Consonant Strengthening in Setswana

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Table of Contents

1. Introduction

1.1. Abstract

Consonant Strengthening is a morphophonological process in the Sotho-Tswana languages in which a "weak" consonant turns into a "strong" one in the following morphological environments given in (Cole 1955):

noun class 9, 10:
-**f**a 'to give' > **mpʰɔ**, di**mpʰɔ** 'gift' (NC9,10)

adjectival concords class 8,9,10:
-**b**edi 'two' > dilɛpɛ tse**p**edi 'two axes' (NC8)

reflexive i-:
-**r**ata 'to love' > χʊi**tʰ**ata 'to love oneself'

1SG.O N-:
-**b**ɔńá 'to see' > óam**pɔna** 'he sees me'

While doing fieldwork with a speaker of Setswana, I came across certain examples where the speaker did not realize the process as expected, as she did not make the change from a weak to a strong consonant in the 1SG.O N_ environment.

(1) ʊ̀-ǹ-**r**ɔbà lùùtú
2SG-1SG.O-break leg
'you break my leg'
expected: ʊ̀-ǹ-**tʰ**ɔbà lùùtú

After further elicitations sessions, I gathered a decent number of examples where the speaker realizes the process differently from what is described in the literature and found out it affects every area of the language where the process usually takes place: nouns, adjectives, verbs. While it seems like the process is starting to become inactive, it turns out there are several different explanations for the irregularities. In this paper, I am going to discuss these examples and present the complex system behind the unexpected forms that the speaker makes. Although this paper is only based on one speaker, it can shed some light into what the process looks like for the modern speakers of Setswana.

1.2. Setswana

Setswana is a Southern Bantu language spoken mainly in South Africa, where it is an official language, and Botswana, where it is the national language. It is spoken by around 13.7 million speakers, of which 6 million are native speakers (Eberhard et al. 2023). It is part of the Sotho-Tswana branch, or S30 according to the Guthrie classification, which is a system of classifying all the Bantu languages in geographic zones developed by Malcolm Guthrie and later updated by (Maho 2009).
As a standardized language with national status in 2 countries, it has already been researched quite well. The main grammar of the language was published in 1955 by Desmond T. Cole (Cole 1955), and I will refer to it extensively in this paper when talking about the standard language.
In English, we can refer to the language as both "Setswana" and "Tswana", the former containing the prefix se- (noun class 7), which is used for languages, while the latter only contains the stem. While both are used in literature, I prefer to use the term "Setswana" because it is the one that the speaker I worked with generally used even when speaking English.

1.3. Speaker, Data collection, Methodology

I first started working on the language during the Linguistic Fieldwork A class in September 2022, where we collaborated with Francis Mushwana, a speaker of Setswana from Johannesburg, South Africa. She comes from a multilingual background, as she is a native speaker of both Setswana and Tsonga and uses English on a daily basis. Her variety also has a lot of influence from the closely related language Sesotho, Sepedi, as well as Afrikaans, which is a national language in South Africa. It is also important to note that at the time of the start of the data collection she was 33 years old, and she had been living in the Netherlands for 2 years.

All the data I collected comes from elicitation sessions during the courses Fieldwork A and Fieldwork B throughout the 3rd year, as well as 2 individual sessions I arranged with the speaker. All these sessions took place in the Netherlands at Leiden University and were recorded with the equipment provided by the professor. Besides the notes I made in class, I listened to the recordings again and transcribed the sentences we elicited in IPA. I always specify whether an example comes from literature or from my own data.

Due to the nature of the paper, I write all the examples, both mine and from literature, in IPA. Setswana is a tonal language with 2 tones: High and Low. However, this is not shown in the orthography, and Cole (1955) only writes it for a couple of morphemes (for example: ó '3sg.S'). I converted all the examples from (Cole 1955) and other papers that use different orthographies to IPA, however because they do

not consistently write the tones, I will only be able to provide them for my own examples.
It's also important to note that Setswana has quite a complex system of vowels, with 11 phones and either 7 or 9 phonemes, depending on the analysis. Cole (1955) analyses a 7 vowel system: /i, ɪ, ɛ, a, ɔ, ʊ, u/, but does explain all the rules for the raisings of /ɪ, ɛ, ɔ, ʊ/ to [ɩ, e, o, ɷ]. Creissels (2009) goes a step further and argues that /e/ - /ɛ/ and /o/ - /ɔ/ have become separate phonemes due to old borrowings that are now part of the language. I chose to use Creissels' 9 vowels system in my transcriptions, and while I do take into consideration the raisings of /ɪ, ʊ/ to [ɩ, ɷ] in 4.1, they are not reflected in writing.

I first collected all the examples from the elicitation sessions we did during the course, that are relevant to the consonant strengthening process. During the extra elicitation sessions for my thesis, I asked new words that I had found in (Cole 1955) that could potentially undergo consonant strengthening. Most of them were also part of the speaker's dialect, but some didn't exist. I always asked for the translations from English into Setswana, so that I don't influence the outcome. Once a certain form was given, I would then ask the form with the other consonant from the pair, so if the process did take place and the consonant was strengthened, I would ask a variant with the weak stem (and vice versa). The speaker then repeated it, and either rejected it, accepted it or was unsure which one was correct, and would explain why. From these explanations we could already tell what was happening with some of the unexpected forms, but for most others it was unclear. I then compiled tables with the stems that do not change as expected and tried to find whether there was a common factor.

2. Literature background

2.1. Consonant Strengthening in Setswana

The phonological process called *strengthening* or *nasalization* occurs in all Sotho-Tswana languages and it describes the change that certain consonants suffer when preceded by a nasal consonant. In Setswana, Cole (1955, 39) lists the following changes:

N + b > (m)p
N + l, d > (n)t
N + s > (n)tsʰ
N + x > (ŋ)kxʰ
N + w > (ŋ)kw
N + f > (m)pʰ
N + r > (n)tʰ
N + ʃ > (ɲ)tʃʰ
N + h > (ŋ)kʰ
N + [ʔ] > (ŋ)k

Cole (1955) analyzes a phonetic glottal stop [ʔ] for stems that begin with a vowel, which strengthens into a /k/, as well as a /w/ that strengthens into a /kw/ after the nasalization process. However, other linguists, such as Dickens (1984), simply analyze it as one rule:

