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Martha Wright  
*University of Illinois*

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## THE CV SKELETON AND MAPPING IN NAVAJO VERB PHONOLOGY

MARTHA WRIGHT

UNIVERSITY OF ILLINOIS

This paper will argue for a simplification of Navajo verb prefix phonology which is possible only with the use of a device such as the CV skeleton. The paper will suggest that a solution to a cluster of seemingly unrelated problems falls out if we assume two specific points about mapping in Navajo.

The two points argued for will be as follows: 1) First of all, Navajo allows mapping of two segments to a possible C position at the prefix-stem boundary, not only yielding affricates as expected by previous proposals, but also yielding apparent single fused consonants with output determined by a feature hierarchy. 2) In Navajo, there exist floating consonants which come about most often by the syllabification rules causing a slot to which a consonant has been linked to become specified as a vowel slot. The clear diagnostic for floating consonants will be the appearance of e in the prefix forms, although certain other rules obscure this.

The problems which this approach helps to illuminate include: 1) the various consonantal changes including devoicing and "d-effects" at the prefix-stem boundary for the full range of verb forms; 2) the special coda changes which occur in the si-perfective forms; 3) vowel length changes in perfectives and futures; and 4) the appearance of e and o in certain forms, which had been irregular in previous analyses.

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The arguments of this paper can be outlined as follows: 1) We examine the consonantal changes at the prefix-stem boundary first. These changes and the analysis set up the first arguments for the double linking of consonants. 2) We examine simple si perfective forms, which can be analyzed via the floating consonant approach, and we see the first appearance of e here in those places where consonants are argued to float.

We then examine more complex verb forms, which show a choice of two or more aspectual prefixes, including inceptive si-perfectives and future forms. These had required certain ad-hoc readjustment rules in Kari's (1973) previous analysis. The particular problems of consonantal loss, vowel length and vowel quality of these forms will follow here from the syllabification rules and consonant floating. Here the appearance of e and o follows naturally from rules needed for simpler forms.

1.0 Preliminaries

Since the syllabification rules and syllable types figure crucially in the discussion, before starting in on verb forms, we need to examine syllable questions for Navajo. Possible syllable types which occur everywhere in Navajo include CVC, CVVC and CVV. We also have n and nC ~ niC everywhere and these will be treated as special cases of CVC. CV appears to be missing from the basic inventory except in special pre-final positions, not relevant to the questions here. The distribution of syllable types is shown in (1), with data drawn from Sapir-Hoijer (1967).

(1) Distribution of syllable typesa. Everywhere

CVC  
CVV, CVVC  
n (except # \_\_ #)  
nC ~ niC

b. Word-final and stipulation

ʂ, ʂh, zʂ, ɬ /CV(V)? . \_\_ #  
V /CVV . \_\_ #  
VV /CV . \_\_ #  
CV / \_\_ VV#

In the standard orthography which will be used here, many words are written with apparent CV syllables, but as noted by Sapir-Hoijer, these apparent CV types undergo two changes, as shown in (2). In final position, an h coda is added to CV syllables (and also to CVV types); and 2) Before a C initial syllable, the initial syllable of the second syllable geminates.<sup>1</sup> [ ] will mark an inserted segment throughout the discussion.

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(2) a. tó [txwóh]<sup>2</sup> 'water'  
 tó.ń.lí [txwó.ń.líh] 'river'  
 gah 'rabbit'  
 gah.go 'being a rabbit'

b. tą.żii [txaź.żiih] 'turkey'

An inventory of vowels, tones and consonants is shown in (3). We will return to possible surface consonants shortly.

(3) Navajo Consonant Inventory

	VL Stop/Aff Unasp	VL Stop/Aff Asp	VL Stop/Aff Glottal.	VL Cont	VD Cont	Nasal ∅	Nasal ?
Labial	b					m	'm
Alv.	d	t	t'			n	'n
	dz	ts	ts'	s	z		
	dl	tł	tł'	ł	l		
Palatal	j	ch	ch'	sh <sub>3</sub>	zh		
Velar	g	k	k'	h(=x) <sup>3</sup>	gh		
Laryn.			?	h			

Glides: y, w, 'y, 'w ( ? often used rather than ' )

Navajo Vowel System

	Front	Back
High	i	o
Low	e	a

Tones

High	Low
´	Unmarked

Nasalization: Ṿ

(o varies in position between u → ə).

