) that there was disagreement among speakers both as to lexical items and to pronunciation. It was not uncommon for one speaker to provide a word in Sebirwa, and for another speaker (of about the same age), to provide the Setswana word instead. For example, some speakers said the Sebirwa word for "again" was [ɸʊtʰɪ], while others gave the Setswana word, [xape]. There was a lot of variation in pronunciation, particularly with the sounds particular to Sebirwa, such as the consonant that we eventually decided to transcribe as a lateral flap, but that Chebanne transcribed as a retroflex [ɖ] as in [ɖaɖele] *follow* and [ɖʷa] *war*, which was pronounced with varying degrees of closure, retroflexion, and lateralization.

Here, we concentrate on the realization of the voiced stops. We asked our speakers to produce 15 verbs with different initial stop consonants, in 3 contexts (3 repetitions each), as shown in (8).

(8) Contexts for the Sebirwa recordings

- phrase-initial
  - kala — *weigh*
- intervocalic
  - ɪrɪ kala ɸʊtʰɪ — *say 'weigh' again*
- post-nasal
  - ʊ ŋ-kala ɸʊtʰɪ — *s/he weighs me again*

Following the same experimental design we had used for Setswana, we measured durations of closure, voicing during closure, burst, and VOT. Results are shown in Figures 8 – 10.

Figures 8 and 9 show that in initial and intervocalic position, the stop series of Sebirwa are indeed distinguished by presence or absence of vocal fold vibration. The voiceless stops are unaspirated, and the voiced stops show prevoicing. There is some perseverative devoicing into the closure phase of the voiceless stops in intervocalic position, but the majority of the closure duraiton remains voiceless.

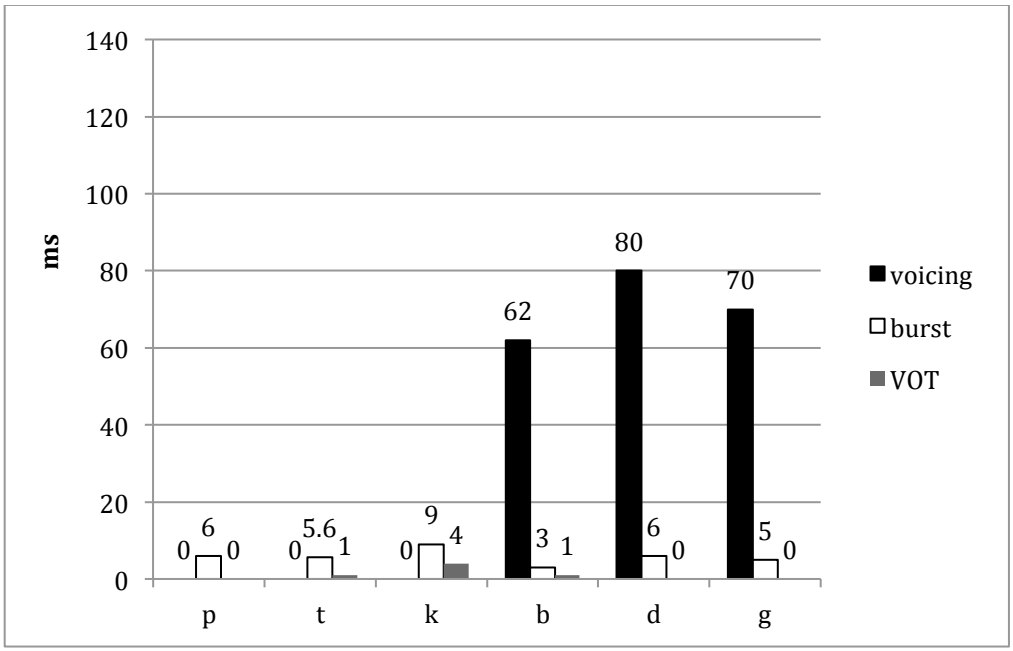

Figure 8. Realization of phrase-initial stops in Sebirwa.

