Stop Voicing and the Phonological Word in Dakota*

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1. Introduction

There are two different morphological constructions in Dakota[1], namely, Reduplications and Lexical Compounds (see Shaw (1980); Chambers & Shaw (1980)), which behave differently with respect to two phonological processes known as Coronal Dissimilation and Degemination. Reduplications obligatorily undergo these two processes while Lexical Compounds systematically do not (Shaw (1985)). The most significant attempt in the literature to account for this fact is the level-ordered lexical model proposed by Shaw (1985). This model, however, is unable to account for a third phonological rule of Dakota known as Stop Voicing, which, like Coronal Dissimilation and Degemination, applies only to Reduplications, and not to Lexical Compounds. Thus, the Stop Voicing rule has been left unexplained. Furthermore, the level-ordered model of Dakota lexical phonology also has problems of a more theoretical nature.

The purpose of this paper, then, is twofold. First, it will provide an account for the selective application of Stop Voicing by appealing to the notion of the phonological word as a prosodic constituent, as developed by Nespor & Vogel (1986). Second, it will be shown that the phonological word in Dakota, independently established in order to account for Stop Voicing, also defines the domain of application of Coronal Dissimilation and Degemination. Thus, the selective application of all three rules can be explained in terms of prosodic structure, without having to appeal to a level-ordered analysis of Dakota lexical phonology.

The organization of the paper is as follows. In § 2, I demonstrate how Coronal Dissimilation and Degemination apply to Reduplications but not to Lexical Compounds, and review previous accounts of this difference in behavior, concentrating in particular on the level-ordered model proposed by Shaw (1985). In § 3, I present the rule of Stop Voicing and discuss why it is undesirable to explain this rule either in terms of syllable structure or in terms of the level-ordered model under discussion. In § 4 I define the phonological word in Dakota and demonstrate that Stop Voicing, which was previously unaccounted for, can be explained in terms of prosodic structure. We will also see that Coronal Dissimilation and Degemination can be accounted for in terms of the phonological word, too, obviating the need to analyze the Dakota lexicon in terms of levels.

2. Coronal Dissimilation and Degemination

As noted above, two phonological rules of Dakota that apply to

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Reduplicated forms (Redups) but not to Lexical Compounds (LCs) are Coronal Dissimilation (Cor Dis) and Degemination (Degem).

Cor Dis dissimilates the [+coronal] non-continuants /t č l n/ to k before another [+coronal] segment. As can be seen in (1) and (2), Cor Dis applies to Redups, but not to LCs:

Reduplicated forms:

(1)	a. /zût/ → /zût-zût/	→	zûkzûta[2,3]	'be upright'
	b. /sut/ → /sut-sut/	→	suksuta	'be hard'
	c. /žat/ → /žat-žat/	→	žakžata	'be forked'
	d. /tʰeč/ → /tʰeč-tʰeč/	→	tʰektʰeča	'be new'
	e. /šič/ → /šič-šič/	→	šikšiča	'be bad'

Lexical Compounds:

(2)	a. /pʰet-nakpakpa/	→	pʰetnakpakpa[4]	'sparks'
	b. /wat-tete/	→	waltete	'gunwale'
	c. /slot-čʰiya/	→	slolčʰiya	'I know you'

As can be seen in (3) and (4), Degem, which deletes the first member of a geminate cluster, also applies to Redups, but not to LCs:

Reduplicated forms:

(3)	a. /xux/ → /xux-xux/	→	xuxuŋa	'to thunder'
	b. /sus/ → /sus-sus/	→	susuza	'to be cracked'
	c. /kʰak/ → /kʰak-kʰak/	→	kʰakʰaka[5]	'to rattle'
	d. /kʰok/ → /kʰok-kʰok/	→	kʰokʰoka	'to sound like wood'

Lexical Compounds:

(4)	a. /hâp-pahi/	→	hâppahi	'to collect moccasins'
	b. /čʰap-pʰat/	→	čʰappʰata	'to butcher beavers'
	c. /tʰok-k'u/	→	tʰokk'u	'to give over an enemy'
	d. /wat-tete/	→	waltete	'gunwale'
	e. /sič-la/	→	silla[6]	'to consider bad'

In the following section, we will review two previous accounts of the selective application of Cor Dis and Degem.