One should note that not all consonants can appear in both onset and coda position. Onsets can be any consonant. Codas can only be the group shown in (4).

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(4) Possible Codas<sup>4</sup>

s, z, ɬ, l, sh, zh, h  
 (d, n, g, ?)

d, n, g and ? have been indicated in parentheses. We do find these word finally, but we have seen in (1) that we find various types of segments that that ordinarily do not occur linking up in word-final position. Thus, these could be linked up by special extrasyllabic rules, necessary in any case to derive the other final possibilities. Since we are treating only word-internal processes in this paper, we will not pursue final-consonant extrametricality further here, but simply stipulate that word-internally, codas can only be [+continuant], as illustrated in (4).

1.1 Navajo Verb Prefixes

The Navajo verb forms that will be discussed here consist of a stem with preceding prefixes expressing aspect, subject marking, etc. Previous analyses suggest that the prefixes have somewhat varying status in phonological rules; cf. Stanley (1969) and Kari (1973). Kari argues against the large number of boundaries posited by Stanley, and divides the prefixes into classes filling ten pre-stem 'slots' with a division into 'disjunct' prefixes (slots 1-3), then a single boundary marker #, then 'conjunct' prefixes (slots 4-10). We will be using a modification of Kari's system here and (5) shows this system, with almost the full array of possible prefixes.

(5) Navajo Verbal Prefixes

Disjunct			Conjunct							
1	2	3	4	5	6	7	8	9	10	[STEM
ADV	-ITĒR	-PLUR	#	OBJ-DEICTIC	-ASPECT	-MODE	-PERFECT	-SUBJ	-CLASS	Form 1
(25-30)	<u>ná</u>	<u>da</u>	shí	?i	di...	∅	<u>í</u>	sh	∅	∴
	na		ni	ji	hi	ghi		ni	ɬ	
	ch'i		nihí	<u>hwi</u>	ni...	ni		iid	l	<u>Form 5</u>
	<u>ná</u>		∴		dzi	si		<u>oh</u>	<u>d</u>	
	cho		<u>∴</u>		si	<u>ó</u>				
	∴				∴					

(Underlining marks end of set; di... etc. stands for various morphemes sharing the same shape.)

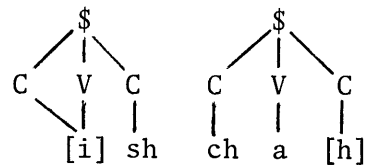
Several things can be noted about this chart. First of all, note that with the exception of ó, 'optative' in position 7, and oh '2nd dual subject' in position 9, all vowels posited for underlying forms of conjunct prefixes are i. Disjunct prefixes have the full range of vowels.

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Furthermore, note that we need an i-insertion rule for Navajo in any case. (6) shows a first person imperfective of the verb 'to weep', a form which 'chooses'  $\emptyset$  from slot 7, plus subject sh. We will need a vowel insertion rule, plus glide formation. Here we assume the smallest possible syllable -- a CVC syllable -- for the aspect form chosen, with sh mapped to coda, i-insertion filling the V slot, and glide formed by association of i to the onset slot.

(6) Underlying form

7 - 8 - 9 - 10 - STEM  
 $\emptyset$  sh cha



Output: yishcha[h]

Let us suggest that the conjunct prefixes have underlying forms without specified vowels. (0 optative presents special problems, and will not be treated in this analysis). The o of second dual, however, need not be indicated in underlying form and can be derived via a special case of vowel insertion. The rule can be informally sketched as "insert back vowel in front of back consonants" or "inserted vowel becomes o in front of back consonants."

1.2 The Prefix-Stem Boundary

We now shift to the first problem at hand -- the consonantal changes at the prefix-stem boundary. We have seen that there is a 'prefix' syllable, as shown in (6) with sh mapped to the coda. The prefix syllable coda is formed from positions 9 or 10. At the boundary, then, we have three underlying consonants, and on the surface, at most two consonants appear. Positions 9 and 10 'compete' for the coda position of the prefix syllable, and d, a [-cont] segment, does not appear on the surface as a coda. The underlying consonants involved are shown again in (7).

