

Phonological and Morphological Issues in the Distribution of Berber Schwa

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1 Introduction

The distribution of schwa is similar across most Northern Berber languages. The general pattern in all cases can be seen as the result of two restrictions on the surface forms of the language: one demanding that all consonants be adjacent to a vowel (or, more or less equivalently, that all consonants belong to a maximally CVC syllable), the other demanding that schwa not occur in open syllables. Certain facts, however, complicate this picture. In this thesis I propose an analysis of the pattern in Optimality Theory, concentrating on two issues, not necessarily related to one another.

The first involves the treatment of geminates. Geminates in Berber are never broken up by epenthesis; C:C clusters are possible on the surface, while CCC clusters are not. Geminate inseparability is common across languages, and various mechanisms have been devised to explain it both in Berber and generally (Guerssel 1977, 1978; Steriade 1982). An analysis of the problem in Optimality Theory faces a difficulty that does not arise in derivational analyses. Not only underlying geminates, but also geminates formed by assimilation, are impervious to epenthesis. In a derivational account, the explanation for both kinds of geminate inseparability can be the same: assimilation creates a structure which is identical to that of an underlying geminate; a subsequent epenthesis rule which is blocked

for whatever reason from applying to one kind of geminate will, for the same reason, be blocked from applying to another.

In a standard OT analysis, no intermediate representation of the necessary sort exists. Where there is no underlying geminate, no constraint demanding that geminates not be broken up will be capable of demanding a surface geminate; the constraint will not be violated by an input-output pair in which neither input nor output contains a geminate. An account which correctly predicts the pattern must hold that in some situations, a C:C surface string is more desirable for phonotactic reasons than a CəCC string in which the first two consonants are capable of assimilation. The need for such an explanation suggests that a specific mechanism for geminate inseparability is unnecessary even where a geminate is underlying; geminates are inseparable not because their breakup is bad in itself, but because the result of breakup is more marked than the result of leaving the geminate alone.

The second issue involves cases where the general pattern of schwa distribution breaks down. Epenthesis never occurs before certain monoconsonantal suffixes, even when this leads to an otherwise illegal CC# cluster. In addition, certain biconsonantal verb roots are resistant to epenthesis; while in most cases these forms follow the usual epenthesis pattern, in phrase-final position CC clusters occur.

In both cases, a certain amount of lexical idiosyncrasy seems to be involved; it has been proposed (Saib 1976, Kossman 1995) that the source of the pattern is that the clustering affixes lack an underlying schwa, while the affixes which follow the general pattern have one. The problem such an approach faces is that given constraints on the distribution of schwa powerful enough to explain its distribution elsewhere, the underlying presence or absence of schwa in these forms should be irrelevant. If the exceptional cases involved schwa occurring where the phonotactic constraints do not permit it, there would be no difficulty; the surface preservation of input schwas would simply be more important than obeying the phonotactic constraints. But since the exceptional cases involve the

absence of schwa where the phonotactic constraints demand it, the situation is puzzling. If we are to say that no schwa occurs on the surface in these cases because no schwa is underlyingly present, we must propose dramatically weaker phonotactic constraints that do not demand the insertion of schwa in these cases; but such an analysis would have to treat the otherwise very regular distribution of schwa as an accidental regularity in the lexicon, unmotivated by surface constraints. In addition, the set of segments that can form such clusters is limited and regular, and an approach relying strictly on the underlying presence or absence of schwa must treat this fact, too, as a lexical accident.

I show that the patterns of affixal clusters can be explained by a combination of two factors. The failure of epenthesis to occur before these affixes is treated as the consequence of a demand that no material intervene between an affix and the associated stem; this demand in some cases outweighs the demand that consonants be in good environments (adjacent to a vowel or within a CVC syllable). This allows the general pattern of schwa distribution to be predicted by the phonotactic constraints, eliminating the need to consider otherwise exceptionless patterns lexical accidents. The fact that clustering affixes always have a particular phonological shape is explained as the result of a variable rather than monolithic restriction on possible consonantal environments. While all consonants are subject to a constraint on their segmental environment, the ranking of this constraint is different for different consonants; some consonants will be left in undesirable environments to permit satisfaction of the constraint on resemblance of words across surface instantiations, while others will be given a desirable environment even if this makes satisfaction of the morphological constraint impossible.