2.1 Previous accounts of the difference between Redups and LCs

2.1.1 Boundaries

Following Chambers (1978), Shaw (1980) accounts for the difference in behavior between Redups and LCs by positing the existence of two distinct boundaries[7] in Dakota. These are the morpheme boundary '+' (the "weaker" of the two) and the lexical derivation boundary '%' (the "stronger" of the two). It is postulated that the boundary linking the root which undergoes Reduplication (R_0) and the copied portion of the root (R_1) is the morpheme boundary, as shown

in (5):

(5) $R_0 \rightarrow R_0 + R_r$,

The boundary linking the stems of a Lexical Compound is the lexical derivation boundary, as shown in (6):

(6) $[\text{stem}]_1$ % $[\text{stem}]_2$

The fact that Cor Dis and Degem apply to Redups but not to LCs is captured in the formulations of these rules which make specific reference to the morpheme boundary '+':

(7) Coronal Dissimilation
/t č l n/ → k / __ + [+cor]

(8) Degemination
$C_\alpha \rightarrow \varnothing$ / __ + C_α

Given these formulations, the rules in question will selectively apply to Redups, which contain the '+' boundary, and crucially not apply to LCs, which contain the '%' boundary.

We will see in the following subsection, however, that the use of these different boundaries in the formulation of phonological rules was replaced by a level-ordered model of Dakota lexical phonology in Shaw (1985).

2.1.2. Lexical levels

Shaw (1985) accounts for the fact that Redups obligatorily undergo the processes of Cor Dis and Degem while LCs systematically do not by positing the existence of two separate levels in the Dakota lexicon. In her model, seen in (9)[8], Redups are on level I, with Cor Dis and Degem as level I phonological rules (operating on the output of Reduplication), while LCs are placed on level II:

(9) Shaw's (1985) model of Dakota Lexical Phonology

	morphology:		**phonology:**
Level I:	Reduplication	→	Coronal Dissimilation
		←	Degemination
Level II:	Lexical Compounding	→	Level II rules
		←	...

While Shaw sees the differential application of Cor Dis and Degem as evidence for the existence of level I and level II, there are at least three problems with this

level-ordered analysis.

The first problem is of a conceptual, or theoretical, nature. LCs are conceived of as being derived in the lexicon because they are "more or less segmentable morphologically; that is, at least one and sometimes both of their syllables are recognized as constituent morphemes" (Chambers & Shaw 1980: 326). Nevertheless, many of these stems are no longer meaningful in the language, and the meanings of LCs in general are not additive. In other words, the semantic contribution of each stem is not obvious. Thus, Shaw (1985: 180) states that "Lexical Compounds exhibit all the classic properties associated with earlier levels of the lexicon: frequent semantic idiosyncracy, less productivity, and tighter phonology." Although Shaw employs this characterization of LCs in her argument in favor of ordering Lexical Compounding on an earlier level than Syntactic Compounding (not represented in the model in (9)), we should also be able to utilize this characterization of LCs when comparing them to Redups. Note that Redups can be characterized as exhibiting properties associated with *later* levels of the lexicon: very little (or no) semantic idiosyncracy and more productivity. The theoretical problem with the level-ordered model under discussion, then, is that, given this characterization of LCs (less productive, semantically idiosyncratic) and Redups (more productive, semantically predictable), LCs should be placed on an *earlier* lexical level while Redups should be placed on a *later* lexical level, contrary to the organization posited in Shaw (1985). Thus, although this level-ordered model accounts for the differential application of Cor Dis and Degem, it is not clear that it is consistent with our standard assumptions concerning the organization of levels in the lexicon.

Furthermore, there are two empirical problems with the level-ordered analysis. First of all, it should be noted that LCs can undergo the process of Reduplication:

(10)

LC:	Redup:	
a. čʰo + k'î	čʰok'îk'î	'to roast in ashes'
('flesh' + ?)		
b. čʰo + kû	čʰokûkû	'to plan to kill s.o.'
('flesh' + 'to covet')		
c. čʰe + sli	čʰeslisli	'to defecate'
(? + 'to squeeze out')		

The level-ordered model in (9) incorrectly predicts that LCs cannot undergo Reduplication. Thus, this model cannot account for the data in (10). Secondly, as we will see in more detail in subsection 3.2, the level-ordered analysis cannot account for the selective application of a third rule of Dakota known as Stop Voicing.