(7) Position #

...	9 <u>SUBJ</u> <sup>5</sup>	10 <u>CLASS</u>	[ <u>STEM</u>
	1s-sh	ɬ	CV...
	1d-d	l	∅V...
	2d-h	d	
	3,4-∅ <sup>6</sup>	∅	

This 'competition' has two effects -- the so-called 'd-effect' and stem-initial devoicing complications. We deal with the d-effects first, and break down the description into two parts.

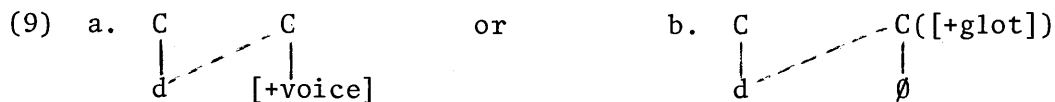
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The first-effect of d is on stem-initial nasals, voiced continuants and ?. Representative data is shown in (8) and includes a mixture of d classifier and d-subject+∅ classifier.

(8) D-Effects on Stem-Initial Consonants

Underlying form (as per tradition, with vowels)							
	<u>Pre-SUBJ</u>	<u>SUBJ</u>	<u>CL</u>	<u>STEM</u>	<u>OUTPUT</u>	<u>GLOSS</u>	<u>GRAM.NOTES</u>
a. <u>?</u>	biza-ni	∅	d	?aah	bizanit'aah	'kiss her'	3s imp.
b. <u>z</u>	di	∅	d	zih	didzih	'breathe'	3s imp.
c. <u>∅</u>	1. (y)	∅	∅	á	yi <sup>á</sup>	'eat'	3s imp.
		iid	∅	á	yi <sup>iá</sup>		1d imp.
-----							
d. <u>m</u>	1.	∅	∅	mas	yimas	'arrive	3s prog.
		∅	∅	mas	yii'mas	walking'	1d prog.
e. <u>gh</u>	'ahi	∅	d	ghah	'ahigáh	'kill each other'	3s imp.

The forms in (8a-b) show most clearly a doubly linked consonant, and (8a-c) can be treated together as derivable by adding an association line linking d to a following onset position as in (9a-b).



The forms in (8d-e) can be treated together. In these cases we can say that the same linking as in (9) occurs, yielding the doubly linked C's as in (10).



However, dm and dgh are not possible affricates of the language and they will undergo distortion to result in a possible surface form. We assume here that the [-cnt] feature becomes transferred or linked to the following consonant with the remainder of the d features not surfacing.

Thus, hardening of the stem initial will be done by double-linking in

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in all cases. If the doubly-linked consonant is a possible surface affricate, all features are retained; otherwise the doubly linked consonant is distorted to an allowable surface consonant. This way of looking at things then leads us to the more interesting part of the d-effect, i.e. that involving the interaction of d-subject from position 9 and l or ɬ classifier from position 10. Examples of d-effect in these cases is shown in (11).

(11) Examples of Subject-Classifier D-Effects

Type	Traditional	Underlying form	Output	Gloss
a. STEM C VD	∅	+ iid + ɬ + ghozh	yiilghozh	'tickle him, imp.'
STEM C VL	d.	+ iid + ɬ + baaɬ	diilbaaɬ	'hang it, imp.'
b. STEM C VD	∅	+ iid + l + ghal	yiilghal	'eat it(meat)', imp.
STEM C VL	∅	+ iid + l + deeɬ	yiildeeɬ	

The first problem that concerns us here is that we do have a prefix coda, l in all cases. This is not surprising in the (11b) forms, but the appearance of voiced l from underlying ɬ occurs only with 1st dual forms; we have in effect a 'fusion' of two voiceless consonants, d and ɬ yielding a voiced l. Furthermore, we will see in the next section that ɬ classifier usually devoices a following voiced consonant. In (11a) we see a voiced stem initial remaining voiced.

The analysis here will be that the same process is at work as with doubly linked onsets. We have seen that if we have a doubly-linked onset such as d-m, this becomes distorted to an allowable surface consonant. Navajo has no dɬ, but does have dl. Once linked, dɬ becomes dl. However, once syllabification occurs, dl is in a coda position, and only continuant consonants can be codas; thus only the l section of the dl surfaces. The actual surfacing of doubly linked codas and rules for this need to include the remaining forms, and so we examine this problem.