N + [Ø] > (ŋ)k

The nasals are in parenthesis because they are often deleted. Cole (1955, 40-42) gives the following morphological contexts where a nasal consonant triggers the change:

a) Noun class 9 N-, 10 diN-
-fa 'to give' > mpʰɔ 'gift' (NC9)
lodi 'twine' (NC11) > dinti 'twines' (NC10)
-dira 'to do, make' > tirɔ 'work' (NC9)
lofuka 'wing' (NC11) > diphuka 'wings' (NC10)

b) adjectival concords class 9 ɛN, 8/10 tsɛ(di)N-
-bedi 'two' > dilɛpɛ tsepedi 'two axes' (NC8)
-be 'ugly' > pʊdi ɛmpɪ 'ugly goat' (NC9)
-rarʊ 'three' > diŋku tsɛtʰarʊ 'three sheep' (NC10)

c) 1st person singular object N-
-bɔna 'to see' > ʊ́ampɔna 'he sees me'
-lʊma 'to bite' > ɪantʊma 'it bites me'

d) reflexive i(N)-
-rata 'to love' > χʊitʰata 'to love oneself'
-sɪχa 'to cut' > χʊitsʰɪχa 'to cut oneself'

e) causative suffix -isa is added to a final nasal consonant of the stem
-bɔna 'to see' > -bɔntsʰa 'to show' (< *-bonisa)

The deletion of the nasal depends on the number of syllables that the word has. For nouns and adjectives, the nasal is only retained in monosyllabic roots, otherwise it is deleted (*ntirɔ > tirɔ 'work'). The verbs always retain the nasal prefix, which is the 1st person singular object marker N-, no matter how long the root is. The nasal of the reflexive i- is always deleted, therefore it's only considered that it has one because it triggers the strengthening of the following consonant.
The fact that the process occurs even in contexts where there is no apparent nasal in the word poses some problems in the synchronic analysis, especially when it comes to the reflexive form: why should we assume that the reflexive has an underlying nasal that always gets deleted? Moreover, we can also ask ourselves: what is the phonetic reasoning behind these outcomes of the strengthened consonants?

These questions cannot be fully answered by a purely synchronic analysis of the language, as Patrick Dickens demonstrates in his article (Dickens 1984). In the paper, he argues against Schaefer's synchronic analysis (Schaefer 1982), going as far as to say that "his analysis fails abysmally" (Dickens 1984, 110). Schaefer tries to explain the exact outcomes by using the sonority hierarchy, however, I agree with Dickens that he does not succeed to explain the process completely, as he does not account for important details about both the language and dialectal variations, and that some of his arguments are "circular", as Dickens calls them. Therefore, I opt for a historical explanation of the process, which I will discuss in the following chapter, as well as how the speakers actually acquire this change when learning the language.

2.2. History of the strengthening process

The root of this process comes from the evolution of the Proto-Bantu consonants into Sotho-Tswana. The inventory of Proto-Bantu, proposed in (Creissels 2007), looks like this:

Table 1

	O_1	O_2	O_3	O_4
S_1	p	t	c	k
S_2	b	d	j	g
S_3	m	n	ɲ	

Creissels (2007) makes the use of the French terms S=Série and O=Ordre to quickly refer to natural groups formed according to the manner and place of articulation. I will also use these notations in this chapter.
The consonant inventories of the modern Sotho-Tswana languages are much larger. This is an example of an inventory for Setswana, proposed by Creissels (2007), where the phonemes are grouped in such a manner to show their Proto-Bantu origin:

Table 2

	O_1	O_2	O_3	O_5	O_6	O_{4a}	O_{4b}	O_7
S_{1a}	(ɸ)	r̥		s	ʃ		χ	h
S_{1b}	p^h	t^h	$tɬ^h$	ts^h	$tʃ^h$	k^h	q^h	
S_{2a}	β	l/r			dʒ			
S_{2b}	p	t	tɬ	ts	tʃ	k		
S_3	m	n		ɲ	ŋ			

The inventory is based on the underlying phonemes that most dialects have, however the actual realization of the consonants differs depending on the dialect. In most

dialects, including the one I'm researching, [β] is realized as /b/, [ɾ] as /r/, [qʰ] as /qχ'/, [ɸ] as [f] and [ɾ] as /d/. In the dialect I am researching, there also seems to be no [ʃ], as it has merged with /s/.

We can clearly see that there are more consonant phonemes in Setswana's inventory than in the reconstructed inventory of Proto-Bantu, which was caused by several phonological changes which usually turned an allophonic variation into separate phonemes. Some of these changes are in direct relation with the consonant strengthening process that we see in Sotho-Tswana languages.
According to Dickens (1977), word-initially and intervocalically Proto-Bantu stops /*b, *d, *g/ had the continuous allophones [*β, *l, *ɣ]. This means that the only place where they were non-continuant was after the nasals, for example: *lala /*dada/ 'to sleep', *landa /*danda/ 'to fetch'. It's important to note that while Dickens marks these allophonic differences in his reconstructions, other authors don't, which is why for example the entry for 'to sleep' is listed as *dáda in (Bastin et al. 2002).

Dickens (1977) then explains the relevant sound changes that lead to the process of strengthening. They are summarized in the following table:

Table 3

	rule	sounds affected	example
1	P → PH	*p, *t, *k >pʰ, tʰ, kʰ	*muntu > *munthu 'person'
2	NV → N̩	*ni- > N̩-	1SG.O N-, NC9 N-, REFL i-
3	β → B/ N_V	*mβ, *nl, *ŋɣ> *mb, *nd, *ŋg	*nluma > *nduma 'bite me'
4	PH → F/{V,#}_V	*pʰ, *tʰ, *kʰ > ɸ, r, h	*muthanda > *muranda 'love him'
5	NC → ØC	*mpʰ, *ntʰ, *ŋkʰ> pʰ, tʰ, kʰ *mb, *nd, *ŋg > *b, *d, *g	*muranda > *murada 'love him' *munthu > muthu 'person'
6	B → P'	*b, *d, *g > p', t', k'	*murada > murat'a 'love him'

These rules neatly explain the exact forms of the "strengthened" consonants, especially for the cases that are harder to explain otherwise, such as why /r/ turns into /tʰ/ and /l/ into /t/. However, there are a couple more changes that need to be addressed.
In the evolution of Setswana, the 3 fricatives *β, *l, *ɣ have all slightly changed:

- β > b
- l > d _{i, u}
- ɣ > Ø

Proto-Bantu *k had 3 different outcomes depending on the following vowel, that further become fricatives (unless preceded by a nasal):

- *k > tsʰ /_[i, ɪ, ʊ] (→ s)

- *k > kʰ /_[u] (→ h)
- *k > qχ /_(other vowels) (→ χ)

According to (Creissels, "L'influence des voyelles sur les évolutions des consonnes en tswana (S31)." Africana linguistica 13 33-52 2007), there are some other sourses for /tsʰ/ as well, such as:

- *c > tsʰ/ _[i,ɪ,u] (→ s)
- *g > tsʰ /N_[i,ɪ,u] (→ s)
- *S1 > tsʰ/ _[i, u]V (→ s), where S1 represents *p, *t, *c, *k from Table 1

We now have all the consonant pairs explained from a historical perspective. One downside is that from this perspective we can see that it was rather a case of "weakening" of the consonants that were not preceded by nasals (besides the phonemes *β in Setswana which fortified into the stop [b] in all weak positions, and /l/ which has the allophone [d] before /i, u/). However, according to Dickens (1977) there are 2 problems:
1) native speakers acquire the language by learning the [-cont] form as the base one, and this is because there are a lot more forms that contain it, therefore they rather experience a [-cont] > [+cont] change in certain environments
2) it's a lot easier to explain the fewer cases of "strengthening" rather than to explain each place where "weakening" takes place in the language synchronically, for example why fricativization occurs in certain words but not others.