3. Stop Voicing

The rule of Stop Voicing (SV) in Dakota spreads the voicing of a sonorant

leftward to a non-continuant within some (yet to be determined) domain:

(11)	a. /kluha/	→	gluha	'to have one's own'
	b. /pluha/	→	bluha	'I have'
	c. /kmikma/	→	gmigma	'to go round'
	d. /knaka/	→	gnaka	'to place'
	e. /kweza/	→	gweza	'lean; thin'

Shaw (1989) claims (in note 5) that the domain of this rule is the onset of a syllable. If we look at Redups, however, we see that SV applies heterosyllabically, as well:

(12)	Redup:		Cor Dis:		SV:	
	a. /lil-lil/	→	/lik-lil/	→	liglila	'very'
	b. /nič-nič/	→	/nik-nič/	→	nigniča	'to have none of'
	c. /lut-lut/	→	/luk-lut/	→	lugluta[9]	'to be red'
	d. /nak-nak/	→	---	→	nagnaka	'to twitch'

Given these facts, we can consider two options concerning the relationship between the syllable onset and SV: (i) adhere to Shaw's (1989) suggestion that SV only applies tautosyllabically, or (ii) reject the claim that the domain of SV is the syllable onset. In the following subsection we will discuss the implications of both options.

3.1 The relationship between syllable structure and SV

If we adhere to the claim that SV applies within the domain of the syllable onset, in order to account for the data in (12) we must follow a resyllabification analysis of the type proposed by Sietsema (1988). Sietsema asserts that Dakota does not allow *any* consonants in the syllable rhyme. He formulates a rule of Onset Formation, which basically syllabifies a coda consonant into the onset of the following syllable. In other words, C_2 in the reduplicated configuration $C_1VC_2C_3VC_4$ (i.e., the configuration seen in (12) above) is resyllabified so that C_2C_3 form the onset of the second syllable. Such an analysis would allow us to maintain the claim that SV applies within the domain of the onset.

There are, however, some problems with Sietsema's proposal that consonant codas resyllabify. First of all, as can be seen by the underlined clusters in (13), resyllabification after Reduplication would create onset clusters which are otherwise not permitted in Dakota[10]:

(13)	a. /xap-xap/	→	xapxapa	'to rustle'
	b. /kax-kax/	→	kaxkaŋya	'to make'
	c. /t'ax-t'ax/	→	t'axt'aŋya	'rough'
	d. /čʰep-čʰep/	→	čʰepčʰepa	'fat'

Second of all, if we follow Sietsema's Onset Formation analysis in order to support the claim that SV applies within the domain of the onset, we have no way of explaining why SV does not apply to LCs:

(14)	a. /šûk-manitu/	→	šûkmanitu *šûgmanitu	'wolf'
	b. /šûk-nuni/	→	šûknuni *šûgnuni	'mustangs'
	c. /tʰak-wohitike/	→	tʰakwohitike *tʰagwohitike	'he is eager to parch it'
	d. /šûk-luzahâ/	→	šûkluzahâ *šûgluzahâ	'race horse'

Given the forms in (14), we would have to make some *ad hoc* statement that resyllabification occurs with Redups but not with LCs. Thus, following a resyllabification analysis in an attempt to relate SV with the syllable onset raises problems which themselves require further explanation.

At this point we will reject the resyllabification analysis, and consequently the claim that SV applies within the domain of the onset. This leaves us with option (ii) above, namely, that the domain of SV cannot be defined in terms of the syllable onset. The domain of application of this rule, however, still remains to be explained. In the following subsection, we will see that the fact that SV applies to Redups and not to LCs cannot be explained in terms of the level-ordered model, either.

3.2 The relationship between level-ordering and SV

Recall that Shaw (1985) accounts for the selective application of Cor Dis and Degem by postulating that Redups are at level I, with Cor Dis and Degem as level I rules, while LCs are at level II. We have seen in (12) and (14) above, however, that SV, just like Cor Dis and Degem, applies to Redups (12), but not to LCs (14). One might ask, then, whether the level-ordered model can account for this selective application of SV, given that this model can account for the same sort of selective behavior of Cor Dis and Degem.