The problem of the biconsonantal root clusters is more difficult. An analysis holding that these clusters occur because they allow the preservation in the output of an underlying schwa can produce the correct result, but only at the cost of making the regular distribution of schwa in other forms largely a matter of lexical accident. In addition, it offers no explanation for certain regularities in the class of verbs which are capable of

forming such clusters, and must treat these patterns, too, as an accidental regularity in the lexicon, unmotivated by constraints on surface forms. I propose an alternative analysis which relies on the fact that verbs forming the exceptional clusters belong to a particular morphological class. Other parts of the paradigm for these verbs are such that the exceptional clusters in the bare form allow closer resemblance in shape to an entire class of derived forms of the verb than would otherwise be possible; various morphological and phonological regularities among the set of clustering verbs thus receive an explanation.

I discuss a number of Berber dialects, with special emphasis on Ayt Ndir Tamazight (Saib 1976, Penchoen 1973) and Kabyle (Bader 1984, 1985; Kenstowicz et al 1985; Kossmann 1995, Dallet 1982). This is necessary because while similar patterns occur in all the dialects considered, and presumably deserve similar explanation, not all sources are equally interested in all parts of the pattern; where Dell and Tangi (1992) mention a particular fact about Ath-Sidhar Rifian in passing, for example, Bader may describe the corresponding Kabyle facts in great detail. In some cases sources appear to contradict each other in ways that do not plausibly correspond to dialectal differences (e.g. Penchoen vs. Saib, Abdel-Massih (1971) vs. most other sources); where the differences are important, I note the disagreement in a footnote and explain my reasons for following one account rather than another.

2 The general epenthesis pattern

In this first half of the paper, I describe the general pattern of Berber epenthesis and offer an analysis of the pattern in Optimality Theory. Epenthesis in Berber has been analyzed with some success as a consequence of syllabification. A nonderivational analysis of this sort, if it is to explain not just the motivation for epenthesis but the sites of epenthesis, must posit a powerful restriction on the distribution of schwa; this restriction, in turn, makes it difficult to discern the exact nature of the factors motivating epenthesis.

2.1 The distribution of schwa

The occurrence of schwa is predictable in all the varieties of Berber discussed here. In Ayt Ndhir Tamazight as described by Saib (1976), schwa occurs in the following environments:

- | | | | |
|-----|----|---|-------|
| (1) | a. | Between a consonant and a word-final consonant | C__C# |
| | b. | Between C ₁ and C ₂ of a C ₁ C ₂ C ₃ cluster | C__CC |
| | c. | Between a consonant and a geminate | C__C: |
| | d. | Before a word-initial CC cluster | #__CC |
| | e. | Before a word-initial geminate | #__C: |

Schwa never occurs except in these environments, and except for the cases discussed in the second half of this paper, the environments in (1) never occur on the surface without schwa or some other vowel.

For the sake of convenience, I will treat schwa for the moment as epenthetic wherever it occurs. In forms without geminates, the surface pattern of epenthesis can be derived from underlying forms lacking schwa by the following rule, applying iteratively right to left:

$$(2) \quad \text{È} \rightarrow \text{ə} / \left\{ \begin{array}{c} \text{C} \\ \# \end{array} \right\} _ \text{C} \left\{ \begin{array}{c} \text{C} \\ \# \end{array} \right\} \quad (\text{Saib 1976, p 128})$$

Thus [əxðəm] ('to work') is derived from underlying /xðm/ as follows:

- | | | | |
|-----|------|-------|-------|
| (3) | i. | xðm | |
| | ii. | xðəm | C__C# |
| | iii. | əxðəm | #__CC |

Two characteristics of the pattern should be given special notice. First, consonant clusters never occur word-initially or word-finally, and triconsonantal clusters do not occur medially; second, schwa never occurs before CV or at the end of a word.