Therefore, Dickens inverts the fricativization rule in order to explain the process more efficiently. In (Dickens 1984), he elaborates the 3 following rules, which sum up the main changes from Proto-Bantu to Setswana:

1. **Morphologised stopping:** m+βona > mbona 'see me'
2. **Inverted Fricativization:** m+ϕa > mpʰa 'give me'
3. **Devoicing:** mbona > mpona 'see me'

He now calls the process **MSID** (Morphologised Stopping, inverted Fricativisation, Devoicing). Although this is a more representative name, I will stick to the more common name of *strengthening* throughout the paper.

3. Findings

All of the historical changes mentioned in the previous chapter can explain how this process of alternating between consonant pairs came to be a part of Setswana, however when collaborating with the speaker I found out that these rules are not always applied as expected. In this chapter I give an overview about the exceptional forms I have found in the speaker's variety and try to explain their origin. This

chapter is divided into 4 categories: nouns, adjectives, verbs, and derivation, as each part of the language was affected slightly differently.

3.1. Nouns

When I was trying to elicit the nouns that Cole (1955) classifies as NC11 with plural forms in NC10, I found out that most of them have either changed to NC5-NC6, or do not exist in the speaker's variety at all.

Table 4

(Cole 1955)		Speaker's variety	
lʊrɪ, dintʰɪ 'walking stick'	(NC10,11)	lɪ̀rɪ̀, màrɪ̀ˊ'spear'	(NC5,6)
lʊʃʊ, dintʃʰʊ 'death'	(NC10,11)	lɪ̀ɪ̀sʊ́, mààsʊˊ'death, funeral'	(NC5,6)
lʊbaka, dipaka 'time'	(NC10,11)	lɪbaká, màbakaˊ'concern, trouble, commitment'	(NC5,6)
lʊχaχa, diqχaχa 'cave'	(NC10,11)	lɪ̀χaχ́a, màχaχ́aˊ'cave'	(NC5,6)

Because of this change in noun class, the plural forms do not exhibit consonant strengthening anymore, because NC6 prefix is ma- with no strengthening. There is one exception:

lʊfuka, dipʰuka 'wing' (NC11, 10) vs. lɪ̀pʰuká, màpʰukaˊ'wing' (NC5, 6)

Although the noun class changed as in the other ones, the strong stem was generalized for both the singular and plural, even though neither NC5 nor NC6 usually have a strengthened stem. The speaker also accepts the variants 'lɪfuká, lɪhuka', as regional variants. They are probably dialects where the strong stem was not generalized.

The only NC11 noun I encountered during the elicitation sessions with the speaker is lʊ̀sikaˊ'family'. However, the plural has also changed from NC10 to NC6 and is now mafikaˊ(NC6) with a weak consonant, in contrast to (Cole 1955), where it is lʊsika, ditsʰika 'vein' (NC11, NC10), which has a strengthened consonant.

3.2. Adjectives

The adjectives in (Cole 1955) have strengthened stems when they agree with nouns of noun class 8, 9 and 10. However, there are certain adjectives that behave differently in the speaker's variety:

Table 5

	Always Strong	Both accepted	Irregular	
	-mɲ̀ʰʲa´'new'	-lɛlle´, -lɛlɛlɛ´'long'	-bɪ´'ugly, bad'	-hibiɗʉ`'red'
NC1 mʊ-	S	S or W	W	
NC2 ba-	S	S or W	W	
NC3 mʊ-	S	S or W		S
NC4 mɪ-	S	S or W		
NC5 lɪ-	S	S or W	S/W	S/W
NC6 ma-	S	S or W	W, ~S	
NC7 sɪ-	S	S or W	S	S/W
NC8 di(N)-	S	S or W	S	S/W
NC9 (N)-	S	S or W	S	S
NC10 di(N)-	S	S or W	S	S
NC11 lʊ-	S	S or W		
NC14 bʊ-	S	S or W		

As we can see in Table 5, the adjective -mɲ̀ʰʲa´'new' has taken a general strengthened form in all environments. This corresponds to -ʃa 'new' from (Cole 1955) where it is a regular adjective that strengthens into -ntʃʰa´only in NC8,9,10. The reason why the strengthened forms are also different, is because the strengthened form in the speaker's variety is most likely derived from the stem -fsa, which is a variant of -ʃa mentioned in (Cole 1955, 36).

There is another monosyllabic stem with a generalized strong stem: -nʦʰʊ´'black'. This stem is already generalized in standard Setswana too, as mentioned in (Cole 1955), where -ntʃʰʊ 'black', as compared to Sepedi -ʃʊ where it is still an alternating stem.

This shows that there is a general tendency for monosyllabic stems to generalize the strengthened form in all environments. We can notice that is staring to happen with the stem -bɪ´'ugly' as well, which is strengthened not only in NC8,9,10 as in (Cole 1955), but also in NC7, as well as a preferred form in NC5 and an accepted form in NC6.

(2) lɪ̀-sɔlɛ̀ lé lɪ̀-**mɲ̀**ɪ´ ~ lɪbɪ´
NC5-soldier NC5 NC5-bad
'the bad soldier'

(3) mà-sɔlɛ̀ á má-**b**ɪ́ ~ má-**m̀b**ɪ́
NC6-soldier NC6 NC6-bad
'the bad soldiers'

(4) sɪ̀tɬʰàrɪ̀ sé sɪ̀-**m̀b**ɪ́, *sɪ̀-**b**ɪ́
NC7-tree NC7 NC7-bad
'the ugly tree'

The strong stem in NC7 is explainable the fact that its equivalent plural, NC8, is already strengthened. The fact that NC5 and NC6 are also starting to have strengthened forms is surprising, but it simply shows the tendency that monosyllabic stems generalize the strong stem throughout the whole paradigm.

Another stem where the strong stem is becoming generalized throughout the paradigm is for -híbídʉ̀'red'. First of all, this is a variant of -húbídʉ̀, which is why we have h > kʰ strengthening in the first place, as usually this should occur before _u (because *ku > *kʰu > hu). Because this is an irregular stem, and the only one with -h-, it's understandable that the speaker is not sure where the strengthening should take place, as we can also see that the weak stem is even accepted for NC8:

(5) di̋-tɬʰarɪ̀ tsé (di̋-)**k**ʰibídʉ̀ ~ (di̋-)**h**ibídʉ̀
NC8-tree NC8 (NC8-)red
'the red trees'

The last stem we have to discuss is -lɛlɛ́, -lɛlɛlɛ́'long', where both the weak and the strong forms are accepted in all environments, as the speaker was not sure whether one form or the other is more correct. There aren't many stem changing adjectives in general, so it makes sense that a generalized strong stem is also appearing for this form, it may point towards the loss of this process as a whole in the category of adjectives, as the only consistent stems I encountered in the speaker's variety were -χɔlű'big', -bèdi̋'two' and -raŕʊ́'three'.