Shaw (1989: note 18) provides a convincing argument for why SV must not apply in the lexicon. In Dakota, voiced obstruents are not permitted in onset clusters or in coda position (see note 10). It should be noted that these are lexical constraints, and, under the assumption that Structure Preservation operates lexically (Kiparsky 1985), SV should not apply in the lexicon, although it may apply post-lexically. Furthermore, adhering to a theory of radical underspecification, we can assume that sonorants are voiced redundantly, and as such have no lexical specification for [voice]. Because sonorants are not specified for [voice] in the lexicon, they are not even *able* to spread this feature until it is filled in, presumably post-lexically. Given these theoretical arguments, it appears that SV must be considered to be a post-lexical rule.

This is the second empirical problem with the level-ordered model, briefly mentioned at the end of subsection 2.1.2. That is, although the level-ordered

model accounts for the selective application of Cor Dis and Degem, it cannot be used to account for the identical behavior of SV, which, as we have just seen, must be considered a post-lexical rule. Thus, until this point we have not encountered an adequate account of this rule. In the following section, I will propose an analysis of Dakota phonology which not only accounts for the selective application of SV, but which also accounts for the selective application of Cor Dis and Degem.

4. The phonological word in Dakota

In the theory of Prosodic Phonology, originally proposed by Selkirk (1978) and further developed by Nespor & Vogel (1986), a particular string is considered a prosodic constituent if there are rules which refer to this string or have this string as their domain of application. In other words, prosodic constituents define the domains of application of phonological rules, which may apply:

(15) a. within a constituent (*domain span rules*);
b. at the edge of a constituent (*domain limit rules*);
c. at the juncture between two constituents of the same type (*domain juncture rules*)

The particular prosodic constituent we are concerned with in this paper is the phonological word (PW). Following the theory of Prosodic Phonology, I propose that the PW in Dakota is defined in terms of a single stem plus any linearly adjacent suffixes[11]. It should be noted that this configuration of the PW exists in many other languages as well (see Nespor & Vogel (1986) for evidence of this configuration of the PW in Hungarian and Italian, and Hannahs (1991) for evidence of this configuration in French). Given this definition of the PW in Dakota, let us now determine the prosodic structure of Redups and LCs.

It has been argued both by Marantz (1982) and McCarthy & Prince (1986) that reduplication rules are normal affixation processes. Marantz specifically analyzes Dakota reduplication as suffixation of a CCVC reduplicating skeleton. Shaw (1980) sees Dakota reduplication as suffixation of a copy of the root-final syllable. However we wish to characterize the constituent being copied, we can conclude that Dakota reduplication involves suffixation to a stem, so that the output of reduplication consists of a [stem + suffix]. Thus, in prosodic terms, Dakota Redups are defined as single PWs, as illustrated in (16):

(16)	stem:	Redup:	
	a. ûspe	$[[\text{ûspe}]_{stem}+[\text{spe}]_{suf}]_{PW}$	'to learn'
	b. hâska	$[[\text{hâska}]_{stem}+[\text{ska}]_{suf}]_{PW}$	'to be tall'

LCs, on the other hand, as noted in section 2.1.2, consist of two stems (Boas & Deloria (1941); Shaw (1980); Chambers & Shaw (1980)). Thus, given

our definition of the PW in Dakota, LCs must be defined prosodically as consisting of two separate PWs, as illustrated in (17):

(17)			
	a. $\check{c}^h$exzi	'brass kettle'	=
	$[[\check{c}^h\text{ex}]_{stem}]_{PW}+[[\text{zi}]_{stem}]_{PW}$	(kettle-yellow)	
	b. $\check{c}^h$âha	'bark'	=
	$[[\check{c}^h\text{â}]_{stem}]_{PW}+[[\text{ha}]_{stem}]_{PW}$	(wood-skin)	

In this section we have defined the PW in Dakota, and proposed that Redups form a single PW, while LCs form two separate PWs. Now let us see how defining the PW in Dakota allows us to account for the SV rule.