2.2 Schwa and syllabification

The surface syllables of Berber, again excluding forms with geminates, are limited to the following:

(4)	CVC	.əm.lil.	'to be white'
	CV	.ʃa.	'something'
	VC	.um.lil.	'white'
	V	.i.ni.	'to say'

(Saib 1976, p 125)

Given that schwa's occurrence is predictable, and that it occurs only when the absence of a vowel would lead to a sequence which could not be broken up into syllables from set (4), it is tempting to conclude that schwa is an epenthetic vowel inserted to allow full syllabification.

Bader (1984, 1985) and Dell and Tangi (1992) propose analyses of this sort. In both accounts, an ordered set of syllabification rules are applied to underlying schwa-less strings of consonants and vowels. When a string contains #CC, CC#, or CCC clusters, the rules build structures in which the nuclei of some syllables lack vowels; where such a syllable occurs (or would occur), schwa is inserted to satisfy the lack.

The same fundamental notion can be captured in OT by a system of constraints in which the demand that syllables have simple onsets and simple codas outweighs the demand that nonunderlying material not be inserted. Specifically, the constraint *COMPLEX must outrank the constraint DEP(ə).

- (5) *COMPLEX
A syllable has neither a complex onset nor a complex coda.
DEP(ə)
A schwa in the output has a correspondent in the input.
*COMPLEX >> DEP(ə)

These constraints, so ranked, demand that a schwa be inserted next to any consonant that could not otherwise belong to a maximally CVC syllable; any consonant, that is, not adjacent to an underlying vowel. They do not, however, determine the location

of the schwa precisely enough to explain the surface pattern. For example: for inputs /mlil/ and /amn/ ('believe', Penchoen 1973 p. 46), the constraints in (5) explain why [əmlil] and [amən] should be preferable to *[mlil] and *[amn], but not why they should be preferable to *[məlil] and *[amnə].

(6)

	mlil	*COMPLEX	DEP(ə)
	(mlil)	*!	
	(mə)(lil)		*
(☞)	(əm)(lil)		*

(7)

	amn	*COMPLEX	DEP(ə)
	(amn)	*!	
	(am)(nə)		*
(☞)	(a)(mən)		*

Note that in the case of [əmlil], the problem is not just that the actual winner is equivalent in constraint violations to *[məlil]. [əmlil] contains an onsetless syllable, and both syllables have codas; *[məlil] has no onsetless syllables, and only one syllable with a coda. With respect to the presumably universal constraints on syllable structure ONSET and *CODA, then, *[məlil] is actually superior to the real form.

(8)

	mlil	*COMPLEX	ONSET	*CODA	DEP(ə)
*☞	(mə)(lil)			*	*
	(əm)(lil)		*	**	*

Why does schwa occur in the places that it does? In the case of [amən], one might propose that schwa occurs before rather than after [n] to allow the last segment of the underlying word to be the last segment of the phonetic form, or to allow the end of the underlying word to be the end of a surface syllable. But a constraint to this effect would be irrelevant to [əmlil], where the location of epenthesis has no effect on the end of the word,

and a corresponding constraint referring to the beginning rather than the end of a word would achieve a result opposite to what is desired.

It is often noted that schwa never occurs in open syllables (i.e. before CV or prepausally) in Northern Berber languages. (Saib 1976, p 125; Kossman and Stroomer 1997, p 463). When words occur in sequence, there is a wholesale reorganization of both syllable structure and the locations of schwa, such that schwa occurs only before CC or prepausal C:

- (9) (əx)(ðəm) 'fix/work' (ax)(xam) 'house'
 but
 (xəð)(m ax)(xam) 'fix the house'
 (Bader 1984)

In the accounts of Bader and of Dell and Tangi, this is a consequence of the nature of the syllabification algorithm. Schwa is only inserted before consonants assigned to syllable rimes, preventing its occurrence prepausally, and a prevocalic consonant is always assigned to an onset. This explanation for the absence of schwa in open syllables is only available when assignment of consonants to particular syllable positions precedes schwa insertion or outweighs it; there is not a straightforward way of translating the mechanism into Optimality Theory.