Relevant data for sh/h subjects and l/ɬ classifiers is shown in (12).

(12) Devoicing effects

	Traditional underlying forms			OUTPUT	GLOSS	GRAM NOTES
	PRE-SUBJ	SUBJ	CL STEM			
a.		sh	∅	ghozh	yish hozh	'be ticklish' 1s imp.
		∅	∅	ghozh	yi gh <sup>h</sup> ozh	3s imp.
		oh	∅	ghozh	woh hozh	2d imp.



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(12) cont.

	<u>PRE-SUBJ</u>	<u>SUBJ</u>	<u>CL</u>	<u>STEM</u>	<u>OUTPUT</u>	<u>GLOSS</u>	<u>GRAM NOTES</u>
b.		sh	ɿ	ghozh	yish h <sub>o</sub> zh	'to tickle'	1s imp.
		∅	ɿ	ghozh	yiɿ h <sub>o</sub> zh		3s imp.
		oh	ɿ	ghozh	woɿ h <sub>o</sub> zh		2d imp.
c.	ha-	sh	l	zheeh	haash z <sub>h</sub> eeh	'to hunt it'	1s imp.
	ha-	∅	l	zheeh	haal z <sub>h</sub> eeh		3 imp.
	ha-	oh	l	zheeh	haoɿ z <sub>h</sub> eeh		2d imp.

We can see that if there is no classifier in the coda of the pre-stem syllable, then sh or h causes devoicing of the following stem-initial consonant. ɿ has the same effect as shown in (12b). However, in (12c), we can see that an underlying voiced l between the subject prefix and stem initial consonant blocks the devoicing process even though it does not surface. This was accomplished in previous analyses by rule ordering, but we have already suggested that we have doubly linked consonants in the coda position, giving voiced l from voiceless d+ɿ. We use this double mapping again here, and suggest that the devoicing rule applies to adjacent elements on the melody tier. To see how this works, consider the mappings in (13).

(13)	(12a)	1s	C	V	C	[C	V	C	(12c)	1s	...V	C	[C	V	V	C	
			∖	/	∖	/	∖	/				∖	/	∖	/	∖	/
			[i]	sh	ɿ-gh	o	zh					sh	l-zh	e	h		
	Output:		yish hozh					haash zeeh									
		2d	C	V	C	[C	V	C		2d	...V	C	[C	V	V	C	
			∖	/	∖	/	∖	/				∖	/	∖	/	∖	/
			[o]	h	ɿ-gh	o	zh					h	l-zh	e	h		

If devoicing is done on the melody tier, (12a) will be subject to devoicing, and (12c) will not be, even though on the surface, identical codas appear.

Given the doubly-linked consonants, we need a principled way of determining what features surface. A hierarchy for feature realization can be stated as in (14).

(14) Coda Hierarchy

- [+cont] > [-cont]
- [+coronal] > [+strident] > [-coronal]
- [-voice] > [+voice]

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Thus far, the coda hierarchy is simply a formalization of the above observations, but it will also figure in the analysis of future and progressive forms, and we return to it there.

2.0 Si-Perfectives

The approach taken here to the CV template will be that the pre-stem syllable is formed by a first choice of aspect prefixes + stem and classifier prefixes. The reasoning for this is as follows. Verbs may show up to five differing stems, depending on semantic class, and other properties of the verb. The aspectual prefixes and stem shape are in effect chosen at the same time, and the classifier is chosen by either transitivity of the verb or other "thematic" reasons. To make this clearer, examine the chart in (15), which shows three aspect/tense forms of the verb 'to capture it'.

(15) Stem choice for naaɫ 'to capture it'

	6	-	7	-	8	CL	[STEM
Imperfective			∅			ɫ	naáh
Perfective			s		H	ɫ	na[h]
Future	d		gh			ɫ	naaɫ
- ...							

Templates for these can be as in (16).

(16) Imperfective	Perfective	Future
C V C [C V H V C	C V C [C V H C	C C V C [C V V C
ɫ n a h	s H ɫ n a [h]	d gh ɫ n a ɫ

We can now start to map in subject prefixes, which will attach to the coda position. Final forms will require vowel insertion, and onset linking for ∅ imperfectives, as previously noted.

