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CONTENTS

ON THE MOTIVATION AND STRUCTURE OF A STRENGTHENING PROCESS IN TSWANA[1]

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Abstract : A synchronic morphophonemic pattern of alternation constituting a single phonological process in Tswana, a Southeastern Bantu language, is examined.[2] In order to account tentatively for this process, a discussion of its motivation and structure is undertaken. Two motivating conditions are identified: the Reflexive morpheme and a syllabic nasal consonant. Restricting subsequent discussion to the nasal condition, a hierarchical strength structure is postulated to underlie the process. This postulated strength hierarchy appears to follow from two principles, an Intersyllable Principle derived from Hooper (1976) and the Inertial Development Principle found in Foley (1977).

Introduction

Phonological processes subsumed under the traditional labels strengthening and weakening have emerged over the last decade as issues confronting synchronic generative phonology. Chomsky & Halle (1968:401) pointed out the inability of their initial theoretical framework to account for a specific strengthening process, notably the root initial strengthening process in Tswana, a Southeastern Bantu Language. Subsequent to its brief mention in Chomsky & Halle, the Tswana process has been mentioned, as in Sommerstein (1977:228), only as an anomaly, a complex phenomenon stretching the capacity of the generative phonological framework. Indeed, the Tswana process appears difficult to fathom from the perspective of binary distinctive features.

Of the two processes identified by the traditional labels, weakening and strengthening, weakening appears to be the most widely attested and most often discussed. It is perhaps familiarity with weakening that has led to definitions like the following, taken from the general discussion in Hyman (1975:165).

> ...a segment X is said to be weaker than a segment Y if Y goes through an X stage on its way to zero. Strengthening, on the other hand, refers to the reinforcement of a segment as when a nongeminate [p] becomes a geminate or double [pp].
>
> ...stronger segments or segment types are more resistant to weakening processes.

In each definition above, the strengthening of a segment is defined either by example or by reference to a weakening process. One might assume, therefore, that a strengthening process is no more complex than

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a weakening process in reverse. What follows will attempt to set forth the actual complexity of at least one process which is postulated to be an instance of strengthening. First, the synchronic facts by which the Tswana process is manifested will be set forth in an attempt to identify its motivating condition. Secondly, it will be argued that a hierarchical strength structure underlying the process can be explicated, tentatively, by means of principles under general consideration within the scope of generative theory, but not necessarily that of binary distinctive feature theory.

Cole (1955) has claimed that a particular phonological process in Tswana is one of strengthening. Evidence of a general process in Tswana resulting in morphophonemic alternation in root initial position is found in verbal, nominal and adjectival roots. Cole (1955) also has claimed that the process he labelled strengthening is motivated by a single condition. What will be challenged first herein is Cole's interpretation of the condition motivating the Tswana strengthening process. Four possible accounts of this condition, including one approximating that of Cole, will be discussed within the framework of generative phonology.

The strengthening process in Tswana is manifested by the pattern of alternation shown in Figure 1. On the left in Figure 1 are listed the segments (the entire set of phonemic segments except for vowels) which function as input to the Tswana process and on the right are listed the segments which function as output. Closer examination of Figure 1 reveals the direction of alternation, the phonemic segments which change in value (1-9) and the segments which fail to change (10-27). It can be observed from the entirety of Figure 1 that the segments which change in value are a subset of the entire set of phonemic segments in Tswana and, moreover, that the alternation pattern cannot be identified accurately as a consonant alternation. In particular, it should be noted that the segment k' is inserted, as a result of the process, at a position preceding a root initial vowel and that the segments failing to change in value can be classified as nasal, affricate and voiceless stop (with its different secondary forms).

Distribution of the Alternation Pattern

Consider now the manifestation of the Tswana process as it is found in verbal, nominal and, finally, adjectival roots. At this juncture it should be mentioned that the data to be discussed will be presented in their surface phonemic form. A further point of mention is that though the data are obtained primarily from Cole (1955) and Cole (1962), they were verified and supplemented by data obtained from a native speaker of Tswana.[3]

In the class of verb roots, the alternation pattern manifesting the Tswana process occurs in the environment of a high-toned high-front vowel or a low-toned nasal consonant. In the first environment mentioned, root initial alternation occurs after the Reflexive prefix, the high-toned vowel -í-. The Reflexive prefix provides rather clear evidence

1.	b	voiced bilabial stop	p'
2.	f	voiceless bilabial fricative	ph
3.	s	voiceless alveolar fricative	tsh
4.	š	voiceless alveopalatal fricative	tš̆h
5.	x	voiceless velar fricative	kxh
6.	h	glottal glide	kh
7.	-	(stem initial vowel)	k'
8.	l	alveolar lateral liquid	t'
9.	r	alveolar trill	th
10.	n	alveolar nasal	n
11.	m	bilabial nasal	m
12.	ny	palatal nasal	ny
13.	ng	velar nasal	ng
14.	p'	voiceless bilabial ejective	p'
15.	ph	aspirated voiceless bilabial plosive	ph
16.	ts'	voiceless alveolar affricate (ejective)	ts'
17.	tsh	aspirated voiceless alveolar affricate	tsh
18.	tš'	voiceless alveoplatal affricate (ejective)	tš'
19.	tšh	aspirated voiceless alveopalatal affricate	tšh
20.	kxh	aspirated voiceless velar affricate	kxh
21.	kh	aspirated voiceless velar plosive	kh
22.	k'	voiceless velar ejective	k'
23.	t'	voiceless alveolar ejective	t'
24.	th	aspirated voiceless alveolar plosive	th
25.	tl'	lateralized voiceless alveolar ejective	tl'
26.	tlh	lateralized aspirated alveolar plosive	tlh
27.	dž	voiced alveopalatal affricate	dž

Figure I

that the segments depicted on the right in Figure 1 are indeed derived not underlying segments, though this evidence is not limited to the Reflexive. Consider now the Reflexive prefix as presented in Figure II. The conjoined form consisting of the Reflexive prefix plus verb root can be predicted from the form of the root in the infinitive, but the form of the root in the infinitive can not be predicted from the conjoined form of Reflexive plus root. For instance, the Reflexive plus root forms xòíkhúmísà, to enrich oneself, and xòíkhúrúmèlà, to cover oneself, can be predicted from the infinitive forms xòhúmísà and xòkhúrúmèlà respectively. However, the form of the roots in the infinitive xòhúmísà and xòkhúrúmèlà cannot be predicted from their corresponding forms consisting of Reflexive plus root, xòíkhúmísà and xòíkhúrúmèlà. It appears, therefore, that the segments on the right in Figure 1 are derived. Henceforth, a segment derived from the Tswana process or a segment not subject as input to the process will be labelled a strong segment. A weak segment, with respect to this process, will be identified as a segment from which a strong segment is derived.

In the second environment noted, root initial alternation occurs after the First Person Singular (FPS) Object prefix, a low-toned nasal segment. As is shown in Figure III, the FPS nasal is homorganic with the root initial segment. (Due to space limitations the full set of 27 alternations is not presented in Figure III or subsequent figures.) Since there is no principled reason at this stage of research in Tswana to choose one of the four surface nasal segments as an underlying form, in this or subsequent instances, the underlying nasal in prefixes will be represented by N.

As with verbal roots, nominal roots manifest the strengthening process in initial position. In general, the effect of the strengthening process is observed when a prefix marking both class and number is adjoined to a nominal root. (For purposes of this discussion, the classification scheme for prefixes, though not the corresponding terminology, found in Cole (1955) will be followed. Cole uses "class" as a term for individual singular and plural prefixes attached to a noun and as a cover term for a singular and plural noun pair. In keeping with Greenberg (1978) and to avoid overlap of terms, Cole's cover term "class" will be replaced by the term "gender".) Perhaps the manifestation of the Tswana process can be most clearly observed when Gender 6 is adjoined to multisyllabic roots. As Figure IV indicates, the segments which alternate in initial position in nominal roots are identical to those segments which alternate in verb roots. In root initial position, strong segments occur when the Gender 6 Plural prefix is adjoined and the corresponding weak segments when the Singular prefix is adjoined. In addition to the identity of the alternating segments, the surface phonemic environment co-occurring with a strong segment, the -i- of the Gender 6 Plural prefix dì-, is identical in form to the Reflexive prefix -í- adjoined to verb roots.

Consistent with the behavior of multisyllabic roots, the mono-

	INFINITIVE		REFLEXIVE
1.	xòbɔ́nà	to see	xòíp'ɔ́nà
2.	xòfísà	to burn	xòíphísà
3.	xòséxà	to cut	xòítshéxà
4.	xòšápà	to thrash	xòítšhápà
5.	xòxólɛ́xà	to tie	xòíkxhólɛ́xà
6.	xòhúmísà	to enrich	xòíkhúmísà
7.	xòáxà	to build	xòík'áxà
8.	xòrɛ́kà	to buy	xòíthɛ́kà
9.	xòlómà	to bite	xòít'ɔ́má
10.	xònáyà	to give	xòínáyà
11.	xòmènà	to fold	xòíménà
12.	xònyàtsà	to despise	xòínyátsà
13.	xòngàpà	to scratch	xòíngápà
14.	xòp'àtàlà	to pay	xòíp'átàlà
15.	xòphùthà	to wrap up	xòíphúthà
16.	xòt'ùkà	to flame up	xòít'úkìsà
17.	xòthúsà	to help	xòíthúsà
18.	xòtl'ɔ́là	to annoint	xòítl'ɔ́là
19.	xòtlhàbà	to stab	xòítlhábà
20.	xòtsɛ́kà	to kiss	xòíts'ékà
21.	xòtshábà	to fear	xòítshábísà
22.	xòtšómà	to hunt	xòítš'ómà
23.	xòtšhà	to dry up	xòítšhà
24.	xòk'ɔ́kɔ́tà	to knock	xòík'ɔ́kɔ́tà
25.	xòkhúrúmɛ̀là	to cover	xòíkhúrúmɛ̀là
26.	xòkxhálémà	to scold	xòíkxhálémà
27.	xòdža´	to eat	xòídžésà

Figure II: Reflexive Prefix

	INFINITIVE		FPS OBJECT
1.	xòbónà	to see	xòmp'ónà
2.	xòfɛ̀nyà	to conquer	xòmphɛ́nyà
3.	xòsɛ́xà	to cut	xòntshɛ́xà
4.	xòšápà	to thrash	xòŋytšhápà
5.	xòxátà	to tread on	xòŋgkxhátà
6.	xòhúmísà	to enrich	xòŋgkhúmísà
7.	xòárábà	to answer	xòŋgk'árábà
8.	xòlómà	to bite	xònt'ómà
9.	xòrátà	to love	xònthátà