3.3. Verbs

There are a lot more verbs with unexpected forms than nouns or adjectives. The following table summarizes the examples for each consonant pair:

Table 6

		/REFL (i)_	/1SG.O (N)_
b > p	-bɔ́ná'to see'	S	S, *W
	-bɛtʰá'to hit'	S	S
	-buìsa̋'to speak'	S	

	-butsa´'to ask'	S	
	-balla`'to read for'		S
l > t	-lʊma´'to bite'	S	W, ~S
	-lɪfɛla´'to pay for'	S, *W	W, ~S
	-lɪbala`'to forget'	S, *W	
	-lɪla`'to cry for'		W
	-lɪmɛla´'to farm for'		S
d > t	-dulɛla´'to sit for'	S, *W	S, *W
	-dirɛla´'to do for'	S	S
	-dumɛla´'to agree'	S, *W	W, *S
	-disetsa`'to herd'	W, *S	W, *S
	-duma´'to crave'	W, *S	W, *S
Ø > k	-irɛla´'to do for'	S, *W	S, *W
	-apɛla´'to cook for'	S	
	-emisa`'to stop'	W	
	-ɛla´'to go for'		S
	-ɔpedisa`'to make sing'		S
	-utɬwa´'to hear'		S
	-eletsa`'to give advice'		S
f > pʰ	-fɛpa´'to feed'	S/W	S/W
	-fɪta´'to pass'	S/W	S/W
	-fʊfisa`'to make fly'	W, *S	W, *S
	-fa´'to give'		S, ~W
	-fɛtɬʰa´'to stir'		W, ~S
	-feɲetsa`'to win for'		W
r > tʰ	-rɛkɛla´'to buy for'	S	S
	-rata´'to love'	S, *W	S/W
	-ruta`'to teach'	S, *W	S, ~W
	-rɔba´'to break'	S, *W	W, ~S

	-rɔbalˈla`ˈ'to sleep for'		S/W
h > k^h	-huḿiśa`ˈ'to enrich'	W, *S	W, *S
	-hɛm̀ɛla`ˈ'to breathe for'	W, *S	W, *S
s > ts^h	-sɪχ̀a`ˈ'to cut'	S	S
	-suńa´ˈ'to kiss'	S, ~W	W/S
	-swabiš̀a`'to shame' (tr.)	W, ~S	
χ > qχ	-χʊd̀iśa´ˈ'to raise'	S/W	S/W
	-χʊp̀ɛla´ˈ'to beg'	S/W	S/W
	-χam̀a`'to choke'		S
	-χaχ̀ɛla´'to build for'		S

It's important to note that χ > qχ corresponds to Cole's g [x] > kg [kx^h] in (Cole 1955). This is because in the speaker's variety, the velar fricative /x/ has become uvular [χ], and the velar aspirated affricate /kx^h/ has become the uvular ejective affricate [qχ'].

For each verb there are 2 columns for the 2 environments where the initial consonant of the stem should strengthen: after the reflexive i- and the 1SG.O marker N-. For each case I have noted the following:

- **S** = Strengthened
- **W** = Weak
- **S/W** = Both forms accepted equally
- **~S, ~W** = the form sounds correct but not as sure
- ***W, *S** = ungrammatical

Although not all of the verb stems have both forms listed in the table, mostly due to lack of data, we can see general trends:

- some consonants (almost) always undergo the strengthening process: b>p, ∅>k
- some have both forms equally accepted: χ > qχ
- some never undergo the process: h > k^h
- the others are more irregular and depend on the verb itself

Another interesting trend we can observe is that the reflexive form is more consistent than the 1SG.O form: whenever it has an accepted weak form, it means that the 1SG.O form can also be weak (but not vice versa). I discuss the possible reason behind this in chapter 4.1.
In the following subchapters I discuss each of these consonant pairs in turn.

3.3.1. b > p

This is the most consistent change, as it virtually always strengthens in both environments.

-bɔ́ná 'to see'

(6) w-à-ì-**p**ɔ́ná
2SG-CONJ-REFL-see
'you see yourself'

(7) w-à-m̀-**p**ɔ́ná, *w-à-m̀-**b**ɔ́ná
2SG-CONJ-1SG.O-see
'you see me'

As we can see in the previous examples, /b/ devoices and becomes /p/ in the two environments, and the weak stem is not accepted in (7). There are 2 verbs that are strengthened in both morphological environments: -bɔ́ná 'to see', -bɛtʰa´'to hit'. The rest of the verbs I have encountered were strong as well, as we can see in Table 6.
A reason for the fact that this change always takes place could be due to the fact that /b/ is the only voiced plosive phoneme currently present in the language, and it occurs in a large number of stems. This is because [d] is merely an allophone of /l/ before [i, u], which results in fewer stems containing it, and *g has completely disappeared from the language (*g > *ɣ > ∅).
This has also been observed by Elisabeth C. Zsiga and One Tlale Boyer in an upcoming article (Zsiga and Boyer in press) where they argue that Sebirwa (S32) has borrowed the strengthening process from Setswana only for the b>p pair, due to the high frequency of this change in Setswana.

3.3.2. ∅ > k

This change is also (almost) completely regular.

-ìrɛlá 'to do for'

(8) mámá ʊ́-ŋ̀-**k**ìrɛlá dìdʒɔ̀
mom 3SG-1SG.O-do food
'mom makes food for me'
*ʊ́-ǹ-ìrɛlá

(9) kɪ̀-ì-**k**ìrɛlá dìdʒɔ̀
1SG-REFL-do food
'I make food for myself'
*kɪ̀-ì-ìrɛlá

As we can see in the previous examples, a -k- is inserted before the initial vowel of the stem in both environments, otherwise the form is ungrammatical. It is also important to note that there are 2 stems for this verb: -iŕɛlá -diŕɛla´'to do for', coming from -iŕá -diŕa´'to do'. The speaker mentions that -iŕa´is the more Setswana form, whereas -diŕa´is more Sepedi. (Cole 1955) explains that -iŕa´is a commonly used contracted form of -diŕá which makes for an interesting example where the change

from Ø>k has been applied to a newly formed verb and does not reflect the historical development of this stem.