We look now at the si-perfectives. The template for all si-perfectives can be schematized as in (17). Note that the H here will be on the same melody tier as the consonantal melody. Since s and H are chosen at the same time, they will be on the same melody tier.

(17) C V C [C...	where Cl is an abbreviation for
	∅, t, ɫ, d
s H Cl X...	

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The si perfectives show the second piece of evidence for doubly linked consonants. The perfectives show certain coda changes dependent upon classifier choice, for the forms that we are considering,<sup>7</sup> with ∅/ɿ verbs and d/l verbs forming two groups. Data is shown in (18).

(18)	a.	<u>∅-tɿ'in</u> 'pile them'	<u>ɿ-tin</u> 'freeze it'	<u>d-tin</u> 'freeze up'	<u>l-jɿɿ'd</u> 'squat'
1s		sé [tɿ'in	séɿ [tin	sis [tin	shish [jɿɿ'd
3		yiz [	yis [	yis [	yish [
4		jiz [	jis [	jis [	jish [
2d		soo [	sooɿ [	sooh [	shooh [

The forms in (18d) show an additional strident assimilation rule at work. This will not be discussed here; see Kari (1973) for details.

We can see from the 1s and 2d forms that we lose subject coda if classifier is ∅/ɿ, and from the appearance of h in (18c & d), we apparently lose d/l. However, more complex forms with l + voiced initial show no devoicing caused by surface voiceless coda as in /n+j+s+H+l+zhee'/, [njish zhee']. This is the first problem of concern.

Secondly, we find the appearance of e in 1st singular forms with H tone, but loss of H tone in other places. Finally, we find s/z coda in 3rd and 4th forms.

The analysis to be pursued here is as follows. Although the causality of the process is unclear, the H tone of the si perfectives (and other perfectives) will be a trigger for floating of the sh/h coda, except if coda = d/l.<sup>8</sup> d/l float otherwise. H is retained if the consonant floats; otherwise H is lost. This much of the analysis is simply stipulation of the facts put into a floating framework.

However, in (18a&b), where we 'lose' sh by floating, we find the appearance of e. The rule will show up in other places, but for now, we simply note:

(19) [i] --> [e] in environment of floating consonant.

The derivations for (18a&b) 1st singular forms can then be as in (20).

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(20) a.	C	V	C	[C	V	C	b.	C	V	C	[C	V	C	
	s	H		tɬ'	i	n		s	H	ɬ	t	i	n	
insert	C	V	C	[C	V	C		C	V	C	[C	V	C	
subj.										h				
	s	H	sh	tɬ'	i	n		s	H	sh	ɬ	t	i	n
sh-float	C	V	C	[C	V	C		C	V	C	[C	V	C	
& vowel														
insert.	s	H[e]	(sh)	tɬ'	i	n		s	H[e]	(sh)	ɬ	t	i	n
Output:	séɬɬ'in						séɬtin							

The second dual form presents an additional problem of template expansion in all perfectives. Various solutions are possible to account for this expansion, but here we will simply stipulate the expansion. The derivation would be as in (21). This form shows the h float parallel to sh-float and then an H-loss needed for other paradigms.-- basically H on the consonantal melody tier can only map to a single slot and not to a geminate vowel.

(21) = (18b)	C	V	C	[C	V	C		
	s	H	ɬ	t	i	n		
insert	C	V	V	C	[C	V	C	
subj.								
	s	H	[o]	h	ɬ	t	i	n
h-float &	C	V	V	C	[C	V	C	
H-loss								
	s		o	(h)	ɬ	t	i	n
Output:	sooɬtin							

The 3rd and 4th forms are particularly crucial to the argument. 3rd and 4th forms have the template shown in (22) for the forms of (18a&b). These forms differ from the others in that there is no consonantal insertion; rather, these subject/object markers occur before the template.