Let us consider instead a constraint which will produce the pattern directly, *ə]_σ:

- (10) *ə]_σ
 Schwa is not in an open syllable.

Ranked above ONSET and *CODA, this will limit epenthesis to exactly those locations where it actually occurs. Note that its ranking above both ONSET and *CODA is crucial:

(11)

mlil	*COMPLEX	*ə] _σ	ONSET	*CODA	DEP(ə)
(mə)(lil)		*!		*	*
(mlil)	*!				
→ (əm)(lil)			*	**	*

2.3 Schwa in open syllables

Note that *COMPLEX and *ə]_σ completely determine the epenthesis pattern of Ayt Ndhir Tamazight. For every form in the language (except those considered in the second half of the paper), schwa occurs such that these constraints are satisfied; between two candidates differing in the occurrence of schwa, no constraint other than these two ever plays a role in the decision. For any schwaless string A of consonants and vowels, there is exactly one string B, differing from A only in the inclusion of schwa, which satisfies *COMPLEX and *ə]_σ. This is true even when string A contains no vowels, as in the case of Berber verb roots consisting entirely of consonants and schwa:

(12)

xǝm	*COMPLEX	*ə] _σ	ONSET	*CODA	DEP(ə)
→ (əx)(ǝəm)			*	**	**
(xə)(ǝəm)		*!		*	**
(xəǝ)(mə)		*!		*	**
(xə)(ǝə)(mə)		*!***			***

A consequence of this fact is that Faithfulness plays no role in the distribution of schwa. I have assumed that schwa, being predictable, is never underlying; that every surface schwa violates DEP(ə). But in the current analysis, violations of DEP(ə) never play any role in the evaluation of a candidate. Pointless epenthesis — insertion of vowels that do not help to avoid a *COMPLEX violation — is prohibited not because of the additional DEP(ə) violation, but because the resultant form would violate *ə]_σ. In any string

satisfying *COMPLEX, every consonant is adjacent to a vowel. We assume that schwa insertion next to a vowel is independently impossible (two vowels are never adjacent in Ayt Ndir Tamazight); thus, the only potential sites for schwa are string-finally (if the string ends with a C) or before CV (since the environment $_CC$ does not exist except after a vowel). Both kinds of site lead to violations of $*\text{ə}]_{\sigma}$. Thus the situation is not exactly that epenthesis is banned except where it is necessary; epenthesis is banned in exactly those positions where it is unnecessary.

If $*\text{ə}]_{\sigma}$ and ranked above $\text{MAX}(\text{ə})$, it is no longer possible to say whether schwa exists in any particular location in any underlying form. The surface form $[\text{əx}\text{ð}\text{əm}]$ will be the winning candidate for any input which differs from it solely in the occurrence of schwa: $/\text{x}\text{ðm}/$, $/\text{x}\text{ə}\text{ð}\text{əm}/$, $/\text{x}\text{ə}\text{ðm}\text{ə}/$, $/\text{x}\text{ə}\text{ð}\text{əm}\text{ə}/$, $/\text{ə}\text{ə}\text{x}\text{ə}\text{ə}\text{ð}\text{ə}\text{ə}\text{m}\text{ə}\text{ə}/$, etc. For any position in an input string, it is impossible to tell from the output whether that position contains a schwa.