Figure III: First Person Singular Object

	SINGULAR		PLURAL
1.	lòbàkà	time	dìp'àkà
2.	lòfúkà	wing	dìphúkà
3.	lòsíkà	vein	dìtshíkà
4.	lòšɛ̀kɛ̀dì	famine	dìtšhɛ̀kɛ̀dì
5.	lòxóngà	piece of firewood	dìkxhóngà
6.			
7.	lòɛ̀tɔ̀	journey	dìk'ɛ̀tɔ̀
8.	lòlémè	tongue	dìt'émè
9.	lòrákɔ̀	stone wall	dìthakɔ̀

Figure IV: Gender 6 Multisyllabic

syllabic roots to which the Gender 6 Singular and Plural prefixes are adjoined manifest root initial alternation. Strong segments appear in root initial position when the root is adjoined to the Plural prefix and the corresponding weak segments appear when the root is adjoined to the Singular prefix. Though the monosyllabic roots to which the Gender 6 Plural prefix is adjoined manifest an alternation pattern identical to that shown by multisyllabic roots, the Gender 6 Plural prefix itself is manifested by a distinct surface form. The form of the Gender 6 Plural prefix adjoined to monosyllabic roots is dì-N-. The nasal segment in the Plural prefix is homorganic with the root initial strong segment, comparable to the nasal in the FPS Object prefix adjoined to verbal roots. The data in Figure V reveal that a nasal segment precedes each strong segment in monosyllabic roots adjoined to the Gender 6 Plural prefix. Since a nasal fails to appear in the Plural prefix adjoined to multisyllabic roots, the basic issue appears to be whether the prefix form adjoined to monosyllabic root forms provides evidence of an underlying Plural prefix requiring obligatory nasal deletion when adjoined to multisyllabic roots, or whether the prefix form adjoined to multisyllabic roots provides evidence of an underlying Plural prefix requiring obligatory nasal insertion when adjoined to monosyllabic roots.

In contrast to the effect of Gender 6, the effect of adjoining the Gender 5 prefixes to nominal roots evinces no apparent root initial alternation. The Tswana strengthening process, despite this lack of alternation, does appear manifest. It is manifest first by the fact that weak segments fail to appear in root initial position when the Gender 5 Singular prefix is adjoined, except in recently borrowed words. Furthermore, it appears that the Gender 5 Singular prefix adjoined to multisyllabic roots is not manifest at the surface level. In multisyllabic roots, shown in Figure VI, root initial weak segments fail to appear. In initial position in monosyllabic roots, weak segments also fail to appear; nonetheless, the monosyllabic roots to which the Gender 5 Plural prefix is adjoined do hold common ground with the monosyllabic roots to which the Gender 6 Plural is adjoined. In particular, the Gender 5 Plural prefix adjoined to monosyllabic roots consists of dì-N, as is the case in the Gender 6 Plural. As for the form of the Gender 5 Singular prefix, it differs from that of Gender 6. The Gender 5 Singular prefix adjoined to monosyllabic roots consists solely of a tonal nasal segment. The data in Figure VII exemplify this fact. By viewing the monosyllabic nominal roots to which Gender 5 and Gender 6 are adjoined as a single category, it can be observed that a nasal segment precedes each root initial strong segment. What remains problematic are the multisyllabic roots, specifically, the multisyllabic roots to which the Gender 5 Singular is adjoined.

The failure of root initial weak segments to appear is not the only evidence of the applicability of the Tswana process under discussion to word forms containing Gender 5 prefixes. In the process of deverbalization, a variety of multisyllabic nominal roots manifest the by now familiar alternation pattern. In Figure VIII, the forms consisting of

	SINGULAR		PLURAL
1.	lòbú	black soil	dìmp'ú
2.			
3.	lòsí	shore, edge	dìntshí
4.	lòšó	death	dìnytšhó
5.			
6.			
7.			
8.	lòdí	bark of a thorn tree	dìnt'í
9.	lòré	spear handle	dìnthé

Figure V: Gender 6 Monosyllabic

	INFINITIVE		SINGULAR
1.	p'ótsɔ̀	question	dìp'ótsɔ̀
2.			
3.			
4.			
5.	kxhámɛ́lɔ̀	bucket	dìkxhámɛ́lɔ̀
6.	khúmɔ̀	wealth	
7.	k'íšsɔ̀	knowledge	
8.	t'ɔ̀ɔ̀tsšɔ̀	whetstone	dìt'ɔ̀ɔ̀tšɔ̀
9.	thìpá	knife	dìthìpá

Figure VI: Gender 5 Multisyllabic

	SINGULAR		PLURAL
1.	mp'à	cane, rod	dìmp'à
2.			
3.	ntshì	fly	dìntshì
4.	nỳtšhú	gizzard	dìnytšhú
5.			
6.			
7.	ngk'ú	sheep	dìngk'ú
8.	nt'á	louse	dìnt'á
9.	nthɔ́	sore, wound	dìnthɔ́

Figure VII: Gender 5 Monosyllabic

	INFINITIVE		SINGULAR
1.	xòbótsà	to ask	p'otšɔ̀ a question
2.			
3.			
4.			
5.	xòxámà	to milk	kxhámɛ́lɔ̀ a bucket
6.	xòhúmà	to become rich	khúmɔ̀ wealth
7.	xòítsè	to know	k'ítšɔ̀ knowledge
8.	xòlòòtsà	to sharpen	t'òòtšɔ̀ a whetstone
9.	xòrípà	to cut, slash	thípá a knife

Figure VIII: Deverbalization Pattern

the Gender 5 Singular prefix plus multisyllabic root and the forms of the non-derived verbal roots are presented. The root initial alternation pattern is apparent. Given the potential evidence from deverbalization, the presence of only strong segments, in initial position in the conjoined form, Gender 5 Singular plus multisyllabic root, appears not fortuitous but determined. Although the exact nature of the condition determining the presence of the strong segment in the multisyllabic deverbalized form is not evident at the surface level, the presence of a nasal segment in the Gender 5 Singular prefix adjoined to monosyllabic roots does provide, if not the determining condition, at least a factor which must be accounted for in any comprehensive analysis.

The data provided by the behavior of the Gender 5 and Gender 6 prefixes discussed to this point reveal segment alternation after the Plural prefix dì-. The data provided by Gender 4 reveal no such alternation but do, nonetheless, bear on the condition motivating the process. As is illustrated in Figure IX, root initial position is constant when either the Gender 4 Singular or Plural prefix is adjoined. The Gender 4 Plural prefix, moreover, is dí-. The surface level prefix dí- thus marks plurality and either Gender 4, Gender 5 or Gender 6 when adjoined to multisyllabic nominal roots. Segment alternation, by contrast, is evident only in nominal roots when the Gender 5 or 6 Plural prefix is adjoined. In summary, when a nominal root is adjoined to the Gender 5 Singular prefix, and the Gender 5 and Gender 6 Plural prefix, a root initial alternation occurs.

Adjectival roots, like verbal and nominal roots, manifest the strengthening process. In Tswana, adjectival forms observe rules of concord such that each adjectival form is marked to reveal the class and number of the nominal form it is to modify. The Adjective Singular Concord prefix, showing grammatical agreement with nominal roots marked for Gender 5 Singular, follows the pattern established for monosyllabic and multisyllabic roots. The Concord prefix is ɛ́-N- when adjoined to monosyllabic roots and ɛ́- when adjoined to multisyllabic roots. The forms in question are presented in Figure X and Figure XI, respectively. The Adjective Plural Concord prefix, showing agreement with nominal roots marked for Gender 4, 5, and 6 Plural, also observes the monosyllabic and multisyllabic pattern. As Figure XII and Figure XIII indicate, the Plural Concord prefix is tsé-dí-N- when adjoined to monosyllabic roots and tsé-dí when adjoined to multisyllabic roots. In both the Singular and Plural of the Adjective Concord prefixes under discussion, therefore, either a front vowel with high tone or a tonal nasal segment occurs and is followed, in the adjectival roots, by a strong segment.

Relying on the data presented in the general discussion above, four hypotheses, each defining a distinct conditioning environment for the Tswana strengthening process, appear to merit attention. Each will be discussed in turn and assessed as to its adequacy.

	SINGULAR		PLURAL
1.	sèbétà	liver	dìbétè
2.	sèfàlà	grain bin	dìfàlà
3.	sèsényì	destructive person	dìsényì
4.	sèšúšù	deaf person	dìšúšù
5.	sèxódì	hawk	dìxódì
6.	sèhúbà	breast	dìhúbà
7.	sèolo	ant-heap	dìolo
8.	sèlɛ́pɛ	ax	dìlɛ́pɛ
9.	serope	thigh	dìrope

Figure IX: Gender 4 Multisyllabic

	STEM		SINGULAR FORM
1.	-bé	bad	ɛ́mp'é
2.			
3.			
4.	-ša	new	ɛ́nytšha
5.			
6.			
7.			
8.			
9.			

Figure X: Adjective Singular Concord
Gender 5 Monosyllabic

	STEM		SINGULAR FORM
1.	-bɔ́tlaná	small	ɛpɔ́tlaná
2.			
3.	-sɛ́sané	slender	ɛ́tshɛ́sané
4.			
5.	-xólò	large	ɛ́kxhólò
6.			
7.			
8.			
9.			

Figure XI: Adjective Singular Concord
Gender 5 Multisyllabic

	STEM		PLURAL FORM
1.			
2.			
3.	-sɛ́sané	slender	tsɛ́ditshɛ́sané
4.	-šwèu	white (of cattle)	tsɛ́ditshwɛ̀u
5.	-xòloxólò	very old	tsɛ́dikxhòloxólò
6.	-hubídù	red	tsɛ́dikhubídù
7.	-wɛ̀bù	roan, grey (of cattle)	tsɛ́dikwɛ̀bù
8.	-lɛ̀ɛ́lé	long	tsɛ́diteelé
9.			

Figure XII: Adjective Plural Concord Gender
4, 5, 6 Multisyllabic

	STEM		PLURAL FORM
1.	-bé	bad	tsɛ́dìmpé
2.			
3.			
4.	-šá	new	tsɛ́dìnyʧ̀šhá
5.			
6.			
7.			
8.			
9.			

Discussion of Motivating Condition

An initial hypothesis with respect to the motivating condition for the Tswana strengthening process may be to assume that the condition is most clearly manifest in those forms where a strong segment is preceded by a nasal. According to what will be referred to as the nasal hypothesis, the condition motivating the strengthening process might be identified as an underlying nasal segment. It is this hypothesis that most nearly approximates the position taken by Cole (1955).

Cole (1955) assumes that a nasal segment motivates the Tswana strengthening process. Moreover, Cole assumes, by positing a glottal stop as the weak alternate of k', that the alternation manifesting the strengthening process is limited entirely to consonant segments, i.e., ? and k' would alternate. There is, however, no evidence that a glottal stop functions as an underlying or surface phonemic segment in Tswana in the pattern under discussion or in any other phonological pattern. Moreover, a glottal stop is not mentioned at any other point in Cole (1955) or Cole (1962). To return to the question of a motivating condition, it may be important to emphasize that, independent of its syllabic position, the nasal segment is not sufficient to cause strengthening. The verb suffix -ana, with a syllable initial nasal, fails to motivate the strengthening process and, thus, illustrates the potential import of syllable position to the nasal hypothesis.