(22)	<u>3rd</u>						<u>4th</u>							
	C	V	C	[C	V	C		C	V	C	[C	V	C	
	y	s	H	ɬ	t	i	n	j	s	H	ɬ	t	i	n

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Now, in these cases, there is no coda, or only a single coda mapped, in contrast to the 1s and 2d forms with doubly linked codas. The s will flip to the coda position, blocking off the H, and bleeding this form from s coda floating, since there is no high-toned vowel. y or j will fill in the onset position; there will be no floating consonant and [i] will appear. Derivations for (18b) are shown in (23)

(23)	<u>3rd</u>	<u>4th</u>																																																
	<table style="margin: auto; border-collapse: collapse;"> <tr><td>C</td><td>V</td><td>C</td><td>[C</td><td>V</td><td>C</td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td>y</td><td>s</td><td>H</td><td>ɬ</td><td>t</td><td>i</td><td>n</td></tr> </table>	C	V	C	[C	V	C							y	s	H	ɬ	t	i	n	<table style="margin: auto; border-collapse: collapse;"> <tr><td>C</td><td>V</td><td>C</td><td>[C</td><td>V</td><td>C</td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td>j</td><td>s</td><td>H</td><td>ɬ</td><td>t</td><td>i</td><td>n</td></tr> </table>	C	V	C	[C	V	C							j	s	H	ɬ	t	i	n										
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	[i]																																																	
Output:	yistin	jistin																																																

Armed with the portion of the analysis presented thus far, we can proceed to the main place where we find floating consonants in this analysis -- those places where two CC aspect markers form the onset of the prefix syllable in Navajo. This CC onset will not be syllabifiable. The two types crucial to discussion here include inceptive si perfectives and future forms. The morphology of these is sketched in (24).

(24) a.	<u>Inceptive perfective</u>	<u>Futures</u>
	6 - 7 - 8 - CL - STEM	6 - 7 - 8 - CL - STEM
	d s H l dzil 'strain, make an effort'	d gh l ghal 'to chew' d gh ɬ bas 'to roll it'

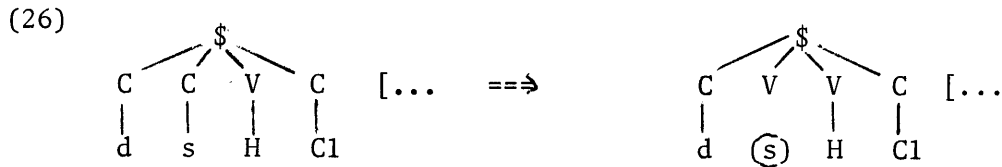
Paradigms for these are shown in (25).

(25)	<u>1-dzil (inceptive perf)</u>	<u>1-ghal (future)</u>	<u>ɬ-bas (future)</u>
1s	dés [dzil	deesh [ghal	dees [bas
3	dees [	yidool [	yidooɬ [
4	jidees [	jidool [	jidooɬ [
2d	dooɬ [	dooɬ	dooɬ

We examine the inceptive perfective first. In (25) note that there is vowel lengthening in all but the first singular forms, and widespread appearance of e.

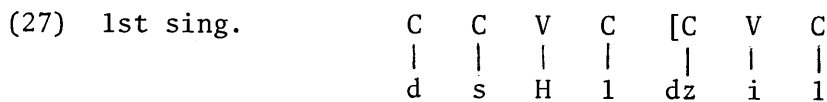
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The CV tier will need at some point to be syllabified, and we assume that the prefix syllable will include as many of the aspectual prefixes as possible. We have 4 segment CVVC syllables, and 4 segments is maximum. Thus, the syllabification of these could include d as onset if the C slot over s were reanalyzed as a V slot, as in (26).

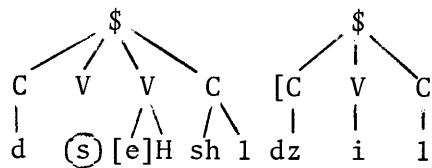


Once the position over s is designated to be a vowel by the syllabification process, then s can no longer remain attached, since it has no vocalic properties, and it will float. The environment for [i] --> [e] is met and we see widespread appearance of [e] except in second dual forms where o again surfaces because of the back consonant.

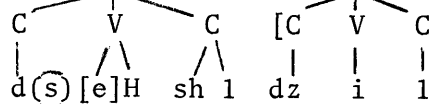
Derivations are given in (27) and (28) for the forms in question. In the first singular forms, the template will shrink down to CVC since there is a regular rule mentioned previously that H can only dock onto a single vowel slot and there are no other rules intervening.



syllab., subj.  
insert., vowel  
insert.



template shrinking



Output: désdzil (strident assimilation has applied)

In the 3rd and 4th forms, we find no CV tier shrinking, since the H tone is lost by the coda docking. Derivations for dzil are then as in (28). Note that there is no thematic object marker for 3rd form in this particular case. The 2nd dual forms will be parallel to previous si perfectives.