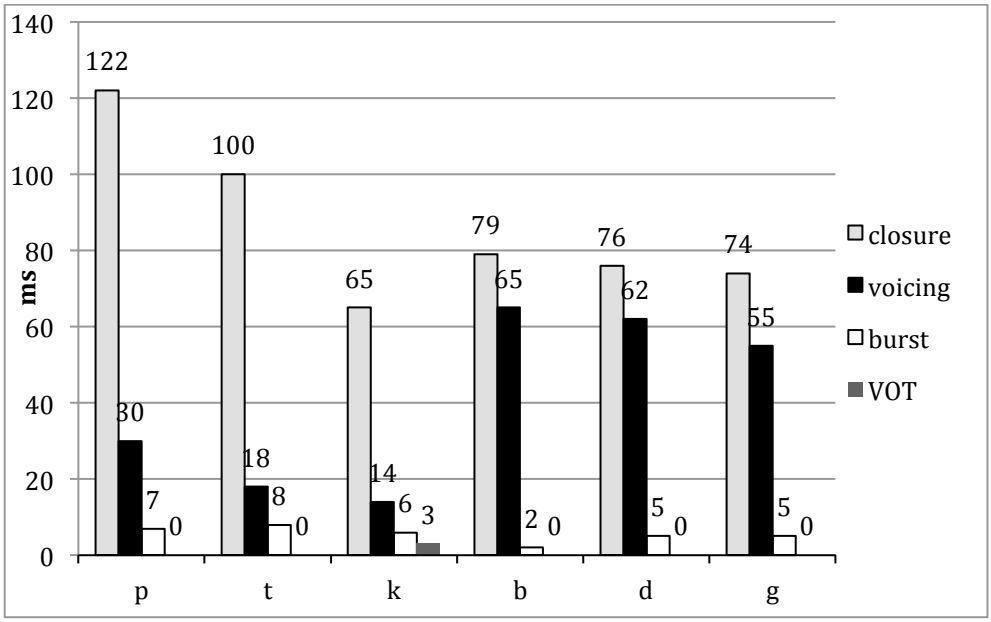

Figure 9. Realization of intervocalic stops in Sebirwa.

The surprising data is found in post-nasal position: example words are given in (9) and average phonetic data in Figure 10.

(9) Realization of stops in post-nasal position in Sebirwa

pala	*fail*	mpala	*fail me*
tadʒa	*fill*	ntadʒa	*fill me*
kala	*weigh*	ŋkala	*weigh me*
bala	***count***	**mpala**	***count me***
dada	*bind*	ndada	*bind me*
gada	*stitch*	ŋgada	*stitch me*
luma	*bite*	nduma	*bite me*

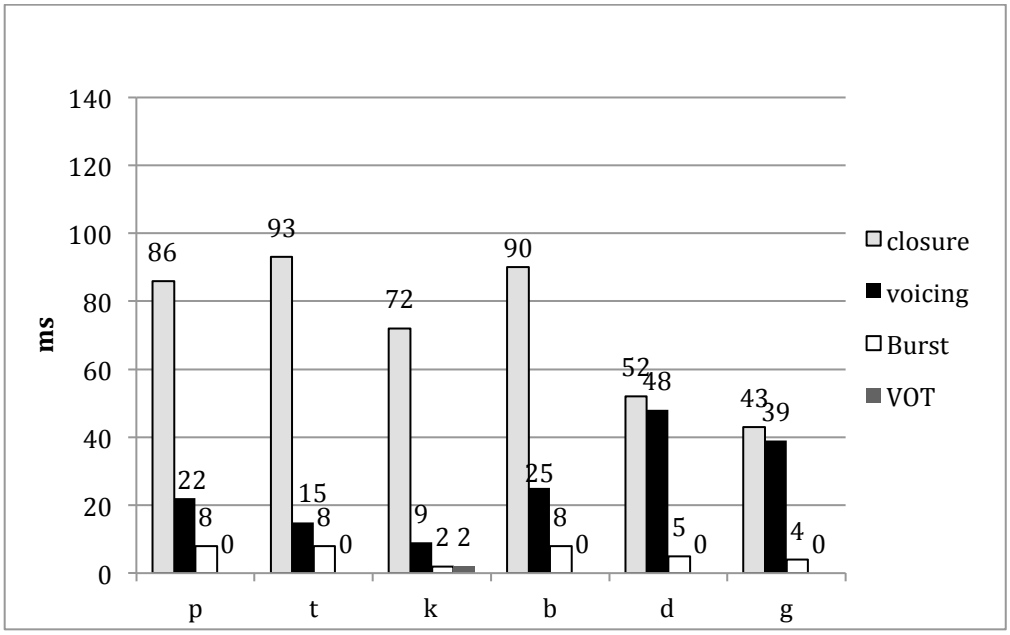

Figure 10. Realization of Sebirwa stops in post-nasal position.