In order to capture the major generalization supporting the nasal hypothesis a rule of the general form shown in (1) can be posited.

$$1.\quad S \rightarrow \begin{bmatrix} S \\ +\ \text{strong} \end{bmatrix} \;/\; N.\_\_\_\_\_$$

Rule (1) states that a segment becomes strengthened when preceded by a syllable boundary and a nasal segment. Rule (1) is a more general formu-

lation of the environment in which strengthening occurs. At present, though, there is no principled reason to choose the less general environment stipulating morpheme boundary and a tonal nasal.

As a consequence of the nasal hypothesis and Rule (1), a nasal deletion rule would be required for certain of the nominal, verbal and adjectival forms under discussion. Nasal deletion would apply to certain prefixes attached to multisyllabic stems, namely Gender 5 and 6 Nominal Plural, Gender 5 Nominal Singular, Adjective Plural Concord of Gender 4, 5 and 6 and Adjective Singular Concord of Gender 5. Accordingly, a rule of the following general form might be posited. Rule (2) asserts that an underlying nasal is delted before strong segments occurring in the

$$2.\quad N \rightarrow \phi \quad / \quad \_\_\_\_\_ \cdot \left[\begin{array}{l} \left[\begin{array}{l} S \\ +\ \text{strong} \end{array} \right] \\ \left] \begin{array}{l} -\ \text{verb root} \\ -\ \text{monosyllabic} \end{array} \right. \end{array} \right.$$

appropriate class of multisyllabic stems. Though one would rather not posit an underlying segment only to have it deleted at the surface, as is the case in the relevant set of prefixes, the presence of an underlying nasal segment can be motivated by the nasal segment appearing in allomorphs of those same prefixes when adjoined to monosyllabic roots.

The postulation of an underlying nasal segment by the nasal hypothesis would presumably extend to the Reflexive prefix. Whether such an extension is justified will be discussed below. Nevertheless, to account for the surface form of a verbal root plus the Reflexive prefix, a rule of nasal deletion, distinct from Rule (2) above, must be posited. Based on Rule (3), the nasal segment in the Reflexive prefix would in all in-

$$3.\quad N \rightarrow \phi \quad / \quad \_\_\_\_\_ \left] \text{reflexive} \right.$$

stances be deleted.

The nasal hypothesis, as it has been sketchily formalized above, is beset with a major difficulty. There is no evidence at the surface level in Tswana that the Reflexive prefix consists of any segment but a high front vowel. The nasal hypothesis, consequently, posits elements which have no surface realization. An hypothesis of this nature would appear to violate the spirit of the Naturalness Condition. The Naturalness Condition holds that the categorization of a segment at the surface level is identical to its categorization at the underlying level, unless the facts of the language require the two levels to differ. There are no phonological facts, presumably facts of alternation, which would require in the example under discussion a distinct underlying and surface categorization. Since the postulated nasal segment in the Reflexive is, so to speak, categorized as null at the surface level and since there is no alternation in the Reflexive form involving a nasal, the postulated nasal must receive a null categorization at the underlying level. In more general terms, the nasal hypothesis, as far as the Reflexive prefix is con-

cerned, is guilty of positing imaginary elements as this has been discussed by Hyman (1975:86) and Sommerstein (1977:214).

In contrast to the nasal hypothesis, Tswana strengthening might be presumed to be most clearly manifest in the forms of the Adjectival Singular Concord prefix and the Reflexive prefix. In line with what might be termed the vowel hypothesis, the front vowels -ɛ - and i- can be posited as the condition motivating the strengthening process, and the process itself characterized as one of assimilation. Since at the surface level a strong segment occurs after -i- in the Gender 5 and Gender 6 prefix adjoined to multisyllabic nominal roots as well as after the Adjective Plural Concord of Gender 4, 5, and 6 adjoined to adjectival roots, the vowel hypothesis gains some initial plausibility. That incorrect forms for nominal roots adjoined to Gender 4 would result from straightforward application of the vowel hypothesis could be obviated by morphological specification in the rule format.

As a consequence of the vowel hypothesis, the following rules would appear to be required. A rule of segment strengthening, motivated by the vowels discussed above and stated without feature specification, might take the following general form.

$$4.\quad S \rightarrow \begin{bmatrix} S \\ +\ \text{strong} \end{bmatrix} \quad / \quad -G4 \begin{bmatrix} i,\varepsilon\ + \_\_\_\_ \end{bmatrix}$$

Abiding by Rule (4), root initial segments, except those following the nominal Gender 4 prefix, would be strengthened when preceded by either of the front vowels - ɛ - or -i-. It is necessary to specify a morpheme boundary in Rule (4), rather than a syllable boundary since a segment normally subject to the strengthening process, the -s- in the causative suffix -isa, is not strengthened.

The vowel hypothesis would also necessitate certain rules of deletion and insertion. Each of these will be specified for purposes of discussion. Insertion rules would be needed to account for the presence of the nasal segment in the Gender 5 and Gender 6 prefixes adjoined to monosyllabic nominal roots. A nasal insertion rule similar to that in (5) might be formulated.

$$5.\quad \phi \rightarrow N \quad / \quad \begin{matrix} +NOM \\ +G5 \\ +G6 \end{matrix} \begin{bmatrix} \_\_\_\_ + CV \end{bmatrix}$$

Similarly, to account for the presence of a nasal in the prefixes adjoined to monosyllabic adjectival roots, an insertion rule of the general form in (6) would be required.

$$6.\quad \phi \rightarrow N \quad / \quad \begin{matrix} +ADJ \\ +G5\ SG \\ +G4,\ 5,6\ PL \end{matrix} \begin{bmatrix} \_\_\_\_ +CV \end{bmatrix}$$

In addition to insertion rules, vowel deletion rules would be needed to account for certain nominal and verbal forms. One vowel deletion rule would be required for the Gender 5 Nominal Singular prefix, which has no surface level manifestation.

7. $i, \varepsilon \longrightarrow \phi \quad / \quad \begin{matrix} +\text{NOM} \\ +\text{G5 SG} \end{matrix} [\_\_\_\_$

A second vowel deletion rule would be required for the FPS Object prefix.

8. $i, \varepsilon \longrightarrow \phi \quad / \quad +\text{FPS OBJ}[\_\_\_\_$

Though the vowel hypothesis does gain some initial plausibility, it too is beset by a number of difficulties. As was the case with the nasal hypothesis, the vowel hypothesis is guilty of positing imaginary elements. In the FPS Object prefix form, there is no cogent evidence that a vowel, much less -i- or -ɛ-, follows the nasal segment. Furthermore, in the conjoined form of Gender 5 Singular plus nominal root there is no surface evidence, such as the distinctive behavior of monosyllabic and multisyllabic roots, for positing a vowel as the underlying Singular prefix.

A difficulty of equal seriousness to that of imaginary elements is the class of vowels which are claimed to motivate the process. Though -ɛ- and -i- are both classified as [-back] vowels, strengthened segments do not appear after all [-back] vowels. The failure of the strengthening process to apply after the Gender 4 Nominal Singular prefix sè- is a case in point. It would appear, therefore, that the condition motivating the strengthening process under the vowel hypothesis is not a natural class, where natural class is defined as a feature configuration not found in items outside that class. Though such a situation in itself may not be a signal of inadequacy, it requires that what appears to be a uniform process be formulated in terms of separate processes.

Beyond the imaginary element and natural class difficulties, the vowel hypothesis exhibits a third major difficulty. Rule (4), though not completely specified in terms of features, implies that the Tswana strengthening process is one of assimilation. In the particular formalization sketched herein, the weak segment would assimilate the feature values of its conditioned environment, the front vowels -i- and -ɛ-. It follows that all strong segments resulting from the strengthening process could be explained along these lines. Presumably, there would be an instance wherein an empty feature matrix would assimilate the feature values represented by k'. Is this phonetic assimilation? On the contrary, it appears to be an instance of segment insertion. Generalizing from this particular instance, the Tswana strengthening process could be viewed as a process of insertion, not assimilation.

Perhaps the difficulties facing the nasal and vowel hypotheses can be circumvented by, in effect, combining them. Such a combined hypothesis might posit a strengthening rule of the general form in (9).

$$9.\quad S \rightarrow \begin{bmatrix} S \\ +\ \text{strong} \end{bmatrix} \qquad / \qquad i,\varepsilon\ (N)\ +\_\_\_\_\_$$

According to Rule (9), a nasal segment occurring between either of the front vowels -i- and -ɛ-, and a weak segment is neither sufficient to block application of the rule, nor necessary for appropriate rule application. The criticism leveled at the nasal hypothesis for positing an underlying nasal in the Reflexive prefix is circumvented by this combined hypothesis; nevertheless, the criticism leveled at the vowel hypothesis is not. An underlying vowel in Gender 5 Nominal Singular is required by the combined hypothesis to account for the presence of strong segments in root initial position. As already argued, no cogent evidence for such a segment can be inferred from surface level facts. More serious, however, this combined hypothesis still claims that the strengthening process is a result of feature assimilation. Given the arguments presented against the vowel hypothesis above, it is apparent that the combined hypothesis is equally subject to those arguments.

If one accepts the criticism leveled at the nasal and vowel hypotheses, root initial strengthening must be viewed as the result of a process, or processes, which require neither assimilation nor imaginary elements. It would appear that the most satisfactory hypothesis regarding Tswana strengthening is to accept two distinct motivating conditions. The following rules attempt to capture the generalizations necessitated by this two condition hypothesis.

$$10.\quad S \rightarrow \begin{bmatrix} S \\ +\ \text{strong} \end{bmatrix} \qquad / \qquad \begin{bmatrix} +\text{REFLEXIVE} \end{bmatrix} \quad +\_\_\_\_\_$$

$$11.\quad S \rightarrow \begin{bmatrix} S \\ +\ \text{strong} \end{bmatrix} \qquad / \qquad N.\_\_\_\_\_$$

$$12.\quad N \rightarrow \phi \qquad / \qquad \_\_\_\_\_ + \begin{bmatrix} -\text{Verb stem} \\ -\text{Monosyllabic} \end{bmatrix}$$

According to Rule (10), weak segments are realized as strong segments before the Reflexive prefix. With a different environment but identical output, Rule (11) states that weak segments are realized as strong segments when preceded by a syllable boundary and a nasal consonant segment. Rule (12), in keeping with the surface behavior of multisyllabic roots as opposed to monosyllabic roots, states that a nasal is deleted in prefixes adjoined to multisyllabic nonverb roots. It should be noted that Rule (12) is ordered with respect to Rule (11), a counterbleeding order, but that Rules (10) and (12) are mutually nonaffecting. That the two condition hypothesis requires the deletion of an underlying segment, the -N- in the prefixes adjoined to multisyllabic roots, cannot be avoided. Positing such an underlying nasal in prefixes adjoined to multisyllabic nominal and adjectival roots, however, can be motivated by the behavior

of monosyllabic roots in the corresponding form classes.