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same type of flip. But, gh is a back consonant, and so the inserted vowel [e] will become o before back consonants. A comparison of derivations for 4th person forms for the two types is shown in (30).

(30) a. Inceptive si-perfective  
4th person

Basic C C V C [C V C  
j d s H l dz i l

syllab. & vowel insert

\$ \$ \$  
C V C C V V C [C V C  
j [i] d (s) [e] H l dz i l

coda docking & e--o

\$ \$ \$  
C V C C V V C [C V C  
j [i] d [e] s (H) l dz i l

Output: jideesdzil

b. Future  
4th person

C C V C [C V C  
j d gh l gh a l

\$ \$ \$  
C V C C V V C [C V C  
j [i] d (gh) [e] l gh a l

\$ \$ \$  
C V C C V V C [C V C  
j [i] d [o] gh l gh a l

jidoolghal

The j consonant cannot be part of the CVC template and so it will become syllabified as an onset of another syllable.

Now, the problem here is why there is no surfacing of gh coda. The coda hierarchy actually predicts the non-occurrence. l will surface over gh -- coronal surfaces over non-coronal. l classifier also surfaces over gh, [-voice] over [+voice]. The only indication we have of the docked gh is the quality of the inserted vowel.

## Conclusions

The analysis to this point has provided evidence for two points about mapping principles at work in Navajo. First, double mapping to a C position is supported by five points: 1) l blocking the devoicing rule; 2) surface l coming from d + l; 3) alternation of consonants in the perfective forms -- the re-emergence of l coda is first coda floats; 4) surface coda s appearing in 3rd and 4th forms where s slips to a 'vacant' second slot under the coda C; and 5) appearance of o in 3rd and 4th future forms where a gh coda is argued to be mapped.



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Any of these five problems can be solved individually by alternative solutions, but the d-effects on stem initial consonants show that some doubly linked consonants must occur, and once we have double mapping we do not need to separate the cluster of properties listed above.

Secondly, the 'possible syllabification' approach changing CCVC to CVVC gives desirable results. Vowel length in these forms is related to the CC onset; furthermore, we do not need rules which specify which of the aspectual prefixes 'delete' -- a consonant which does not have vocalic properties, i.e. s and gh of first singular future forms will 'delete' because they are attached to slots which require vowel segments. We do not need morphological rules stipulating the appearance of e and o in the various environments -- the single rule [i] --> [e] in the environment of floating consonants plus the already needed o-in-front-of back consonants gives us the correct results.

FOOTNOTES

\*I would like to thank Toni Borowsky and Peggy Speas for discussions which were extremely helpful to me. In addition, James Kari's dissertation made Navajo understandable to me.

<sup>1</sup>Actually, this characterization is not strictly accurate, since we find certain sequences of CVn and CVV word internally, with certain affixes. These can all be analyzed as the result of syllabification.

<sup>2</sup>Redundant velarization and labialization added in the phonetic transcription, from Sapir-Hoijer.

<sup>3</sup>Note that h is used for x and h. Both show a range from velar to laryngeal in identical environments; Sapir-Hoijer claim original h allophones to be somewhat briefer than those of x.

<sup>4</sup>Actually, gemination of a consonant under the CV case discussed above will allow certain consonants to become codas which under normal circumstances would not appear here.

<sup>5</sup>Second person singular prefix n will not be treated in this analysis. It has no effect on the classifier and stem consonants and the alternations for 2s suggest that it is best seen as primarily mapped to a V slot, yielding nC~niC or high tone.

<sup>6</sup>3rd and 4th person have no prefix in position 9. 4th person is

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indicated by j in deictic (5) position; 3rd person often has object marker in object (4) position for transitivity or thematic reasons.

<sup>7</sup>2s and 1d forms present additional problems not related to the problems being discussed here, and so we leave them out of the discussion.

<sup>8</sup>Actually, this rule is complicated somewhat in si-perfectives with additional aspect markers, which show both codas remaining docked, but otherwise follow the si perfective analysis. Perhaps only one element can float at a time.

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