The voiceless stops /p, t, k/ are unchanged, though again showing a small amount of perseverative voicing. /d/ and /g/ remain fully voiced following a nasal, as described by Chebanne (2000). Surprisingly, however, /b/is devoiced: indistinguishable in post-nasal position from underlying /p/. Example spectrograms, contrasting underlying voiced and voiceless stops in post-nasal position, are shown in Figures 11, 12, and 13. The spectrograms show that unlike those in Setswana (Figure 6), post-nasal voiceless stops in Sebirwa really are voiceless.

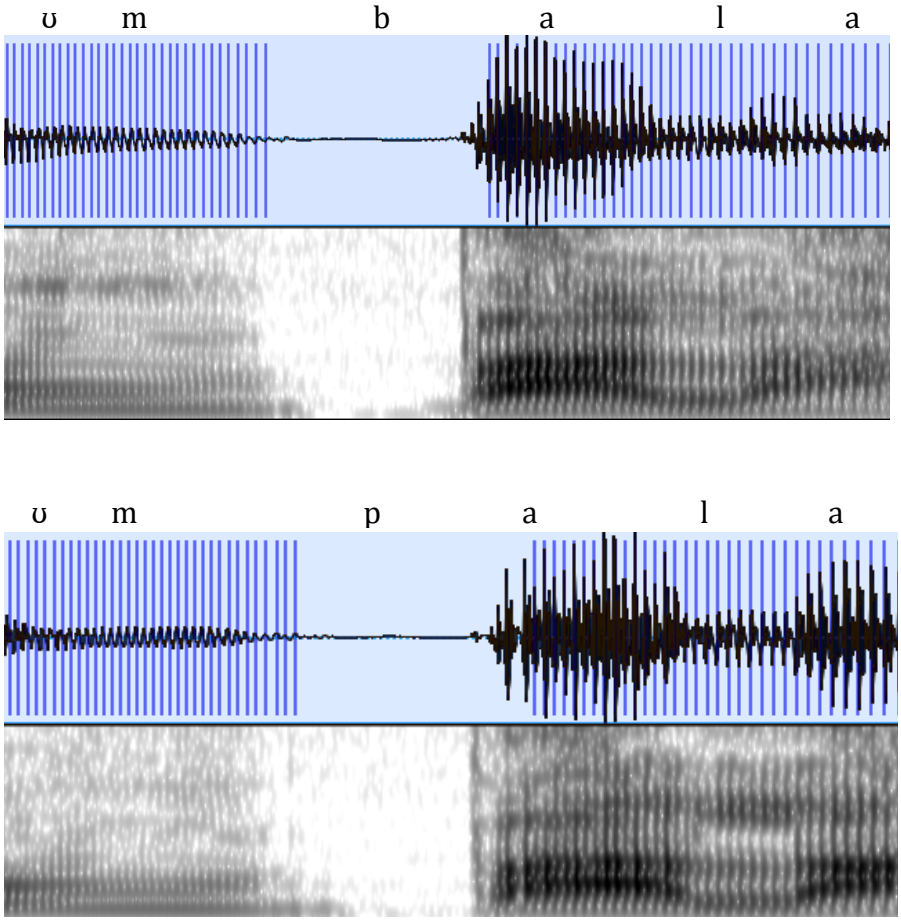

Figure 11. Labial stops in post-nasal position in Sebirwa. Top: *s/he counts me* from /bala/ *count*. Bottom: *s/he fails me*, from /pala/ *fail*. The two are indistinguishable.