Note that since schwa never occurs before CV, any claim that schwa occurs underlyingly in Berber words requires that $*\text{ə}]_{\sigma}$ outrank $\text{MAX}(\text{ə})$. It also requires that *COMPLEX outrank $\text{MAX}(\text{ə})$. Imagine that the underlying form of $[\text{əx}\text{ð}\text{əm}]$ is identical to the surface form. When this verb occurs before a vowel-initial word, it occurs as $[\text{x}\text{ə}\text{ðm}]$, as shown in (9). The deletion of the second schwa is a consequence of the ranking $*\text{ə}]_{\sigma} \gg \text{MAX}(\text{ə})$. The insertion of the surface schwa in $[\text{x}\text{ə}\text{ðm}]$ a consequence of *COMPLEX. But the deletion of the first underlying schwa is not predicted if $\text{MAX}(\text{ə})$ outranks *COMPLEX; $*[\text{əx}\text{ðm}]$, in which $[\text{ð}]$ must incur a violation of *COMPLEX, is predicted.

In the next section, we will see that $\text{DEP}(\text{ə})$ does play some role in the grammar, since it prevents unnecessary epenthesis between the halves of a geminate.

2.4 Geminate clusters

Geminates exist in Ayt Ndhir Tamazight, and their distribution is not entirely similar to that of nongeminate CC clusters. Clusters consisting of a geminate followed by a singleton consonant exist, as do word-final geminates. Clusters consisting of a singleton consonant followed by a geminate do not, nor do word-initial geminates.

- (13) a. **annli** 'brain'
 b. **θimnəqqsin** 'women's shoes'
 c. **əkksən** 'they (m.) took off/away' (Saib 1976, pp. 54-55)
- (14) a. **imlall** 'gazelles' (ibid, p. 56)
 b. **əkḵ.** 'to pass by' (ibid, p. 123)
- (15) a. **aʃəddis** 'belly' (Penchoen 1973, p. 102)
 b. **asəkka** 'tomorrow' (ibid, p. 74)
 c. **βəddu** 'to start' (intensive stem) (Saib 1976, p. 89)

Note that geminates occur as codas, but never as onsets. I will claim that geminate codas, unlike codas containing multiple distinct segments, do not violate *COMPLEX. This notion derives from Jones' (1999) analysis of vowel epenthesis in Kolami, where it is claimed that it is multiple place gestures in syllable margins, rather than multiple consonants per se, that violate *COMPLEX-type constraints on syllable structure. (17) The inability of geminates occur solely as onsets (as opposed to being simultaneously onsets and codas) will be banned by the constraint *LONGONSET:

- (16) *LONGONSET
 An onset is a singleton consonant.

Since geminate codas do not motivate epenthesis, there is no immediate reason to make reference to geminate inseparability. If nothing prevents epenthesis between the elements of a geminate, then here, for the first time, we see situations where epenthesis could occur without violating *ə]_σ, but does not occur because there is no need for it; DEP(ə), then, does play a role in the grammar, eliminating candidates with unnecessary epenthesis like *[anənli].

(17)

	annli	*LONGONSET	*ə] _σ	*COMPLEX	DEP(ə)
→	(ann)(li)				
	(an)(nə)(li)		*!		
	(a)(nən)(li)				*!

(18)

	askka	*LONGONSET	*ə] _σ	*COMPLEX	DEP(ə)
	(ask)(ka)	*!			
	(as)(kə)(ka)		*!		*
→	(a)(sək)(ka)				*

In the case of [annli], epenthesis does not occur because there is no need for it. Geminate codas do not violate *COMPLEX, so epenthesizing in the middle of the geminate causes a violation of DEP(ə) with no compensating benefit. In the case of [asəkka], schwa is inserted because the geminate would otherwise violate *LONGONSET. Because intervocalic geminates close the syllable whose nucleus is the preceding vowel, insertion here does not violate *ə]_σ.

In certain cases, however, a problem arises. Consider a form like [əkkɾəm] 'he stands'. This form does not violate *LONGONSET or *COMPLEX. Neither, however, does the nonoccurring form *[kəkkɾəm], in which an epenthetic schwa has been inserted within the geminate. Moreover, the actual form violates the presumably universal constraint ONSET, while *[kəkkɾəm] does not; given the constraints proposed so far plus ONSET, *[kəkkɾəm] should be the winner. Why does epenthesis not break up the geminate?