There is one exception where the weak form of a Ø- stem is used in the reflexive: -eǹmìsà`'to stop':

(10) ʊ́-ì-èmìs-ìtsè
3SG-REFL-stop-PST
'she stopped herself'

However, I do not know whether the strong stem is ungrammatical, and I only found the reflexive form. And because I have only encountered the strong stems for the other 6 verbs in this category, it is safe to say that the Ø>k change takes place consistently. Moreover, we see in the case of -iŕɛla´'to do for' in (8) and (9) that it occurs even for newly formed stems. I argue that the Ø>k change is consistent because there is also a large number of vowel initial verb stems, and the insertion of -k- is quite salient and makes the structure of the verb closer to all other verbs which begin in a consonant. The alternative, which means the deletion of the -k-, would lead to uncommon forms, especially after the 1SG.O N- prefix, where the speaker would have to choose between {m, n, ŋ} before the vowel, which is not something I could find to be part of the language. The deletion of -k- after the reflexive i-, however, is more likely to happen, as this would simply make it more similar to the environment of the NC9.O ɪ- prefix, which the speaker often mentions to be similar (see 4.1).

3.3.3. χ > qχ

The speaker consistently uses the strengthened form in both environments, however upon asking for the weak form, she accepted it as well:

-χʊ̀pɛlá 'to beg'

(11) kɪ̀-à-ì-**qχ**ʊ̀pɛlá ~ kɪ̀-à-ì-a**χ**ʊ̀pɛlá
1SG-CONJ-REFL-beg
'I beg myself'

(12) ʊ̀-à-ɴ̀-**qχ**ʊ̀pɛlá ~ ʊ̀-à-ɴ̀-**χ**ʊ̀pɛlá
2SG-CONJ-1SG.O-beg
'you beg me'

As we can see, both the strengthened and the weak forms are equally accepted by the speaker. This is also true for the verb -χʊ̀diśa´'to raise'. After the reflexive i-, the speaker was more likely to strengthen the consonant, however after the 1SG.O N- it

was slightly unclear. At first, the speaker was pronouncing the weak form, and when I asked whether it's also correct to use the strong form, she could not hear the difference (which is most likely due to my inaccurate pronunciation). Upon listening to the recording again, I could hear both forms being used in this environment. She was more aware of the difference in the reflexive form, and we concluded that both the weak and the strong stems are correct.
The speaker claimed that the weak -χ- form is used a lot due to Sesotho influence, where they generally reduce the affricate /qχ/ to [χ], and many Setswana speakers are influenced by this. This is also noted in (Doke and Mofokeng 1957, 21), where they mention that the velar affricate /kxʰ/ (which is equivalent to Setswana's /qχ/), is often reduced to the velar fricative [x]. This seems to affect any word in the speaker's variety, including nouns: qχɔ́mʊ́ ~ χɔ́mʊ́'cow', especially in fast speech.
There are 2 more verbs in this category: -χaa̰ma̰`'to choke', -χa̰χɛlá'to build for', and as we can see in Table 6, both have strengthened forms in the 1SG.O N_ environment, however I have not yet tested whether the weak form is also correct. Considering the 2 aforementioned examples and the variation between qχ~χ, I don't believe this poses a problem to the analysis as of now, but it does show a preference for the strong stem in this environment.

3.3.4. h > kʰ

The consonant /h/ never undergoes the strengthening process in verb stems:

-húmísà 'to enrich'

(13)	ɪ́-à-n̰-**h**úmísà	(14)	kɪ̰-à-ì-**h**úmísà
	NC9-CONJ-1SG.O-enrich		1SG-CONJ-REFL-enrich
	'it enriches me'		'I enrich myself'
	*ɪ́-à-n̰-**kʰ**úmísà		*kɪ̰-à-ì-**kʰ**úmísà

As we can see in the 2 examples above, only the weak form is accepted in both environments, even though we would expect a strengthened form. This is also true for the verb -hɛ̀mɛla`'to breathe for'. However, this stem is different, as it probably comes from a historic *pʰ, because /h/ should only appear before _u (*ku > *kʰu > hu, check 4.1 for more on f vs h). This is confirmed in (Cole 1955, 446), where it shows up starting with /f/: "Fêma thata! ... (breathe deeply!)". Although we could disregard this stem because of its peculiarity, I think it's synchronically relevant and belongs to this group and shows that /h/ does not strengthen in verbs, similar to the case of -iɾɛlá'to do for' in examples (8) and (9), where synchronically the change of Ø>k takes place, even though it originally comes from a d- stem.
I believe the reason why h does not strengthen to kʰ is the fact that there are too few verbs with this stem: in the speaker's variety I have only come across the 2 aforementioned verbs, and in literature only one more: -húpá 'to hold in the mouth'

(Creissels 2007, 40). This means that it's the most likely consonant to stop strengthening, as there are too few instances for it to maintain this process. However, we can still see that the noun deriving from this verb does have the strengthened consonant: kʰumo 'wealth', probably because it has already been lexicalized (see 3.4.1).

The rest of the consonants are slightly more irregular: sometimes both the weak and the strong forms are accepted, sometimes the weak form is preferred or even the only one accepted, usually depending on the stem itself.

3.3.5. r > tʰ

As we can see in Table 6, it's consistently strong in the reflexive form, but less consistent in the 1SG.O form.

-rátá 'to love'

(15) ʊ̀-à-ì-**tʰ**átá
2SG-CONJ-REFL-love
'you love yourself'
*ʊ̀-à-ì-**r**átá

(16) ʊ̀-à-ǹ-**tʰ**átá ~ ʊ̀-à-ǹ-**r**átá
2SG-CONJ-1SG.O-love
'you love me'

As we can see in the examples above, after the reflexive i-, the strengthened form is required, with the weak form deemed ungrammatical, whereas after 1SG.O N-, both forms are accepted. However, in most cases the speaker initially did use the strengthened form, and upon asking whether the weak form is correct, the speaker accepted it. This is also true for the 1SG.O forms of the verb -rɔbalɬa`'to sleep for'. For the verb -ruta`'to teach', however, the speaker accepts both forms, but prefers the strengthened one.
A case that stands out is that of -rɔbá 'to break'. The reflexive i- is always followed by the strengthened form, however after the 1SG.O N- the speaker at first deemed the strengthened form as ungrammatical.

(17) ʊ̀-ì-**tʰ**ób-ìlè
1SG-REFL-break-PST
'you broke yourself'
*ʊ̀-ì-**r**ób-ìlè

(18) ʊ̀-ǹ-**r**ób-ìlè lʊʊ̀tʊ̀
2SG-1SG.O-break-PST leg
'you broke my leg'
*ʊ̀-ǹ-**tʰ**ób-ìlè lʊʊ̀tʊ̀

In a later session, when I asked these 2 examples again, the speaker was consistent in rejecting the weak form after the reflexive i-, however she did accept the strengthened form after 1SG.O N-, but still preferred the weak one.
The weak stem in the 1SG.O environment is also noticed at some speakers of Sesotho, as mentioned in (Doke and Mofokeng 1957, 26) but it is not considered standard. I

believe that the reason why this change is slowly becoming inactive is possibly due to the fact that it's a slightly unnatural change, from the trill /r/ to the aspirated plosive /tʰ/ (see 4.1).

3.3.6. f > pʰ

The strengthening of /f/ is inconsistent in both environments.