Discussion of Structure

As the preceding has attempted to argue, the Tswana strengthening process appears motivated by two distinct conditions. Though this summation of the facts relevant to the process has been brief, the task now is to attempt an understanding of these facts. In particular, though, the following will only consider the nasal condition. Accordingly, one might attempt to articulate a structure underlying the strengthening process and to identify general principles from which such a structure might follow. More to the point, a strength hierarchy hypothesized to underlie the Tswana process should answer both a general and a specific question. First, why does this particular subset of phonemic segments, as a result of the process, change in strength value? And secondly, what accounts for the occurrence of the specific changes in strength value?

At least since their mention in Chomsky and Halle (1968), phonological processes of strengthening and weakening have received some attention within the theoretical framework of generative phonology. Schane (1972, 1973), under his typology of natural phonological processes, includes that of strengthening and weakening. Lass and Anderson (1975) and Lass (1971), relying on data from the historical development of various language families, develop a framework wherein strength is defined by reference to a parameter on which segment types are assigned strength values. Hooper (1976) taking explicit note of the universal properties of strength processes, provides a network of theoretical mechanisms by which a strength process can be articulated as a process of minimal feature change. Of more recent design, Foley (1977) has rejected some crucial assumptions of classical generative phonology, in particular that of distinctive features, and has defined the basic elements of generative theory based on their behavior in historical phonological processes. From the perspective of the latter three models, the structure of the Tswana strengthening process will be examined.

The first theoretical framework to be examined provides a rationale for the notion strength based on historically reconstructed patterns of sound change. For Lass and Anderson (1975), certain positions within the structure of a word are subject to a particular process or, with sufficient time, a sequence of processes. Arrangement of these processes in their historical sequence and a companion arrangement of the segments manifesting these processes can result in a strength parameter. Certain aspects of the Tswana process are highlighted by the Lass and Anderson framework, but, in general, it appears to obscure the structure underlying the process.

Either at a position adjacent to word boundary or at a position between two phonological segments within a word, it is claimed by Lass and Anderson (1975) that sequences of phonological processes tend to be repeated. They assert, furthermore, that the processes, when historically

ordered one to another, reflect an overall hierarchical arrangement of processes. Two such sequences of processes, derived from Uralic, Indo-European and Dravidian languages, are illustrated in Figure XIV.

VOICELESS STOP in V_____V

A. voiceless stop → voiced stop

B. voiced stop → voiced fricative

C. voiced fricative → approximant consonant

D. approximant → vowel

E. vowel → ∅

SUPRASEQUENCE A

VOICELESS STOP in ##_____

A. voiceless stop → aspirated stop/affricate

B. aspirated stop/affricate → voiceless fricative

C. voiceless fricative → h

D. h → ∅

SUPRASEQUENCE B

Figure XIV: Sequence of Sound Changes

The suprasequence in A or B of Figure XIV is a doubtful find in any one language according to Lass and Anderson. Nonetheless, they maintain that the subsequences are well attested.

On the basis of the suprasequence of processes in Figure XIV, Lass and Anderson (1975) articulate a concept of phonological weakening and, so it seems, a concept of strengthening. Weakening is defined as a descent, either within a sequence (not necessarily from the highest point), or across sequences. Strengthening by way of contrast is defined as the converse: as an ascent within a sequence or across sequences. Having given some substance to the general notion strength as it relates to phonological processes, Lass and Anderson (1975) outline the structure underlying the sequences of processes in terms of phonological segments. Specifically, the hierarchical arrangement of processes noted above is manifested by a hierarchical arrangement of segment types. This

hierarchy of segment types, for Lass and Anderson, is viewed as the reflection of a continuum of complex phonetic properties by which the notion strength can be defined. Strength, defined in terms of phonetic properties, is equated with resistance to airflow through the vocal tract and, equally, with reduced output of periodic acoustic energy. It follows that the strongest segment type exhibits both the most resistance to airflow through the vocal tract and the least amount of acoustic energy, while the opposite obtains for the weakest segment type. Two background assumptions formulated by Lass and Anderson are crucial to the structure of the hierarchy or parameter reflecting strength. The first assumption is that in the formation of any phonological segment two separate phonetic gestures are involved: a supraglottal gesture of occlusion or approximation and a glottal gesture. A second assumption is that a voiceless unaspirated stop, in addition to being the strongest segment type, can be viewed as consisting of two temporal phases, a closure and a release.

As a consequence of their gesture assumption, Lass and Anderson (1975) identify two general types of phonological process. Within each process type the temporal phase assumption is delineated. In what is called a process of Opening, focused on the supraglottal gesture, a continuant release phase is extended until, ultimately, it supercedes the closure phase. Figure XV depicts for the process type Opening its se-

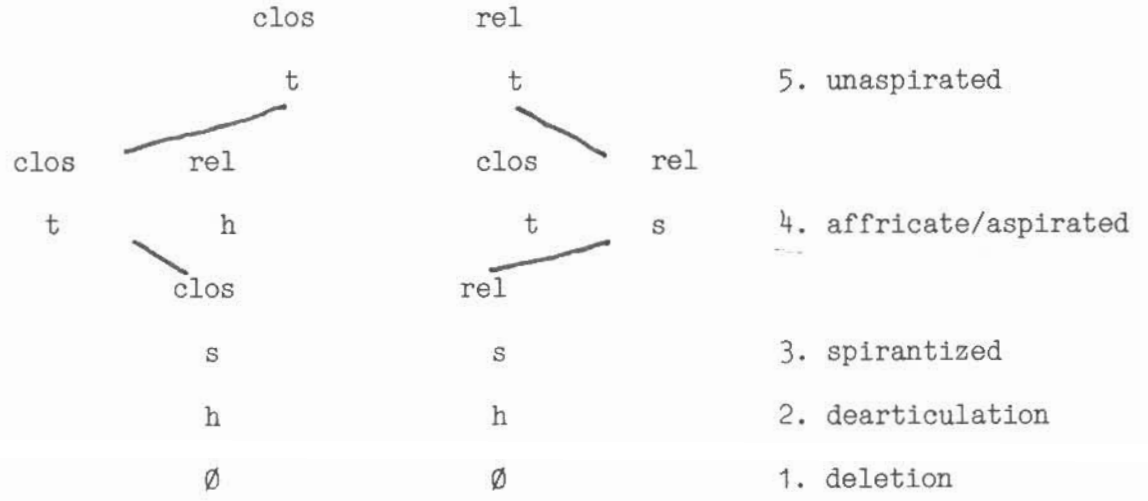

Figure XV: Sequence of Processes for the Type Opening

quence of processes and its corresponding strength parameter. In contrast to the emphasis on the supraglottal gesture in the process type Opening, the process type Sonorization emphasizes the glottal gesture, which progressively increases. The relevant sequence of processes and the corresponding strength parameter for the process type Sonorization are presented in Figure XVI.

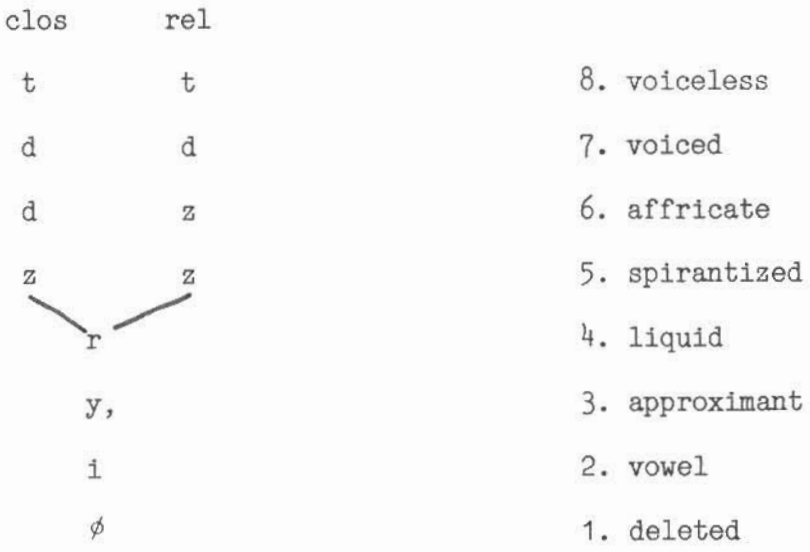

Figure XVI: Sequence of Processes for the Type Sonorization

The sequences corresponding to the two strengh process types, though they may find broader conditions of applicability, resulted from the application of phonological processes to specific environmental conditions. Several aspects of these environmental conditions are discussed by Lass and Anderson (1975).

A major aspect of the conditioning environment for a strength process appears to be the notion of preferred environment. Lass and Anderson (1975) point out that even if the environmental conditions required for the application of a process are met, the actuation of that process may not occur. The inability to deal further with the actuation issue is found in subsequent discussion of strength as well.

A second aspect of the conditioning environment is that of the general notion "protection". Protection, for a weakening process, is defined by Lass and Anderson (1975) along the following lines: Any less than maximally weak segment in a weakening environment will tend to alter, relative to ideal conditions, the extent of the process. In the development of Toda from Proto-Dravidian, for instance, k > x intervocalically but k > g between a nasal and a vowel. Assuming that intervocalicness is the ideal condition for the process under discussion, Lass and Anderson appear to claim, by means of the notion protection, that the segment type nasal prevents the ideal extention of a weakening process. The notion of protection, therefore, appears to alter the notion of strength and strength process. Instead of a process in which only input is directly dependent on environmental conditions, it is now claimed that output is similarly dependent on environmental conditions. Moreover, segment

strength, as delineated on a strength parameter, defines not only the substages of a strength process but the extent of that process as well. The notion of protection would thus appear to be intimately bound with that of segment strength.

Though Lass and Anderson (1975) provide both a rationale for the notion strength and an explicit framework within which to view other phonological processes, the particulars necessary to deal with the Tswana process seem lacking. At a general level the following comments can be made. Consider, with respect to Tswana, the sequence of processes in Figure XV and XVI and their corresponding strength parameters. A singular omission in both figures, given Lass and Anderson's notion of protection, is a strength value for the segment type nasal. To ignore the value of nasal relative to other segment types may be to ignore crucial information bearing on the outcome of a strengthening process. Secondly, though the function of syllable structure in the Tswana process is not entirely clear at this time, the fact that the Lass and Anderson strength parameter is determined by reference to word boundary, not syllable or possibly root boundary, may limit its applicability. As an aside, it may be the failure to consider the conditioning function of syllable boundary that prevented further explication of the notion protection.