The explanations given by Guerssel (1977, 1978) and Schein and Steriade (1985) attribute facts like this to *geminate inseparability*. While the mechanisms of the proposals differ, the basic idea behind both is the same: geminates have some property which sequences of nonidentical consonants do not, and this property blocks the application of processes which would make the halves of the geminate nonadjacent.

Assuming that some mechanism of the appropriate type is decided upon, the correct result can be obtained in this case by ranking whatever constraint or constraints are responsible for violated by the breakup of an underlying geminate above ONSET:

(19)

	kkrm	(Geminate Inseparability)	ONSET
	kəkrəm	*	
☞	əkkrəm		*!

As I will show in the next section, however, a mechanism specifically prohibiting geminate breakup is unnecessary. Assimilation in Berber creates derived geminates which, like underlying geminates, are impervious to epenthesis. Since no constraint against geminate breakup can be violated by an input-output pair in which neither input nor output contains a geminate, geminate inseparability is useless for explaining the resistance of such clusters to epenthesis. I claim instead that these geminates are the result of constraints banning sequences of identical or nearly identical consonants that are adjacent or separated only by schwa. This proposal provides an independent explanation for the nonoccurrence of *[kəkrəm]; geminate inseparability, then, has nothing to do with constraints against the separating the halves of an underlying geminate, but is instead a consequence of phonotactic constraints violated by the string that would result from such separation.

2.5 Derived geminate clusters

Guerssel describes a process of coronal voicing assimilation in Ait Segrouchen Tamazight which leads to the formation of geminates and geminate + singleton clusters. This dialect differs from Ayt Ndhir Tamazight in a number of ways, most notably in the

optionality of word-initial epenthesis (e.g. both [əxðəm] and [xðəm] are acceptable surface forms). For the moment, I will ignore these differences.

The morphologically complex word [əddlu]¹ 'she covered' has the morphological structure shown in (20):

(20) [əddlu] /t + dlu/ (Guerssel 1978, p. 223)

The puzzle here is why the surface form is [əddlu] rather than *[tədlu]. While the alternatives are equivalent with respect to *COMPLEX and *ə]_σ, [əddlu] violates both ONSET and whatever constraint is violated by the loss of the underlying voicelessness of the affix. The current constraint set predicts that *[tədlu] will be the surface form:

(21)

	t + dlu	*ə] _σ	*COMPLEX	ONSET
☞	tədlu			
	əddlu			*!

What distinguishes this situation from that of [əkkərəm] is the fact that here, the geminate is not underlying. The superiority of [əkkərəm] to *[kəkərəm] can be explained if some constraint or principle banning the breakup of geminates ranks higher than ONSET. It is difficult, however, to devise any mechanism for geminate inseparability that *[tədlu] would violate; however geminate inseparability is conceived, the mechanisms involved presumably cannot apply in cases where no geminate exists at any level of representation. Were *[tədlu] to be the output of underlying /t + dlu/, no geminate structure would exist in either the input or the output; geminate inseparability has no foothold here.

Other assimilation processes also create derived geminates of this sort. Consider the Ayt Ndir Tamazight word [əllxurðərθ] 'of vegetables'. Here, too, the geminate is derived, in this case through a process by which [n] assimilates completely to an adjacent coronal sonorant:

¹ Guerssel states that word-initial epenthesis is optional in Ait Segrouchen. I have included an initial schwa not transcribed in the original example to avoid making it seem that avoidance of DEP(ə) violations is what is at issue here.