-fɛ́pa´'to feed'

(19) kɪ̀-à-ì-**pʰ**ɛ́pá ~ kɪ̀-à-ì-**f**ɛ́pá
1SG-CONJ-REFL-feed
'I feed myself'

(20) ʊ́-á-m̀-**pʰ**ɛ́pá ~ʊ́-á-m̀-**f**ɛ́pá
3SG-CONJ-1SG.O-feed
'S/he feeds me'

The speaker came up with both versions from the beginning when asked to translate the English sentences, and deemed both equally as correct, but this may be due to the fact that we had already been working on this process, so the response might not be natural, and we can't tell whether there is a preference. A similar response happened for the verb -fɪta´'to pass', however there was a preference for the strengthened form in the 1SG.O environment.
When asked about the verb -fʊfiśa`'to make fly', the speaker completely rejected the strengthened forms:

(21) ʊ́-á-ì-**f**ʊfísà
3SG-CONJ-REFL-make.fly
'he makes himself fly'
*ʊ́-á-ì-**pʰ**ʊfísà

(22) ʊ̀-à-m̀-**f**ʊfísà
2SG-CONJ-1SG.O-make.fly
'you make me fly'
*ʊ̀-à-m̀-**pʰ**ʊfísà

This may be because the verb itself is newly formed, as it's the causative of the verb -fufa´'to fly', which could point to the fact that the f > pʰ change is not productive anymore for the speaker. This is also supported by the verb -feɲɬsa`'to win for', which is also a newly formed verb from -fɛɲa`'to win' and also has a weak stem in the 1SG.O environment. In the same environment the speaker also preferred the weak stem for the verb -fɛʈɬʰa´'to stir', but does accept the strong stem too.
The only conservative verb seems to be -fa´'to give', where the strengthened stem was actuated multiple times by the speaker through-out different elicitation sessions, which makes sense considering that this is one of the most basic transitive verbs in Setswana. However, when asked about the weak stem, the speaker accepted that too, which shows that even this verb is starting to become less strengthened.

When looking at all the verb stems starting with f-, we notice a striking thing: the weak stem is always accepted in both environments, but not the strong stem. The

weak stem in the 1SG.O environment is also noticed in (Doke and Mofokeng 1957, 26). The cause for the decline of this change could be due to the fact that in this variety, /ɸ/ is the bilabial fricative [f], and the change from f > pʰ is less natural than ɸ > pʰ. However, Cole (1955) mentions that even in varieties where /ɸ/ has become [h], they still strengthen the consonant from h > pʰ, which he even mentions as a test to check whether [h] in that word is an allophone of /ɸ/ or the actual phoneme /h/ (which should strengthen to kʰ).
The speaker often mentioned that words with /f/ might be pronounced as [h] by some speakers, which shows that there is f~h variation in the dialect or even cross dialectally. Therefore, I believe the cause for the decline of both f > pʰ and h > kʰ is the fact that they are merging and it's becoming increasingly difficult to tell which is the original consonant and therefore which should be the strengthened consonant. More about this in 4.1.

3.3.7. s > tsʰ

When it comes to the strengthening of /s/, there are 3 stems that all behave differently.

-sʉ́na´'to kiss'

(23) ʊ́-á-ì-**tsʰʉ**ná ~ ʊ́-á-ì-**sʉ**ná
3SG-CONJ-REFL-kiss
'he kisses himself'

(24) ʊ́-á-ǹ-**sʉ**ná ~ʊ́-á-ǹ-**tsʰʉ**ná
3SG-CONJ-1SG.O-kiss
'he kisses me'

In the reflexive environment, the speaker preferred the strengthened stem, but accepted the weak stem as well. In the 1SG.O environment however, she first pronounced the weak form, but then also accepted the strengthened form. This is a similar pattern to the verb -rɔba´'to break', which also had a strengthened stem in the reflexive environment but a preference for the weak stem after 1SG.O N-. However, in contrast, the verb -swabìsa`'to scare' had a weak stem in the reflexive when first uttered by the speaker, but also accepted the strong stem when asked. The verb -sɪχ̀a`was always strengthened in the 2 environments during elicitations, but I have not asked whether the weak form is correct or not.
I believe that the reason behind the inconsistency of the s > tsʰ change is because -swabìsa`'to shame' and -sʉ́na´'to kiss' actually come from stems that start with /ʃ-/. Cole (1955, 25) mentions that [s] before _u is always a dialectal variation of /ʃ/. The cluster -sw- also must come from -ʃw-, as the only source for this is palatalization (Cole 1955, 42).Due to the fact that /s/ and /ʃ/ are merging, this causes problems to the strengthening process. The stem -sɪχ̀a`, however, is actually attested as such in (Cole 1955) too, which is why the strengthened stem is still regularly used, as it the actual phoneme /s/ and not an allophone of [ʃ].

It's also interesting to note that the verb -ʃa 'to burn' from (Cole 1955) has become -tʃʰa´in the speaker's variety, which means that the strengthened stem has become the regular one in all forms, which seems to be common with monosyllabic roots also found in (see 3.2) It seems like [ʃ] is completely missing in the speaker's variety, which is why I have not encountered any examples of ʃ > tʃʰ strengthening.

3.3.8. l > t

There is a tendency for verbs beginning with /l/ to have a strong stem in the reflexive form, and a weak stem in the 1SG.O form.

-lʊ́ma´'to bite'

(25) kɪ̀-à-ì-**t**ʊ́má
1SG-CONJ-REFL-bite
'I bite myself'
*kɪ̀-à-ì-**l**ʊ́má

(26) ɪ́-á-ǹ-**l**ʊ́má ~ ɪ́-á-ǹ-**t**ʊ́má
NC9-CONJ-1SG.O-bite
'it bites me'

As we can see in (25), in the reflexive environment only the strengthened stem is accepted. However, in the 1SG.O environment, the weak stem is preferred, but the speaker also accepts the strong stem. This seems to be a general tendency in the l > t group, as -lɪ**f**ɛla´'to pay for' is also strengthened after the reflexive i-, but with a preferred weak stem after 1SG.O N-. Similarly, the verb -lɪ**b**ala`'to forget' requires a strong stem in the reflexive form, and the verb -lɪ**l**a`'to cry for' has a weak stem in the 1SG.O form (although the strong stem has not been tested).
The only exception seems to be -lɪ̀mɛla´'to farm for', where the speaker preferred the strong stem in the 1SG.O form. However, the weak stem has not been tested and I believe it's safe to assume that the general tendency of the l>t group is to have a strong stem in the reflexive form and a weak stem in the 1SG.O form.
The weak form in the 1SG.O environment is also present in Sesotho, as mentioned in (Doke and Mofokeng 1957, 26). The change from the liquid /l/ to the voiceless plosive /t/ is also quite unnatural, and therefore unsurprising that it's starting to become inactive. It looks like the l > t is only remaining active in the reflexive form, and the speaker often mentions that the weak stem sounds is wrong because it sounds too close to NC9.O ɪ-. More on this in 4.1, where I try to explain generally why the reflexive form seems to be more conservative.