Despite the omission of factors relevant to the conditioning environment of the Tswana strengtheing process, nasal strength value and syllable boundary, an examination of the Tswana process along lines laid down by Lass and Anderson's (1975) strength parameter can still be attempted. First, however, a synthesis of the parameters in Figure XV and XVI seems required. As support for the proposed synthesis, notice that the single strengthening process in Tswana consists of the process types Opening and Sonorization. For instance, the subprocess b > p' illustrates an increase from value 7 to value 8 on the parameter in Figure XVI, a Sonorization process, and the subprocess s > tsh illustrates an increase from value 3 to value 4 on the parameter in Figure XV, an Opening process. A synthesis of the parameters in Figure XV and XVI might assume the form of the composite parameter in Figure XVI.

Provided that the parameter in Figure XVII is a fair representation of the principles underlying Lass and Anderson (1975) there are a number of instances relating to the structure and complexity of the strengthening process in Tswana where these principles fail. In the first instance, the strength measure implicit in Parameter XVII may not be of sufficient complexity. The liquids r and l, for example, are assigned by Parameter XVII to the identical input value, 4, but must somehow be assigned to unequal output values, 6 and 8 respectively. (Not every segment type, fricative for instance, requires distinct output values.) A potential additional strength measure could be that found in a discussion by Lass (1971) of a secondary strength parameter. The secondary strength parameter envisaged by Lass was founded on positional criteria so that segment strength values would be assigned on grounds of place of articulation, velar, bilabial, etc. A secondary or positional parameter would not directly apply to the segment type liquid

A third instance where the Lass and Anderson (1975) framework appears to fail is the lack of a rationale for the unequal power of the subprocesses. The two subprocesses involving the extreme value on Parameter XVII are noteworthy. That the subprocess resulting in k' (value 1 value 8) and the subprocess resulting in p' (value 7 value 8) both occur, indicates that the Tswana process overall cannot be identified as either a single-value or multi-value process. It requires both. But why? Moreover, it is not clear why subprocesses accepting segments of lower value on Parameter XVII are more powerful, judged by value appreciation, than subprocesses accepting segments of higher value. As an issue of more general standing, the tremendous power inherent in the Lass and Anderson framework should not be overlooked. Since both single- and multi-value subprocesses are countertenanced, what is to prevent l from strengthening to tsh? A principle of restraint seems required. In summary, it appears that Lass and Anderson fail to provide, for the Tswana strengthening process, an answer to either the general or specific question set forth at the outset.

In contrast to Lass and Anderson (1975), Hooper (1976) appears to provide an an answer to the general question regarding the Tswana strengthening process. Hooper's theoretical framework can be interpreted as providing a more explicit treatment of the notion "protection" through the interrelating of segment strength and syllable structure. The theoretical mechanisms provided by Hooper, however, fail to adequately answer the specific question with regard to the Tswana process, the amount of strengthening question.

The notion of segment strength is discussed by Hooper (1976) in the context of an attempt to formalize the insertion of syllable boundary. Segment strength is wedded to the structure inherent in the syllable, hence, explicit recognition can be given to phonological processes, such as those of strengthening, that appear to be motivated by the structure inherent to the syllable. The notion "strength," as a consequence of Hooper's syllable structure framework, can be distinguished as to that inherent to a segment and that inherent to a position.

Hooper makes several observations with regard to position strength. There is, for instance, any asymmetry in the distribution of phonological processes as they apply to syllable initial and syllable final position. The process whereby glides are realized as fricatives, as in Spanish, typically occurs in syllable initial not syllable final position. In like fashion, processes of consonant deletion typically occur in syllable final, not syllable initial position. There is also some sense in which syllable initial, as opposed to syllable final, position may be thought of as manifesting greater strength value, if for no other reason than the lack of a syllable final consonant segment in the postulated universal structures of CV. Finally, a position occupied by a segment of a certain strength value may constrain the application of a process to a contiguous position. According to Hooper (1976), the spirantization process in Spanish, which normally applies, as in (1a) to syllable initial dental stop, fails to apply in (1b) when the dental stop is preceded by a

syllable final nasal.

1.	a.	padre	paðre	father
	b.	onda	ɔnda	wave

Though complete analysis of the dynamics preventing the stop in (1b) from spirantizing may not rest solely on the segment in a contiguous syllable, for the strength value of syllable internal r in (1a) should not be slighted, the interplay of position and segment strength in contiguous syllables appears worthy of further research. In this regard recall Lass and Anderson's (1975) notion of protection.

In addition to observing an asymmetry in the application of certain processes to the various syllable positions, Hooper (1976), as others before her, observes that the distribution of segment types to positions within a syllable is nonrandom. Certain syllable positions are characteristically occupied by certain segment types. Jespersen, as presented in Hooper, asserted that sounds group themselves in a syllable according to a sonority hierarchy, the most sonorant sound occurs at the center of the syllable and the least sonorant sounds occur at the margin. The acoustic dimension of sonoracy is not the only one by which the positional structure of a syllable can be analyzed. de Saussure (1959) relied on the phonetic dimension of aperture to arrive at a positional structure of the syllable similar to that of Jespersen.

The distribution of segment types within a syllable reveals a potential structure of positions internal to the syllable. At the same time, the distribution of segment types reveals a strength quality inherent to the various segment types. Figure XVIII presents for comparison the hierarchy of segment types resulting from distributional analysis of the syllable by Jespersen and de Saussure. The two hierarchies

Jespersen	de Saussure
1. voiceless obstruent	1. occlusive
2. voiced stop	
3. voiced fricative	2. fricative
4. nasal, lateral	3. nasal
5. trill, flap	4. liquid
6. closed vowel	5. glides, high vowel
7. mid vowel	6. mid vowel
8. open vowel	7. low vowel

Figure XVIII: Hierarchy of Segment Types Based on Jespersen and de Saussure

differ in points of detail, but not in overall scheme, i.e., voiceless stop opposed to vowel. The traditional observations by Jespersen and de Saussure with regard to syllable structure and segment strength have been sharpened by Hooper into what is called the suitability hierarchy. The suitability hierarchy states that a converse relation holds between segment types in syllable initial and syllable final position. In observance of the suitability hierarchy, a voiceless stop would be the most expected segment type in syllable initial position and the least expected in syllable final position. Indeed, for Hooper (1976), it is a consequence of the distribution scheme within the syllable that positional and inherent strength are interrelated.

Before discussing further the interrelatedness of the two notions of strength, consider the notion of inherent segment strength. Concrete expression is given to segment strength in hierarchical or parametric arrangements of the sort postulated by de Saussure and Jespersen. That additional parameters will be required for the analysis of language has been noted by Lass's (1971) notion of secondary or positional strength. Henceforth in this dicussion the following distinction will be observed: a primary strength parameter will refer to the assignment of strength value based on segment type, voiceless stop, nasal, liquid, etc., and a secondary or positional strength parameter will refer to the assignment of strength value with regard to place of articulation within a segment type, bilabial b is stronger than velar g.

To return to the notion of inherent strength, Hooper (1976) claims that the arrangement on what is here called the primary strength parameter can be justified independent of syllable structure, i.e., position structure. Though Hooper's claim of independence may be justified, the examples she discusses may be reinterpreted as pointing to the potential dynamic, but principled, relation existing between segment strength and a more general notion of position strength. Consider the strength processes in Ijo and Pali discussed by Hooper.

In Ijo, a Nigerian language, the strength value of a syllable initial consonant within a word may not exceed the strength value of a word initial consonant. For instance, with regard to (2), if C_1 is a member of strength category A, then C_2 may be a member of strength category A, B or C. On the other hand, if C_1 is a member of strength category B, then C_2 may be a member only of category B or C, not A.

2. C_1 V C_2 V

What makes Ijo of interest is that the strength categories A, B and C fit nicely into the hierarchical scheme of inherent strength outlined by Jespersen and de Saussure.

Category A: Voiceless stop

Category B: Voiced stop

Category C: Nasal, liquid and glide

In a manner somewhat opposed to Hooper, strength assignment in Ijo may be interpreted as the outcome of an intersyllable process whereby the strength value of a segment occurring in a syllable initial position, that is word internal, is a function of the strength value of a segment occurring in a syllable initial position that is word initial. It may be detrimental to a comprehensive strength framework to discount the potential role of syllable positions other than those defined by an isolated syllable.

Thus far it has been suggested that the notions of inherent and positional strength are interrelated, but the complexities of that interrelationship remain untouched. The example of Pali discussed by Hooper (1976) reveals that the two notions of strength are not always in a state of equilibrium. In Pali, consonant clusters other than geminates and nasal plus obstruent fail to occur. Potential clusters, however, do occur when a morpheme with a syllable final consonant is adjoined to a morpheme with a syllable initial consonant. In the event of such an adjoined cluster, a process of assimilation occurs. The output of this assimilation process, despite Hooper's disclaimer, may be interpreted as dependent on position strength as well as inherent strength. The structure types upon which the assimilation process operates, with subscript value proportionate to strength value, are indicated in (3).

3. $C_1 . C_1$ $\quad C_1 . \ . \ C_1$

$C_2 . C_2$ $\quad C_2 . \ . \ C_2$

$C_1 . C_2$ $\quad C_2 . \ . \ C_2$

$C_2 . C_1$ $\quad C_2 . \ . \ C_2$

As revealed in (3), if the adjoined segments are of equal strength value or if the value of the segment in syllable initial position exceeds the value of the segment in syllable final position, the syllable final segment assimilates entirely to the syllable initial segment. If, in contrast, the syllable final segment is of greater value than the syllable initial segment, the syllable initial segment assimilates to the syllable final segment. Rather than claim that syllable position is not relevant here, it may be prudent to recognize Pali as an instantiation of Hooper's Intersyllable Condition. The principle underlying the Intersyllable Condition holds that in contiguous syllables, the strength

value of the syllable initial segment must not be less than the immediately preceding syllable final segment. (Hooper merely refers to what is here called the Intersyllable Condition as Condition 12.) When, as in Pali, the inherent value of a syllable final segment cannot be exceeded by strength values inherent to segment types in the language, the value of the syllable initial segment will increase. Hence, the Intersyllable Condition will not be violated. The strength process in Pali may be interpreted then, not as an instance where segment strength is independent of position strength but, rather, as the outcome of a conflict between inherent and position strength.

In order to relate position strength as defined by syllable structure to inherent strength, Hooper (1976) advances a network of a formal theoretical mechanisms. The Syllable Structure Condition (SSC) appears to be the pivotal mechanism. It specifies the segment strength values allowed in various intrasyllable positions. The segment value itself, in line with Hooper's proposed universal strength parameter, is assigned by a cover feature to each allophone of a language. The SSC functions to specify the conditions for syllable boundary placement and to motivate processes of segment insertion or of alternation in segment strength value. When required by the SSC, Universal Feature Redundancy Rules (UFRR), formulas which make explicit the strength relation between segments on the strength parameter, alter segment strength by changing the feature composition of a segment. Two principles, that of Identity and Minimal Feature Change, govern segment insertion and the feature changing capacity of the UFRR. The final mechanism to be considered is the Intersyllable Condition, mentioned earlier, which functions as a condition on the SSC and governs processes affected by a contiguous syllable. Taken from Hooper's discussion of Spanish, the SSC, the Intersyllable Condition and the corresponding strength parameter are depicted in Figure XIX.