4.1 An analysis of SV in terms of the PW

We have seen (section 3) that SV applies to Redups, but not to LCs. We have also seen that the selective behavior of this rule cannot be explained in terms of syllable structure (section 3.1), nor by appealing to a level-ordered model (section 3.2). However, defining the PW in Dakota allows us to account for SV in terms of prosodic structure. Let us reanalyze some of the Redup examples from (12), repeated here as (18), and see how SV applies in relation to their prosodic structure:

(18)	Redup after Cor Dis:	SV:		
	a. $[\text{lik}+\text{lil}]_{PW}$	$[\text{lig}+\text{lil}]_{PW}$	→	liglila
	b. $[\text{nik}+\text{nič}]_{PW}$	$[\text{nig}+\text{nič}]_{PW}$	→	nigniča
	c. $[\text{luk}+\text{lut}]_{PW}$	$[\text{lug}+\text{lut}]_{PW}$	→	lugluta

Let us also reanalyze some of the LC examples from (14), repeated here as (19), in terms of their prosodic structure:

(19)	LC:	SV:		
	a. $[\text{šûk}]_{PW}+[\text{manitu}]_{PW}$	---	→	šûkmanitu
	b. $[\text{šûk}]_{PW}+[\text{nuni}]_{PW}$	---	→	šûknuni
	c. $[\text{šûk}]_{PW}+[\text{luzahâ}]_{PW}$	---	→	šûkluzahâ

As can be seen, SV applies within a PW (18), but not between two PWs (19). To account for this selective behavior of SV, I propose that SV is a *domain span rule* (15a), with the PW as its domain of application:

(20) Stop Voicing
$[\text{-cont}] \rightarrow [\text{+voi}] / [\ldots \_\_ [\text{+son}] \ldots]_{PW}$

Rule (20) allows us to account for the fact that SV, a post-lexical rule, selectively applies to Redups but not to LCs, a fact previously unaccounted for. Furthermore, as we will see in the next subsection, defining the PW in Dakota

allows us to account for the selective application of Cor Dis and Degem in terms of prosodic structure, too.

4.2 Further motivation for the PW: Cor Dis and Degem reanalyzed

To show that the PW, as defined above, is not an *ad hoc* solution that can only be used to explain the selective behavior of SV, I will show that it also defines the domain of application of Cor Dis and Degem.

Let us reexamine some of the Redups that undergo Cor Dis (examples from (1), repeated here as (21)) in terms of their prosodic structure:

	Redup:	Cor Dis:		
(21) a.	[zût+zût]$_{PW}$	[zûk+zût]$_{PW}$	→	zûkzûta
b.	[šič+šič]$_{PW}$	[šik+šič]$_{PW}$	→	šikšiča

Let us also reexamine some of the LCs from (2), repeated here as (22), in terms of their prosodic structure:

	LC:	Cor Dis:		
(22) a.	[p^{h}et]$_{PW}$+[nakpakpa]$_{PW}$	---	→	p^{h}elnakpakpa
b.	[slot]$_{PW}$+[č^{h}iya]$_{PW}$	---	→	slolč^{h}iya

As can be seen, Cor Dis applies within a PW (21), but not between two PWs (22). As with SV, I propose that this selective behavior of Cor Dis can be captured by defining Cor Dis as a domain span rule, with the PW as its domain of application:

(23) Coronal Dissimilation
/t č l n/ → k / [... __ [+cor] ...]$_{PW}$

Note that rule (23) allows us to account for the fact that Cor Dis applies to Redups but not to LCs, without having to make reference to morphological structure.

An analysis of Redups and LCs in terms of prosodic structure also allows us to reanalyze Degem as a rule which makes reference to phonological structure rather than to morphological structure. Note that Degem, too, applies within a PW (24), but not between two PWs (25):

	Redup:	Degem:		
(24) a.	[xux+xux]$_{PW}$	[xu +xux]$_{PW}$	→	xuxuŋya
b.	[sus+sus]$_{PW}$	[su +sus]$_{PW}$	→	susuza
c.	[k^{h}ak+k^{h}ak]$_{PW}$	[k^{h}a +k^{h}ak]$_{PW}$	→	k^{h}ak^{h}aka