3.3.9. d > t

Although this actually represents the same change as from l > t, as [d] is merely an allophone of /l/ before the high vowels _{u,i}, I discuss this separately because there are different results in this group.

There are 2 stems that are consistently strengthened: -duɭɛla´'to sit for', -diŕɛla´'to do for'.

-duɭɛla´'to sit for'

(27) kɪ̀-kʊ́pá ʊ̀-ǹ-**t**úlél-é mɔ´ sítúló-ŋ̀
1SG-beg 2SG-1SG.O-sit.for-SUBJ on chair-LOC
'can you sit for me on the chair?'
*ʊ̀-ǹ-**d**úlél-é

(28) ʊ́-ì-**t**úlɛlá mɔ´ sítúló-ŋ̀
3SG-REFL-sit.for on chair-LOC
'he sits for himself on the chair'
*ʊ́-ì-**d**úlɛlá

As we can see in the examples above, only the strong stem is accepted in both environments. It's already interesting to note that both -duɭɛla´and -diŕɛla´are newly formed stems from -duɭa´'to sit' and -diŕa´'to do', yet they are the ones that strengthen more consistently than the other verb stems in this group. They are also more consistent than the verb stems from the l > t group, which could be due to the fact that the change from [d] to /t/ is more direct than /l/ to /t/, as it is simply devoicing.
The verb -duǹmɛla`'to agree' has the meaning of 'to become happy' in its reflexive form and is always strengthened. However, in the 1SG.O environment, only the weak stem is accepted:

-duǹmɛla`'to agree'

(29) kɪ̀-ì-**t**ùmètsɪ̀
1SG-REFL-agree.pst
'I am getting happy'
*kɪ̀-ì-**d**ʉ̀m-ètsɪ

(30) ɪ́-á-ǹ-**d**yǹmɛlà
NC9-CONJ-1SG.O-agree
'It is agreeing with me'
*ɪ́-á-ǹ-**t**ùmɛlà

The strengthened stem in the reflexive is consistent with the 2 aforementioned stems of this group, however the weak stem in the 1SG.O is unexpected. The reason why the 1SG.O form is not strengthened is because, as the speaker mentions, the verb -duǹmɛla` is mostly used intransitively, and therefore the sentence in (30) is unnatural and therefore the speaker does not apply the usual rules.
There are 2 stems in this group which are always weak: -diɜ̀ɛtsa`'to herd for', and -duḿa´'to crave'.

-diɜ̀etsa`'to herd for'

(31) ʊ́-ì-**d**ìsɛ̀tsà dìqχómʊ́
3SG-REFL-herd.for cows
'he herd cows for himself'
*ʊ́-ì-**t**ìsɛ̀tsà

(32) ʊ́-ǹ-**d**ìsɛ̀tsà dìqχɔ́mʊ́
3SG-1SG.O-herd.for cows
'he herds cows for me'
*ʊ́-ǹ-**t**ìsɛ̀tsà

The speaker mentions that she does not accept the strengthened forms because they sound like the verb -tiɬsɛtsa`'to strengthen for'. This is an interesting case where the speaker consciously makes the choice to distinguish the 2 verbs in these environments by not actuating the strengthening process for the verb containing [d]. In another study by Elisabeth C. Zsiga and One Tlale Boyer (Zsiga and Boyer 2012), they conclude that the speakers do not make distinctions between a verb that has a strengthened consonant and another verb which has that consonant as its stem, such as -tisa 'to bring' and -disa 'to guard' in the 1SG.O environment -ntisa 'to bring/guard me'. However, the speaker I collaborated with seems to find an alternative solution to the conflict, by not actuating the process of strengthening, as we can see in (31) and (32).

The last verb in this group left to discuss is -duʍa´'to crave', which the speaker also never strengthens in the 2 environments. She mentions that it sounds very close to the strengthened form of -lʊʍa´'to bite', however this is surprising because there is a phonemic distinction between /ʊ/ and /u/. Another reason could be that this is a loanword, as I could not find it in (Cole 1955) and the speaker mentions that this is mostly used by people in regions influenced by Sepedi, therefore it could be a Sepedi word. While there is also consonant strengthening in Sepedi, where l, d > t, just like in Setswana (Louwrens et al. 1995, 13), the word was most likely borrowed in its weak form, and as it is not native to Setswana the strengthening does not take place.

3.4. Derivation

There are 2 kinds of derivation where the strengthening process takes place: verb > noun and adjective > noun. I chose to deal with these in a separate chapter from nouns, as it relates to adjectives and verbs as well.

3.4.1. verb > noun

The most common type of derivation is from verb to noun, by changing the infinitive class prefix NC15 χʊ̀- to NC9 (N)- prefix, as well as changing the final vowel suffix -a specific to verbs, to the nominalizer suffix -ɔ. Some examples I found in the speaker's variety are:

Table 7

infinitive		noun	
χʊ̀-lɪfa`'to pay'	(NC15)	**tɪ**fɔ`'payment'	(NC9)
χʊ̀-**h**ʊ̀ma 'to be rich'	(NC15)	**kʰ**ʊ̀mɔ`'wealth'	(NC9)
χʊ̀-ɔ́pɛla`'to sing'	(NC15)	**k**ɔ́pɛlɔ`'singing'	(NC9)

It's interesting to notice that this always renders a strong stem, even in the case of -huʊ̀ma`'to be rich', where its causative form -huʊ̀mìsa`'to enrich' did not strengthen in either the reflexive or the 1SG.O environment (see 3.3.4). This is probably because these are lexicalized items that are simply learned, and not a case of synchronic strengthening that the speaker has to do.

3.4.2. adjective > noun

Another form of derivation is forming NC14 nouns from adjectives.

(1) -lɛllɛ́'long' > bʊ̀-tɛllɛ́'length', *bʊ̀-lɛllɛ́
(2) -bɪ́'ugly' > bʊ̀-bɪ́'ugliness', *bʊ̀-mp̀ɪ́

There should be no strengthening in this process, as nc14 bʊ̀- does not require it, but surprisingly in the case of -lɛllɛ́'long', only the strong stem is accepted, even though as an adjective both stems are always accepted. This again points to the fact that the stem is starting to become regularly strengthened everywhere, including in its noun form.

3.5. Summary

In chapter 3 I analyzed the main parts of the language that are affected by the consonant strengthening process. I discussed each relevant stem I found in my speaker's variety, especially those that behave differently from what is expected in the literature. There were a lot of different examples and reasonings for each consonant change, especially in the chapter about verbs, so in this subchapter I summarize everything by explaining when the consonant strengthening takes place.

The main difference is that the nouns from NC10, NC11 have become NC5, 6. This change led to a generalized weak stem for all except one noun: lɪp̀ʰuká, map̀ʰuká 'wing' (NC5, 6), which has generalized the strong stem.