The formal mechanisms briefly sketched above are implemented in Hooper's discussion of a strength process in Spanish. In Hooper's interpretation, syllable initial r is strengthened when preceded by a syllable final l. How is this strengthening accomplished? By means of a cover feature value derived from the strength parameter in Figure XIX, l is assigned a value of 3 and r a value of 2. The adjoining of l and r in such a contiguous syllable structure violates the Intersyllable Condition, where x must be of greater strength value than y.

4.
l	.	r
3		2
y		x

In order to correct this violation of the Intersyllable Condition, Hooper (1976) claims that feature values must be changed. Moreover, in keeping with the Principle of Minimal Feature Change, the manifestation of r in syllable initial position should differ, by as few features as possible, from its manifestation in other positions while attaining the

SYLLABLE STRUCTURE CONDITION (SSC)

. $C_m\ C_n\ C_p\ V\ C_q\ C_r$. where $n \leq 3$

if $n > 1$, m 6
$m > n$
$p, q = 1$
$r \leq 5$
$n > p$
$r > q$

INTERSYLLABLE CONDITION

XVC_y . C_X V where there is no pause between C_y, C_x

$x > y$

STRENGTH PARAMETER

			m		β	Y		f			
y			n	s	ð		r̃	b	p		
w	r	l	ɲ	x	ɣ	ɣʷ		d	t	č	
								g	k		
1	2	3	4	5	6			7	8		

Figure XIX: Formal Mechanisms Postulated by Hooper (1976) for the Analysis of Spanish

necessary strength value.

In Hooper's (1976) feature analysis of Spanish, non-trilled r is assigned the feature [-tense] and trilled r is assigned the feature [+tense] . Taking account of this feature difference, a UFRR formalizes the strength relation between trilled and non-trilled r. In the formula below, taken from Hooper, A represents a set of features constituting an archiphoneme.

$$\text{strength}\left(\begin{bmatrix} A \\ +\text{tense} \end{bmatrix}\right) > \text{strength}\left(\begin{bmatrix} A \\ -\text{tense} \end{bmatrix}\right)$$

Motivated by the Intersyllable Condition, non-trilled r with the feature [-tense] is manifested as trilled r with the feature [+tense] . Since trilled r is assigned a feature value greater than 1 on the strength parameter in Figure XIX, the Intersyllable Condition is no longer violated. Strength change, thus conceived, appears to be a process of feature value change.

As far as the Tswana strengthening process is concerned, Hooper's (1976) notion of position and inherent strength appears to find direct application. The twin notions of position and inherent strength allow the Tswana process to be defined as the outcome of conflict motivated by the Intersyllable Condition. A resolution of this conflict can be framed in terms of the postulated universal strength parameter found in Hooper (1976) and the Principle of Minimal Feature Change.

The Intersyllable Condition furnishes a potential motivation for the Tswana strengthening process. It provides an initial answer to one of the major questions set forth at the outset. The general why question can be answered by assuming a conflict exists between positional strength value, accorded syllable initial position relative to a preceding syllable final position, and inherent strength value, accorded the segment types occupying syllable initial and syllable final position. The more specific output question can be answered, tentatively, by assuming that the segment type nasal, in syllable final position, provides an absolute strength value that must be exceeded by the value of the subsequent syllable initial segment.

In accordance with the Intersyllable Condition and the other mechanisms postulated by Hooper (1976), an explication of the Tswana strengthening process might commence with an examination of the universal strength parameter postulated by Hooper. Immediately, however, the applicability of this universal parameter, depicted in Figure XXA, to the Tswana process is limited. Vowel segments, which function as input to the Tswana process, lack an assigned value in Figure XXA. A tentative value, justified by the more comprehensive strength parameters postulated in Jespersen, Saussure and Lass and Anderson (1975) can be assigned to the segment type vowel. The assigned value accordingly would be one unit less than that assigned to glide. Furthermore, since voiced fricative

has no phonemic status in Tswana, it can be eliminated from the present discussion of parameter value. (Notice that the Tswana parameter will be limited to the traditional phonemic segment, rather than to allophonic segments.)

A strength parameter which incorporates a value for vowel, illustrated in Figure XXB, still appears insufficient. Consider the manifestation of the segment l under the Tswana process and the Intersyllable Condition requirement that it be manifested as a segment with a strength value greater than the assigned value of the segment type nasal. The principle governing this manifestations, the Principle of Minimal Feature Change, would seem to allow s as the output of the Tswana process. However s is the incorrect output and must itself increase in strength value.

To account for the status of s, and for that matter voiceless fricative and voiced stop in general, one might assume that the Intersyllable Condition is basically correct and, therefore, that the primary strength parameter is not yet sufficient. Assuming that the segment type nasal provides the pivotal strength value called for by the Intersyllable Condition, the segment type nasal can be assigned a value one strength unit less than the various forms of voiceless stop. The assignment of nasal to a value less than that of voiceless stop and affricate appears justified since these types do not function as input to the Tswana process. Furthermore, the placement of nasal between voiceless stop and fricative does not appear wholely arbitrary. The overall structure of the parameter can be thought of as manifesting a degree of stopness. Recall Lass and Anderson's (1975) notion of strength involving resistance to airflow in the supraglottal tract.

The placement of the type voiced stop relative to the type nasal on a degree of stopness parameter is somewhat more problematic. Following the lead of Lass and Anderson (1975), the segment type voiced stop might be assigned a value, one unit greater than voiceless fricative. As required by the interpretation of the Intersyllable Condition as an absolute condition, voiced stop would also be assigned a strength value less than the type nasal. The result of incorporating certain aspects of the Lass and Anderson parameter into that of the Hooper parameter would result in Figure XXC.

The establishment of a tentative primary strength parameter has proved an uneasy task and one requiring assumptions of, as yet, questionable generality. Nonetheless, the strength parameter arrived at provides a structure for implementing Hooper's (1976) framework. In observance of the Principle of Minimal Feature Change, consider the segment nearest to the type nasal, the b segment. As predicted by the Principle of Minimal Feature Change and in agreement with the Tswana facts, b is strengthened to p'. Figure XXI sets forth the relevant feature specifications for the complement set of labial segments with a strength value greater than nasal. Since p' differs from b by only one feature specification, compared to two for ph, p' is the predicted strengthened alternate.

A	glide	liquid	nasal	voiced fricative	voiceless stop voiceless fricative	voiceless stop	
	1	2	3	4	5	6	
B	vowel	glide	liquid	nasal	voiceless fricative	voiceless stop	
	1	2	3	4	5	6	7
C	vowel	glide	liquid	vless fricative	vd stop	nasal	vless stop affric
	1	2	3	4	5	6	7 8

Figure XX: Strength Parameters Derived from the Discussion of Hooper (1976)

	b	p'	p^h
consonantal	+	+	+
sonorant	-	-	-
anterior	+	+	+
coronal	-	-	-
voice	+	-	-
continuant	-	-	-
tense	-	-	+

Figure XXI: Relevant Feature Specifications

Notice also that it is apparently only the place of articulation features that would constitute the Archiphoneme in the Universal Feature Redundancy Rules of Hooper (1976).

The Principle of Minimal Feature Change, in contrast to its correct prediction with b, fails to correctly predict the strengthened alternate for s. Figure XXII identifies the feature specification for s and the complement set of alveolar segments assigned a value greater than nasal.

	s	t'	th	ts'	tsh	tl'	tlh
consonantal	+	+	+	+	+	+	+
sonorant	-	-	-	-	-	-	-
anerior	+	+	+	+	+	+	+
coronal	+	+	+	+	+	+	+
voice	-	-	-	-	-	-	-
continuant	+	-	-	-	-	-	-
strident	+	-	-	+	+	-	-
del rel	-	-	-	+	+	-	-
tense	-	-	+	-	+	-	+
lateral	-	-	-	-	-	+	+

Figure XXII: Relevant Feature Specifications

Two segments, t' and ts', rather than one segment differ by a minimal number of features from s. However, neither of these two segments is the correct strengthened alternate for s. Compared to the difference of two feature specifications between s and the segments t' and ts', the required strengthened alternate, tsh, differs from s by three feature specifications.

The Principle of Minimal Feature Change fails also as it applies to the segment type liquid. In Figure XXIII are presented the feature specifications for the liquid segments and the complement set of alveolar

	r	l	t'	th
consonantal	+	+	+	+
sonorant	+	+	+	+
anterior	+	+	-	-
coronal	+	+	+	+
voice	+	+	-	-
continuant	+	+	-	-
strident	-	-	-	-
del rel	-	-	-	-
tense	-	-	-	+
lateral	-	+	-	-

Figure XXIII: Relevant Feature Specifications

segment types assigned a value greater than nasal. For the sake of argument, ignore what might be the segments with the greatest strength value, affricate. (Note that Hooper claims in her interpretation of Spanish that affricate is stronger than voiceless stop. This general interpretation, contrary to Lass and Anderson's (1976), has been followed in constructing the parameter in Figure XXC). What is of consequence in Figure XXIII for the Principle of Minimal Feature Change is its lack of predictability, namely it predicts as output the exact opposite of that required. Since r differs from t' by 3 feature specifications and from th by 4, the strengthened alternate of r should be t'. On the other hand, l differs from t' by 4 feature specifications and from th by 5, so the strengthened alternate of l would be t' also. Contrary to these predictions, the strengthened alternate required for r must be th and for l it must be t'. In order to avoid alternating both l and r with t', the Principle of Minimal Feature Change could ordain that r alternate with t' and l with th, since r differs from t' by fewer feature specifications than l does. This proposal, however, is directly contrary to the phonological facts.

The failure of the Principle of Minimal Feature Change to predict the strenghtened alternate for the segment types liquid and voiceless fricative should not be considered isolated instances, but instances revealing a fundamental inadequacy. To circumvent the failures outlined in the previous paragraphs, the manner in which the Tswana process applies to the primary strength parameter might be altered. The weakest segment type, vowel, might become subject to the strength process first. Initially this tact appears promising. It is promising if, in accordance with a secondary strength parameter, it is assumed that within the type voiceless stop, velar position is assigned the weakest value, and, furthermore, that the type voiceless stop is of weaker value than aspirated stop. Given these assumptions with regard to the order of strengthening and the structure of a primary and secondary strength parameter, the Principle of Minimal Feature Change would predict the insertion of k' before vowel. The issues raised by the segment types liquid and voiceless fricative, however, cannot be circumvented.

As a final measure to preserve a feature approach to the Tswana strengthening process, a more explicit recognition of the particular input and output segments of the process might be formulated. One could, first of all, provide each segment with a separate cover feature. A Feature Redundancy Rule might state the strength relations between specific segments and, hence, formally relate the input and output segments of the strengthening process. There is in this measure, however, no predictive value. It merely describes the fact that two segments are found in a particular relation without explicating the basic principle providing for that relation. In summary, an approach to the Tswana strengthening process derived from Hooper (1976) provides a potentially fruitful understanding of the motivation for the strengthening process, the Intersyllable Condition; nonetheless, it fails, by means of the Principle of Minimal Feature Change, to predict the relations underlying

the process.