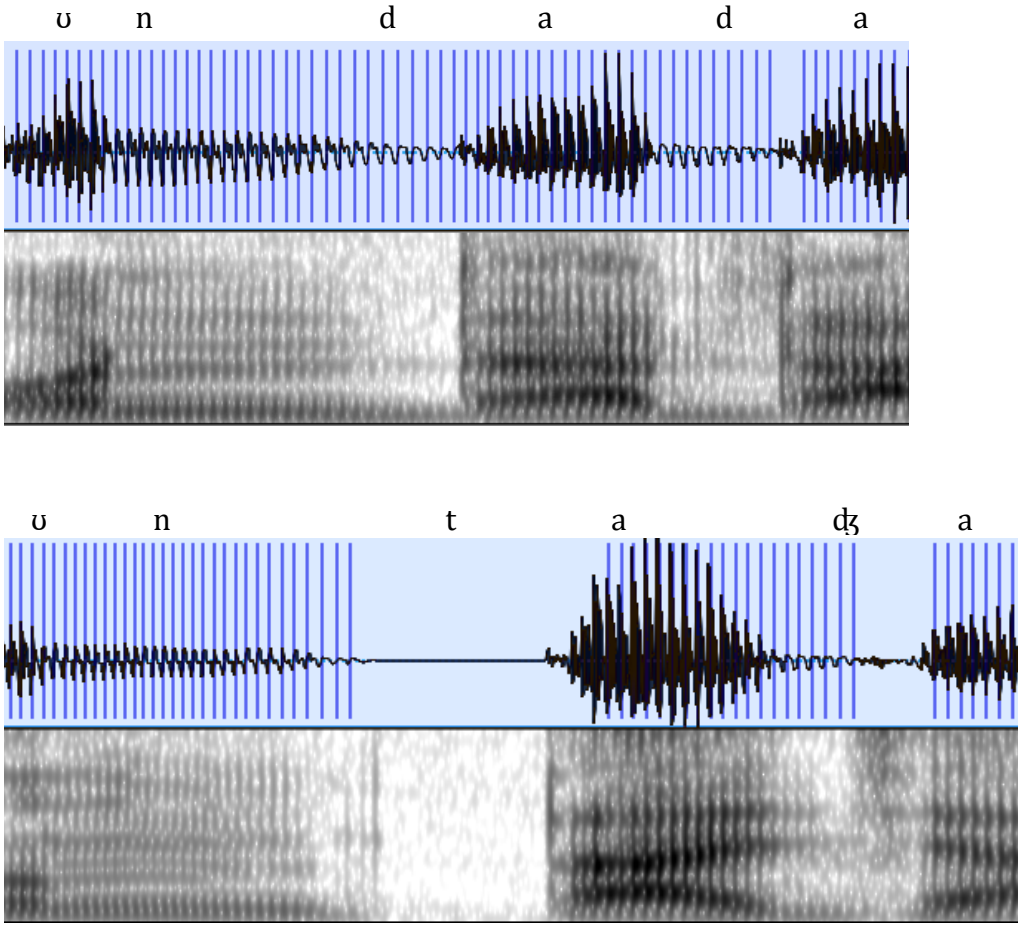

Figure 12. Alveolar stops in post-nasal position in Sebirwa. Top: *s/he binds me* from /dada/ *bind*. Bottom: *s/he fills me*, from /taʤa/ *fail*.