All adjectives, starting with the monosyllabic ones, are starting to generalize the strong stem throughout the whole paradigm. As such, 2 stems: -bɪ́'ugly' and -hibiɗʉ̀` 'red' have become irregular while undergoing this transition, and 1 stem has

generalized both the weak and the strong stems throughout its whole paradigm: -lɛl̪lɛ́/-tɛl̪lɛ́''long'.

Although there should be no strengthening after the NC14 prefix bʊ-, we can observe that the noun form of -lɛl̪lɛ́/-tɛl̪lɛ́''long' is bʊ̀tɛl̪lɛ́''length' and is based on the strong stem, which further proves the generalization of strong stems in all adjectives.

The most complex part of the analysis was focused on the verbs, as there is a lot of variation and a lot of different reasons for each case. These are the general rules I found:

1. voiced plosives b-, d- → consistent strong stem
   - exception: weak stems may be used to differentiate between verbs that have the strong consonant as part of their basic stem (-disa 'to herd' vs -tisa 'to strengthen')
2. vowel initial stems Ø- → consistent strong stem
3. χ → both strong and weak stems accepted
4. h → only weak
5. s → strong stem preferred
   - exception: if originally from <ʃ-, variation occurs
6. liquids l, r: only strong stem in reflexive form, mostly weak stem in 1SG.O form
7. f → both strong and weak accepted
   - exception: -fufiśa`'to fly' because it's a newly formed verb

exception: -fa 'to give' because it's one of the most popular verbs and therefore more archaic

4. Discussion

4.1. Issues

One of the main issues I encountered was the fact that the speaker often accepted or rejected a form based on its similarity to another already existing form. Some of these cases were easy to understand, such as that of -diše̱tsa`'to herd' and -tiše̱tsa`'to strengthen for', where the speaker consistently chose the weak stems for the former in order to avoid confusion with the latter.
However, she often gave examples of similar forms that in reality contain different vowel phonemes, especially the environment of the reflexive i- compared to NC9.O ɪ-. For example, the speaker avoided the weak from of kɪà-̀i-̀lʊ́ma´'I bite myself', because it sounded like kɪà-̀ɪ́-lʊ́ma´'I bite it'.
Cole (1955) mentions that there is a raising rule where /ɪ/ becomes [ɪ] before _i, u, which is a vowel higher than /ɪ/ so close to /i/ that some speakers do not differentiate between [ɪ] and [i]. This can be seen in the fact that /lɪ, lʊ/ can become [di, du] in cases where the /ɪ/ and /ʊ/ have been raised to [ɪ] and [ʊ̈] respectively.

However, in most examples there is no reason for the raising of ɪ > ɩ, and as we saw in the example above with -ɪlʊ́ma´'bite it'.
I believe there are 2 options: either the vowels /ɪ/ and /i/ are already similar for the speakers without the raising and they interact in more complex ways than described, or the speaker mentions the similarity simply because she is trying to find a motivation for their choice of weak or strong stem, but this is not the actual reason and it is not a conscious choice.

Another issue is that of the phonemes /f/ and /h/. Historically, /h/ derives from *ku, whereas /f/ derives from *p. However, Cole (1955) mentions that there is variation among dialects and speakers on whether a stem will contain one or the other. There is also variation in their realization: most dialects have a bilabial [ɸ] for the phoneme deriving from *p, however the speaker's variety has a labiodental [f].
Throughout the elicitation sessions the speaker mentioned that some words with -f- may be realized with -h-, but the main word which has been relevant in my analysis is -hɛ̀mɛlà 'to breathe for'. This cannot come from a historical *ku, and therefore must come from a stem starting with -f-. It's unclear whether this because there is an ongoing process in the dialect where /f/ is merging with /h/ in general, or whether these are loanwords from other dialects or languages that have -h- instead of -ɸ- for that stem.

In general it seems that loanwords and newly-formed words are affected differently in the strengthening process. This makes sense, considering that it's a learned change and it looks like each stem is learned separately. However, it's unclear what determines whether a loanword or a newly-formed word will take part in the strengthening process or not. It's further complicated by the fact that many of these loanwords are from languages that are also affected by the strengthening process (Sesotho, Sepedi), but with slightly different rules.

Another issue is that of so-called "natural" and "unnatural" changes. Usually, phonetic changes are more natural when they require less changes in quality, for example a change from b > p is that of devoicing, as they are both already bilabial plosives. However a change from l > t requires 2 things: devoicing and stopping. Moreover, a change such as r > t^h requires stopping, devoicing and aspiration. But there isn't a very clear reason why /l/ should only strengthen until /t/, and not become the aspirated /t^h/, as /r/ does. Therefore, these changes are rather more complex than unnatural, and although we can explain them historically, as we see in section 2.2, in the context of the process becoming inactive, complex changes are the ones that will stop being active first. In other words, the process of "strengthening" could simply become one of "devoicing" in time, as the stopping rule is becoming less active, and these fricatives will simply remain unaffected.

Especially in the case of h > k^h, we see that another important factor is frequency. Because the changes within the strengthening process are learned by being exposed to the 2 stems of each verb that takes part in this process, when there aren't enough verbs that contain a certain consonant in the onset, such as is the case of /h/, the speakers will not have the chance to learn this change. Although this is an extreme case where only 2 stems seem to contain /h/, there seems to be a correlation between frequency and the activeness of the change, such as in the case of b > p, which is the most regular change, with /b/ also being the most frequent consonant in the onset of verb stems (a frequency also noticed in (Zsiga and Boyer in press)).

Another big problem is, of course, the lack of data. I only had 2 hours of private elicitation sessions with the speaker, where I focused on the strengthening stems, which is not enough to have all the necessary forms. This is the reason why in many parts both the adjective and the verb tables are incomplete. I think I had enough data to see the general trends and rules, but there is a lot more to discover even in just the idiolect of the speaker.

4.2. Conclusion

In this paper I discussed the (in)famous strengthening process of Setswana, by first presenting its history and synchronic analysis as described in the literature, and then presenting examples from my own collaboration with a modern speaker of Setswana, where we can observe a lot of variation. I conclude that there is a slow decline in the use of this process, especially for the more complex consonant changes (such as l > t, r > t^h), due to a leveling of the paradigm, where eventually all the verbs would have the same stem throughout the whole paradigm.
This is all true for the idiolect of the speaker I have collaborated with, and while this does shed some light on the situation of the process for the modern speakers of Setswana, it's far from a detailed analysis. In order to understand the situation better, more fieldwork is needed in collaboration with speakers of Setswana of the same dialect, and later from other dialects as well. A cross dialectal research would allow us to understand the variation better, because there are phonetic differences across dialects for the consonants that take part in the process (β ~b, ɸ ~ f ~ h, d ~ ɻ, s ~ ʃ) and we could see how these behave when strengthened. We would also get a bigger look at the language as a whole and see whether these unexpected forms are only in this dialect, in the speaker's idiolect, or whether the whole language is affected by this change.

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