The prime weakness of the approach to the Tswana strengthening process based on Hooper (1976) was its inability to predict the amount of strengthening undergone by a segment. This failure was a consequence of the apparent lack of a comprehensive strength principle. In Foley (1977) a possible comprehensive strength principle can be identified. Just as Hooper may be interpreted as providing a recharacterization of the Lass and Anderson (1975) notion of protection, so Foley may be interpreted as providing a recharacterization of Hooper's Principle of Minimal Feature Change.

The space provided here is insufficient for an adequate summation of the theoretical posture adopted by Foley (1977). A few words, nevertheless, seem called for. Foley, in contradistinction to classical generative phonology, assumes the set of distinctive features to be, not the basic elements of phonological theory, but a manifestation of those basic elements. In general, it is assumed in Foley that there is a set of universal rules which state the relationship of the basic phonological elements one to another. Governing these universal rules is a set of abstract principles. It is Foley's discussion of one such principle, the Inertial Development Principle, which appears applicable to the Tswana strengthening process.

According to Foley (1977), the internal structure of a phonological process, by which is meant the relationship of one segment of that structure to another, is revealed by the behavior of the phonological elements. Phonological processes, in turn, are governed by principles such as the Inertial Development Principle (IDP). The Inertial Development Principle assumes that phonological segments can be assigned values reflecting their relative inherent strength. In a similar manner it assumes that the position occupied by segments can be ranked as to their strength value. In the context of these two assumptions, the IDP stipulates that a process of the type strengthening applies preferentially and most extensively to a strong segment in a strong position. Likewise, the IDP stipulates that a process of the type weakening applies preferentially and most extensively to a weak segment in a weak position. The IDP, hence, specifically addresses itself to the relative order in which segments are subject to a phonological process and to the relative extent the segment value will strengthen or weaken. In addition to inherent and positional sources of strength, Foley recognizes strength as derived from the contiguity of elements. In a typical instance of assimilation, the contiguous placement of two segments may result, for one of the segments, in an increase in strength value.

At a more particular level than that of principle, Foley (1977) provides what might be viewed as tests for the assessment of strength value. As a test of position strength, the applicability of a particular process to a set of positions can be assessed. Consonant devoicing, for instance, typically occurs syllable finally, not syllable initially.

Some languages, German for example, exhibit consonant devoicing syllable initially as well as syllable finally. According to Foley, the German example illustrates the essential relational nature of the phonological system in that syllable initial devoicing is a generalization to initial position of the more typical syllable final devoicing.

As a test of inherent strength value, the behavior of a set of segments under a particular process in application to a particular position can be assessed. For instance, the intervocalic spirantization process as it applied in the development of the Indo-European languages did not apply in a symmetical manner to the segments g, d and b. Only g spirantized in some languages, g and d in other languages and g, d and b in still other languages. Spirantization failed to occur in yet other languages. In this regard, recall Lass and Anderson's (1975) discussion of the actuation issue. Foley (1977) argues that the asymmetrical patterning of phonological segments, as in the spirantization instance, reveals a relative strength value among those phonological elements, i.e., g is the weakest element, d the next weakest and b the strongest.

As a test of strength derived from contiguity, consider the effect of a nasal consonant on a preceding vowel. Of the set of vowels, the segment a is typically nasalized prior to other vowels. According to Foley (1977), a might be considered to be the strongest vowel. Moreover, since vowel nasalization is usually tautosyllabic, Foley allows for phonological processes that may be sensitive to conditions of syllable structure.

How does the Tswana strengthening process fair under these three tests of strength? The position test suggests that the Tswana process is indeed a strengthening process. It applies only to a syllable initial position. (More specifically though, the process applies to root initial position). Foley (1977) acknowledges syllable and word initial positions as those of greater strength value than syllable and word final positions. However, an example cited by Foley argues that syllable and word initial position may observe a strength relation. The reflex in Spanish syllable initial position of Latin w is b or β depending on word initial or word internal position, with word initial being the stronger position.

Latin	wiwo
Spanish	biβo

Consistent with this example, it may be suggested that root initial position is a position of strength with a value distinct from word or syllable position. In this regard, recall that the process in Ijo allowed elements of greater strength value in word initial position than word internal position. It may be that the motivation for the Tswana strengthening process should be sought as it applies to root initial position, not syllable initial position. No further stance will be taken on this matter until additional processes in Tswana have been examined.

Under the terms of the second test provided by Foley (1977) the inherent strength value of phonological segments in Tswana can be assessed. Contrary to what might be expected in a typical strengthening process, not all segment types are subject to the Tswana process, voiceless stop, affricate, lateralized stop and nasal for instance. The behavior of phonological segments with respect to the Tswana process might be taken, following Foley's procedure, to define the internal structure of that process and, hence, to define the strength parameter from which each strengthened alternate is derived. The proper assignment of strength value to the segment types on this parameter is not immediately evident however.

As a prelude to determining a strength parameter for Tswana, consider Foley's (1977) discussion of depotentiation, the manner in which segments are realized under the application of a phonological process. Two modes of depotentiation are advanced by Foley. Simple promotive depotentiation requires that a segment be strengthened to the next stronger segment on a parameter, usually an appreciation of one value unit. Modular depotentiation, maintaining the notion of incremental appreciation, allows a segment with the greatest strength value on a parameter to be realized as the segment with the weakest strength value. (The set of segments on a parameter thus observe a closure property).

Consider for the Tswana process the applicability of modular depotention to a revised version of the Hooper parameter. Since the forms of voiceless stop, affricate and nasal fail as input to the process, but function, in the case of aspirated and unaspirated voiceless stop and affricate, as output, these segment types could be assigned a low strength value. Therefore, a parameter might be arrived at in which the voiceless stop forms, affricate and nasal were assigned appropriately low values and the remainder of the parameter, from the segment types vowel to voiced stop, were assigned ascending strength values. The resultant parameter is represented in Figure XXIVA.

A	vless stop	affric	nasal	vowel	glide	liquid	vless fric	vd stop
	1	2	3	4	5	6	7	8

B	affric	vless stop	nasal	vd stop	vless fric	liquid	glide	vowel
	1	2	3	4	5	6	7	8

Figure XXIV: Strength Parameter

Two objections arise from the application of modular depotentiation to the parameter in Figure XXIVA. Compared to the parameters discussed by Foley (1977) and others, the parameter shown in Figure XXIVA reflects no coherent structure. Each of the parameters discussed by Foley can be viewed as a structured phonological quality, such as resonance or place of articulation. Secondly, the paramter in Figure XXIVA

implies that the strongest segment, b, would strengthen by one unit while a weaker unit, s, would strengthen by three units. The notion of preferential strengthening explicit in the IDP appears thus to be violated. For instance, the IDP asserts that the strongest segment, symbolized by b, should strengthen most extensively relative to other weaker elements such as s. To remedy the second of these objections the relative order of the segment types voiceless stop and affricate might be reversed on the strength parameter. The type liquid, still lower on the parameter than fricative, would nonetheless increase by four units compared to a two unit increase for fricative. As a final point it is not clear that a strict interpretation of modular depotentiation would allow any segment but that with the highest value on the parameter to strengthen in a modular mode.

As a more structured alternative to Figure XXIVA, but one to which a general notion of modular depotentiation could still apply, suppose the internal structure of the Tswana process to be based on a resonance parameter. The segment types voiceless stop and affricate would be assigned the weakest values and the segment type vowel the greatest value on a resonance parameter. The normal position of the type nasal on such a parameter, between liquid and fricative, is problematic since nasal does not strengthen in Tswana, and the type fricative does. Assume, for the sake of argument, that nasal is assigned a value as that shown in Figure XXIVB, between voiceless stop and voiced stop. This seemingly structured parameter is still inadequate, judged by the IDP. A strength process based on the parameter in Figure XXIVB violates the IDP by claiming that all strong elements in a strong position weaken.

The brief arguments brought against the parameters in Figure XXIVA and XXIVB suggest that a more adequate parameter might be one similar to the constructured in the discussion of Hooper (1976). Accordingly, the segment type vowel would received the weakest strength value and affricate and voiceless stop forms the strongest values. Furthermore, the placement of nasal on the Hooper parameter can be maintained following Foley's discussion of nasal structure. Foley postulates that the structure of a nasal is that of an affricate, i.e., stop closure and nasal release. The postulation of such a structure for nasal, reminiscent of Lass and Anderson's (1975) structural analysis of segments into a closure and release phase, seems to add further justification to the assignment of the type nasal to a value greater than that of the partial closure fricative. The relationship of nasal to voiced stop can only, at this moment in research, be inferred from their behavior in the Tswana strengthening process. In addition to the nasal strength value, a second aspect of the Hooper discussion, the Intersyllable Condition, appears compatible with Foley's (1977) general framework. Indeed, the Intersyllable Condition appears to be a more explicit formulation of Foley's general notion of contiguity strength.

Additional explicitness can be provided the primary and secondary parameters found in Hooper (1976) and Lass (1971) by means of still a

third strength parameter. This tertiary parameter, akin to Foley's (1970) notion of manner strength, defines a strength relation between segments of the same place and manner of articulation. The notion of a tertiary strength parameter has particular applicability to the Tswana strengthening process in that it allows a mode of further categorizing strength relations. A composite categorization of strength relations for Tswana, encompassing primary, secondary and tertiary parameters, might be dealt with the following fashion. Voiceless stop, incorporating aspirated and unaspirated forms, can be assigned a single strength value on a primary strength parameter relative to other segment types. On a secondary parameter, the positions at which the type voiceless stop is manifest, velar, alveolar and labial, would be assigned relative strength values. Finally, on a tertiary parameter within the primary and secondary parameters, unaspirated voiceless stop would be assigned a strength value, a weaker value, relative to aspirated voiceless stop. Other segment types can be dealt with in a similar fashion. For instance, the segment type liquid can be assigned a single value on a primary strength parameter, and the individual liquid segments can be assigned, on a tertiary parameter, their respective strength values. Based on Foley, the tertiary parameter within the type liquid would assign r a greater strength value than l. The composite strength hierarchy consisting of the primary, secondary and tertiary parameters suggested here to define the Tswana strengthening process is shown in Figure XXV. In Figure XXV the right-most-segment within each segment type is assigned the greater relative strength value.