	LC:	Degem:		
(25) a.	[hâp]$_{PW}$+[pahi]$_{PW}$	---	→	hâppahi
b.	[č^{h}ap]$_{PW}$+[p^{h}at]$_{PW}$	---	→	č^{h}app^{h}ata
c.	[t^{h}ok]$_{PW}$+[k'u]$_{PW}$	---	→	t^{h}okk'u

Thus, like SV and Cor Dis, Degem is a domain span rule, with the PW as its domain of application:

(26) Degemination
C_{α} → ∅ / [... __ C_{α} ...]$_{PW}$

Again, the formulation in (26) allows us to account for the fact that Degem applies to Redups but not to LCs, without having to make reference to morphological structure.

5. Conclusions

Let us review some of the consequences of the analysis presented in this paper. First and foremost, defining the PW in Dakota has enabled us to provide an account for the rule of SV, which was not adequately treated previously. SV is seen as a domain span rule, with the PW as its domain of application. Furthermore, given the configuration of the PW proposed for Dakota, we are also able to reanalyze Cor Dis and Degem as rules which make reference to prosodic structure, as well, with the PW as their domain of application.

This reanalysis in turn has several advantages. First, the generalization that all three rules (SV, Cor Dis, and Degem) apply selectively in the same way is captured. Second, by accounting for the selective application of these rules in terms of prosodic structure, we obviate the need for lexical levels. This is a significant advantage, since, as we saw in subsection 2.1.2, there are both theoretical and empirical problems with the level-ordered analysis. Finally, while it is not clear what the cross-linguistic correlates of the lexical levels discussed in this paper might be, we find that the configuration of the Dakota PW proposed herein exists in many other unrelated languages, as noted above. Thus, by proposing that SV, Cor Dis, and Degem make reference to phonological structure rather than morphological structure, we are able to capture a greater cross-linguistic generalization.

Footnotes

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1. The particular language discussed in this paper is Teton Dakota Sioux, also known as the "L-dialect" of Dakota, or "Lakota." Although "Lakota" is probably a more accurate term, the term "Dakota" is used for the sake of consistency with the literature.

2. The graphemes a̱, i̱, and u̱ are used to denote the nasal vowels of Dakota.

3. A rule of a̱-epenthesis inserts an -a̱ after the final consonant of a CVC stem in word-final position.

4. In the examples in (2), /t/ → l by Coronal Lenition, which applies under different conditions from Cor Dis (see Shaw 1980).

5. Note that aspiration (as well as glottalization) is irrelevant to the establishment of the identity of geminates.

6. /č/ → l by Coronal Lenition (see note 4).

7. Actually, Shaw discusses four different boundaries, but only two of them are relevant to the present discussion.

8. I have greatly simplified Shaw's model for the purposes of this paper, including only the levels and rules that are relevant to the present discussion.

9. As Shaw (1980) points out, Beuchel (1970) gives two alternative reduplicative forms for /lut/: lugluta and luluta. Shaw suggests that luluta is derived by ordering Coronal Lenition before Degemination:

Redup:	/lut-lut/
Cor Len:	/lul-lut/
Degem:	/lu -lut/ → luluta

It should be noted that in Shaw (1985) it is claimed that Coronal Lenition is a post-lexical rule. If this is the case, the model of Dakota lexical phonology under discussion cannot account for alternative Redup forms such as luluta.

10. The following is a list of permissible onset clusters:

pt, pč, ps, pš, pl (→ bl), pn (→ mn)
tk
kp, kt, kč, ks, kš, ; kl, km, kn, kw (→ gl, gm, gn, gw)
sp, st, sč, sk, sl, sn, sm, sw
šp, št, šk, šl, šn, šm, šw
xp, xt, xč, xl, xn, xm, xw

The following is a list of impermissible onset clusters:

pk, px, pm, pw
tp, tč, ts, tš, tx, tl, tn, tm, tw
kx
sš, sx
šč, šs, šx
xk, xs, xš

Furthermore, aspirates, ejectives, voiced obstruents, and the glottals [h] and [ʔ] do not cluster in onsets.

11. At this point we will only be concerned with defining [stem + suff] as a PW in Dakota. Whether or not the prefix can be defined as a separate PW in Dakota is a matter for further research.

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