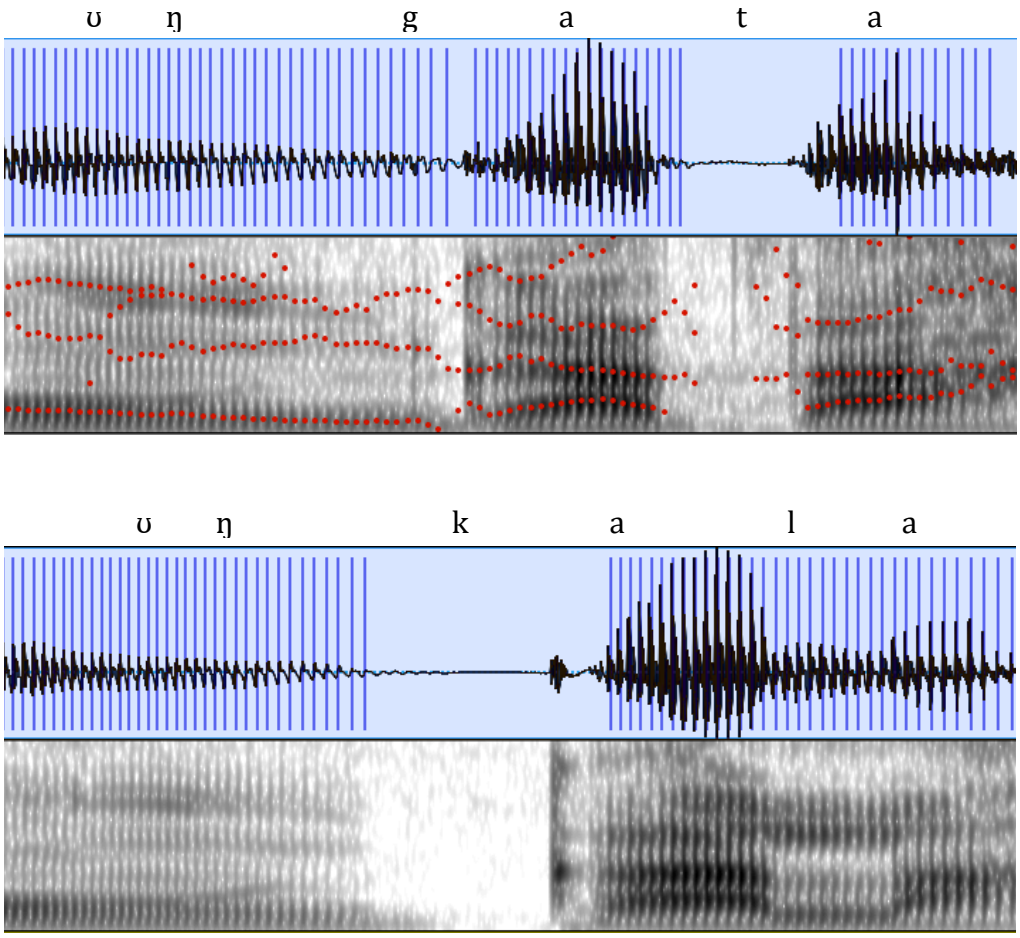

Figure 13. Velar stops in post-nasal position in Sebirwa. Top: *s/he stitches me* from /gata/ *stitch*. Bottom: *s/he weighs me*, from /kala/ *weigh*.

The finding that /b/, and not /d/ and /g/, devoices in post-nasal position is doubly unnatural. As discussed above, post-nasal devoicing is unexpected in the first place, since phonetic factors favor voicing in post-nasal position. This is seen even in Setswana (Figure 6), where the contrast between voiced and voiceless stops is neutralized in post-nasal position, but the obstruent closure still shows perseverative voicing. Further, if only one of /b, d, g/ was going to devoice, we would expect it to be /g/. A smaller supralaryngeal cavity leaves less room for airflow from the glottis, meaning that supra-glottal and sub-glottal pressure equalize more quickly, meaning that voicing stops sooner. Voicing is

harder to sustain for [g] than for [d], and is harder to sustain for [d] than for [b]. Again, this phonetic tendency is borne out in Setswana, where [b] is contrastive, [d] is marginal, and [g] is absent. It is also seen in Figures 9 and 10, where the (presumably passive) perseverative voicing in voiceless stops lasts longest in the labial and shortest in the velar. The need to maintain a longer voiceless closure after voicing ceases, in order to maintain contrast, may also explain the different closure lengths in intervocalic position.

Why, then, should only /b/ devoice in Sebirwa? It is not phonetically natural, and according to Chebanne it did not arise historically from the kind of telescoping that occurred in Setswana. We conclude that Sebirwa speakers borrowed the alternation from Setswana, as part of the "massive Tswananization" noted by Chebanne. Why only /b/? We believe the answer must be frequency. Setswana has no /g/, therefore there would be no exposure to a [g] ~ [k] alternation. Because of the limited distribution of [d], the [d]~[t] alternation is just less frequent than [b]~[p], and because [l] and [d] are not allophonic in Sebirwa, Sebirwa speakers would not interpret an alternation between [l] and [t] as having anything to do with [d]. Thus, the [b] ~ [p] alternation is what they hear most frequently, and that is what they borrow.

6. Conclusions

We conclude from our accidentally-discovered natural experiment in learning an unnatural alternation, that yes, one *can* learn an unnatural alternation. In this borrowing from Setswana to Sebirwa, it appears that frequency of exposure was more important than phonetic naturalness in determining what would be borrowed. Since frequency and naturalness usually go together (more natural things usually being more frequent), the

situation of Sebirwa in contact with Setswana offers an opportunity to study an unusual learning situation. The unnatural alternation in Setswana arose through historical telescoping, but Sebirwa speakers were, it seems, willing to take the alternation at face value and borrow what they heard most frequently, regardless of phonetic naturalness. Such data support the hypotheses of Evolutionary Phonology (Blevins 2006).

Still, one would like to follow the situation into the future, to see what further historical developments might ensue. Would children acquire the labial-only devoicing, or would they regularize the pattern? If so, in what direction? To devoicing of all voiced stops, or away from any devoicing at all? Sadly, it appears that we will not have the chance to find out. The inundation of Sebirwa by Setswana set up the situation for borrowing in the first place, but modulo immediate revitalization efforts, or the discovery of a truly more vigorous community of Sebirwa speakers, perhaps in Zimbabwe or South Africa, Sebirwa will not survive.

Which leads to some concluding thoughts about the different ways in which a language can die. Language death can occur through shift – this seems to be what is happening in Bobonong and in many homes in Molalatau, where ethnic Babirwa people have shifted conciously and entirely to speaking Setswana in all spheres of daily living. In other homes in Molalatau, however, Sebirwa is dying by dilution. Molecule by molecule, aspects of Sebirwa, including lexical items and sound patterns, are being replaced by Setswana. The similarities between the two languages are in fact hastening the death: the Sebirwa slowly disappears, sometimes without the speakers even noticing that it has happened.

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