	(w)		f	b		p',ph		
		l,r	s		tl',tlh	t',th		ts',tsh
	(y)		š				dž	tš',tšh
	h		x			k',kh		kxh
vowel	glide	liquid	vless fric	vd stop	nasal	lat stop	vless stop	affric
1	2	3	4	5	6	7	8	9

Figure XXV: A Strength Hierarchy Encompassing Primary, Secondary and Tertiary Parameters

Provided by Figure XXV with a tentative parametric structure for the Tswana strengthening process, the issue from the perspective of Foley is the compatibility of the parameter in XXV with the IDP. That is, is the IDP compatible with the fact that segments with the greatest strength value in positions of strength fail to strengthen while segments of lesser value do strengthen? Consider the IDP more closely, particularly as it pertains to order of strengthening and extent of strengthening.

The order sub-component implicit in the IDP is graphically outlined in Figure XXVI. As mentioned earlier, the IDP addresses itself to

	ELEMENT	POSITION	ORDER
1.	strong	strong	first
2.	weak	weak	first
3.	strong	weak	
4.	weak	strong	

Figure XXVI: Outline of the Order Sub-component

preferential strength order, strong segments in strong positions strengthen first. An analysis of the order sub-component does not preclude what might be termed differential strengthening, the strengthening of weak segments in strong positions or the weakening of strong segments in weak positions. The latter process is discussed by Foley in the example of the degemination of Latin kk to Spanish k. For the most part the IDP addresses itself to absolute agreement between inherent and position strength. In cases of conflict between inherent and position strength, such as that tentatively postulated for Tswana, the sub-component of order is no less viable. The order of strengthening instead of being sensitive to a strength value defined by the extreme value on the strength parameter, becomes sensitive to a relative value, a value equal to the segment type defining the differential condition. For Tswana, the strength value assigned to nasal has been established, tentatively, as the differential value. Differential strengthening, allowed for by the assumptions of the order-component of the IDP, does not seem to require that the IDP be violated.

As with preferential ordering, the preferential extent of strengthening required by the IDP does not appear violated under the proposal of differential strengthening. Figure XXVII depicts the outline of factors

	ELEMENT	POSITION	EXTENT
1.	strong	strong	more extensively
2.	weak	weak	more extensively
3.	strong	weak	
4.	weak	strong	

Figure XXVII: Outline of the Extent Sub-component

derived from the assumptions of the IDP relevant to the extent of strengthening. The IDP, as expressed by Foley, addresses only the absolute conditions governing the extent of strengthening: strong segments in strong positions strengthen more than weaker segments in strong positions and weaker segments in weak positions weaken more than stronger segments in weak positions. Configuration 1 and 2, where inherent and position strength agree, capture absolute conditions. Configurations 3 and 4 appear relevant to non-absolute, differential, instances of strengthening. Indeed Configuration 4 appears to define the condition existing in Tswana.

The tentative recognition of the Tswana strengthening process as an instance of differential strengthening, and the seeming compatibility of differential strengthening with the IDP, allow for the application of the IDP to the parameter in Figure XXV. To be more specific, the application of the two sub-components, order of strengthening and extent of strengthening, encompassed by the IDP is allowed for.

Application of the order sub-component to the parameter in Figure XXV seems to be straightforward. The order sub-component, under differential strengthening, claims that the first segment type assigned a value weaker than the differential value, that of the type nasal, would increase by a unit of value sufficient to exceed that of the differential value. Each segment type which is successively weaker would increase in strength value in a similar manner until all segment types weaker than that of nasal had strengthened.

The application of the extent sub-component also appears straightforward, except in the case of one segment type. Observing the extent sub-component, a segment type on a parameter would increase to a value proportionate with its initial strength value. That is, at output, the assignment of strength value resulting from a strengthening process should maintain among segment types the relative strength status that existed at input. The maintainence of relative strength status, in fact, obtains except in the case of b, the only voiced stop segment in Tswana.

A review of the effect of the Tswana strengthening process on each segment type, setting b in abeyance and assuming that place of articulation is a relative constant, seems in order. The segment type fricative maintains its strength status relative to other segment types. The alveolar fricative s, for example, consistent with its greater strength value below nasal, is strengthened by assignment to the alveolar affricate value, the greater strength value on the parameter in Figure XXV. Strengthening to the alveolar affricate value is not sufficient for the appropriate assignment of a strengthened alternate however. To achieve the required alternate, the segment s is assigned a strength value within the alveolar affricate value. In this second stage of the process, the segment would strengthen first and most extensively within the tertiary parameter at alveolar affricate. The stronger segment

within this parameter is the segment tsh, in agreement with the Tswana facts. The strengthened alternates for the remaining segments of the type fricate can be predicted in a similar manner. A further consequence of the apparent stage quality of the process to the parameter in XXV, and the notion of tertiary strength parameter, is that predictions about more complex strength processes can be made. For instance, if a language contained in respective parameters both z and s as well as ts' and tsh, and subsequently z and s become subject to a strength process, the predicted alternate of z would be ts', since z would be assigned within its tertiary parameter a weaker value than s, and the predicted alternate of s would be tsh.

The type liquid also appears to involve a two-stage process. The type liquid, consistent with the IDP, would alternate with a strength value at alveolar that is greater than that of nasal but less than that assigned to the strengthened alternate of the type fricative alveolar. The type liquid would thus be assigned to the type alveolar voiceless stop. The initial strengthened value assigned to liquid, as was the case with fricative, is insufficient to specify the strengthened alternates required. At alveolar voiceless stop, two alternates are possible. Abiding by the IDP, the Tswana process assigns the segment on the tertiary parameter at alveolar liquid with the greatest strength value to the segment on the tertiary parameter at alveolar voiceless stop with the greatest strength value. Since r is assigned the stronger value within the liquid tertiary parameter, it would alternate with th, assigned the stronger value within the tertiary parameter at alveolar voiceless stop. The segment l, with the weaker liquid value would alternate with t', the segment of weaker value within its tertiary parameter. Thus the two possible strengthened alternates are assigned in a principled manner to their respective non-strengthened segments.

The segment types glide and vowel perhaps can be considered together. As for glide, one can assume that w and y are manifestation of underlying vowel segments, u and i respectively, as has been the general practice within generative phonology. These glides, therefore, would not be available as input to the strengthening process. On the other hand, structural pressure, derivable from the limited output alternates available may have cause the glides w and y and their corresponding vowels u and i, to conflate as single units. Assitional research on Tswana may help clarify the character of the issues surrounding the behavior of glides.

Apart from the behavior of the glides w and y, the glide h would alternate with a value weaker than that assigned to the strengthened alternate of liquid but stronger than that assigned to nasal. Since liquid alternates with the alveolar value at voiceless stop, h should alternate with a weaker value. On the secondary strength parameter, velar is assigned a value weaker than that of alveolar. The segment h is thus assigned to the velar strength value at voiceless stop.

Turning for the moment to vowel, it appears that it would observe conditions of strength change similar to those for the glide h. The strength value of vowel should alternate with a strength value less than that assigned to the glide alternate but greater than that assigned to nasal, in effect it would be assigned to the velar value too. In observance of its weaker value relative to h, vowel must be assigned a value less than the glide h, not an identical value. The outcome of the required strength assignment is consistent with the IDP. As preferential strengthening ordains, the segment with the greater strength value would strengthen most. It follows that h would strengthen by alternating with kh, the strongest segment within the tertiary parameter at velar voiceless stop. The vowel segment would strengthen by the insertion of the velar segment of weaker value than kh, k'. In general it can be observed that successively stronger segments attributed a value less than the value assigned nasal, alternate with successively stronger segments attributed a value greater than nasal.

The complex functioning of the IDP to this point has left two issues untended. The first issue, already met briefly, pertains to the strength status of b. The differential interpretation of the IDP dictates that b alternate with a value greater than the strengthened alternate of a segment of less value than itself and greater than the value of nasal. In accord with the IDP and parameter XXV b ought to receive a value greater than f. In direct contrast, the strengthened alternate of b is of less strength value, based on the parameter in Figure XXV, than the laternate of f. This apparent problem could be offset by the assignment of voiced stop to a strength value one unit less than fricative. To restructure parameter XXV in such a fashion at the present stage of research in Tswana appears unprincipled. From another perspective, the apparent inconsistent strength alternate of b may reflect a more abstract relation existing between b and f. Since b has no corresponding alveolar or velar mate, it is structurally isolated compared to the fricative f. It is perhaps structural isolation that is signaled by the seemingly inconsistent behavior of b in the Tswana strengthening process. The conditions that could have led to the structural isolation of b can possibly be found in the historical development of Tswana. In this event, b might have acquired its present phonemic status some time after the onset of the strengthening process. With additional research this matter could be set on firmer ground.

A second issue, underscoring the whole phenomenon of strength assignment, pertains to the status of the type lateralized stop. Lateralized stop has herein been identified as a segment type of greater strength value than nasal but of less value than voiceless stop since it fails to alternate with a weak segment. The same might be said for dž, although the notion of tertiary strength parameter would appear to define the value of dž within palatal affricate. A thorough examination of additional processes in Tswana and other languages could possibly lead to a more principled understanding regarding the assignment of strength value to lateralized stop as well as other segment types.

Conclusion

What has been advanced herein is tentative in nature. It can be assessed by thorough exploration of the assumptions on which it is built. Foremost among these assumptions is the structure of the parameter in Figure XXV. If the notion of segment strength is to gain in substance then the dimensional structure underlying this parameter will require detailed probing. An additional assumption requiring careful exploration is the interpretation of the Intersyllable Principle as setting an absolute value that must be exceeded by weaker segment types. It is possible that the Intersyllable Principle provides, not an absolute value that must be exceeded, but a value to which other segments must maintain a proportionate strength value. In such an interpretation, nasal might assume its value between liquid and fricative on a descending resonance parameter. The Intersyllable Principle, then, might motivate a phonological process if the ratio between the value of nasal and some following segment type did not exceed a particular level. It is perhaps such a proportionate or relative interpretation of the Intersyllable Principle that may account for the other condition governing the Tswana strengthening process, a high toned high front vowel. In this regard it may be important to probe further into the behavior of vowels in strength processes in Tswana, and more specifically, into the behavior of high front vowels with high tone.

To summarize, the condition motivating a synchronic process in Tswana and the potential structure underlying that process were discussed. Two motivating conditions were identified: the morphological marker Reflexive and a syllabic nasal consonant. Restricting subsequent discussion to the nasal condition, it was seen that the structure underlying the process follows from two principles. The first of these, the Intersyllable Principle, in conjunction with a postulated relative strength value for the segment type nasal, appears to account for the fact that only a subset of the phonemic segments change in strength value. A second principle, the Intertial Development Principle, interpreted as consistent with the notion of differential strengthening, appears to account for the specific amount of strength change undergone by each of the segments in the subset. Though the tentative nature of the preceding must be stressed, it seems that investigation of phonological processes, by means of the notion "strength" may lead to an understanding of language structure that the notion of binary distinctive feature does not reveal.

Footnotes

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2 The term phonological process is used here in its generic sense and, consequently, does not reflect the distinction in Natural Phonology between processes and rules.

3 The data were collected in West Germany while the author was a Graduate Exchange student at Johannes Gutenberg Universitat, Mainz.

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