- (22) /n/ 'of' + /lxuðrθ/ 'vegetables' → [əllxuðərθ]²
(Penchoen 1973, p. 8)

The alternative realization *[nəlxuðərθ] contains exactly as many epenthetic schwas as the actual form, does not violate *ə]_σ, does not violate ONSET as the actual form does, and does not violate whatever faithfulness constraint preserves the nature of /n/. No reranking of the current constraint set will predict [əllxuðərθ] rather than *[nəlxuðərθ], as [əllxuðərθ] violates a superset of the constraints violated by *[nəlxuðərθ]:

(23)

/n + lxuðrθ/	*ə] _σ	*COMPLEX	DEP(ə)	ONSET
[əllxuðərθ]			*	*
[nəlxuðərθ]			*	

I propose that these facts are a consequence of the same forces that drive assimilation in the first place. Certain sequences of consonants are banned; replacement of these sequences by geminates removes the offending sequence while preserving maximal similarity to the input, both in consonant quality and in durational properties. An intervening schwa is irrelevant to the ban on the sequences in question: if C₁C₂ is banned, C₁əC₂ is banned also. The constraints banning these sequences are more highly ranked than *COMPLEX, and thus a C:C cluster on the surface is always preferable to a CəCC sequence. The proposal is worked out in detail in the next section.

2.6 Assimilation and its motivations

To understand why assimilation occurs rather than epenthesis, we must first explain why assimilation occurs at all. In Ayt Ndhir Tamazight, two different assimilation processes lead to C:C clusters. The first process is identical to the Ait Segrouchen process

² The final cluster [rθ] here is an example of one or another of the exceptions to the general pattern discussed in the second half of the paper; either a morphologically conditioned failure of epenthesis before the feminine -θ suffix, or a lexical exception common to Arabic loan words (which /lxuðrθ/ is).

already described, and turns two coronal obstruents into a geminate if they differ in voicing, or do not differ at all:

(24) að + θ + ddu → attəddu³ 'she will go' (Penchoen 1973, p. 72)

When the underlying consonants differ in voicing, the surface geminate always maintains the voicing of the second consonant of the underlying cluster. (I do not propose to account for this fact here.) Note that the geminate is a stop rather than a fricative. In general, nonstrident obstruents in Berber are fricatives when single and stops when geminate, though certain phonological processes can create singleton stops.

In the second process, /n/ assimilates completely to an preceding or following /l/ or /r/:

(25) n + lxuðrθ → əllxuðərθ not nəlxuðərθ 'vegetables'
 kkr + n → əkkərr⁴ not əkkərən 'they (m) stand'
 (Penchoen 1973, p. 8)

C:C and C:# clusters also arise in some circumstances even when overt assimilation has not taken place; that is, when a geminate arises through the juxtaposition of underlyingly identical elements.

I assume that geminates in Berber are single melodic elements, distinguished from singleton consonants by multiple association to slots on a timing tier, by their moraic associations, or by their value for the feature [long]. The effect of the process described above, then, is always to replace a pair of similar or identical segments with a single geminate segment. Accordingly, I propose that assimilation is motivated by a restriction against the cooccurrence of similar consonants.

³ Singleton consonants do not assimilate to underlying geminates.

⁴ Although Saib claims epenthesis before initial clusters is obligatory in Ayt Ndhir Tamazight, Penchoen does not mention it or, for the most part, include it in his transcriptions. As Saib was the principal consultant for Penchoen's work, I have chosen to follow Saib where the two conflict; accordingly, I have inserted an initial schwa here where none exists in the original.

2.7 Mechanisms for assimilation

Yip (1988) gives a brief account of Ait Segrouchen voicing assimilation that works in this way. Yip suggests that a Coronal tier exists in Berber. When two coronal segments are adjacent, there is a violation of the OCP on the this tier.

- (26) *The Obligatory Contour Principle (OCP)*
 At the melodic level, adjacent identical elements are prohibited.
 (Yip 1988, p. 66; McCarthy 1986, p. 208)

This OCP violation triggers a rule which deletes the first feature matrix of the consonant cluster, but not the associated timing slot. The feature matrix of the second member of the cluster then spreads to the vacating slot, creating a geminate. Deletion and spreading presumably precede and block epenthesis.

- (27) $\begin{array}{cc} X & X \\ | & | \\ t & t \end{array} \rightarrow \begin{array}{cc} X & X \\ | & | \\ \emptyset & t \end{array} \rightarrow \begin{array}{cc} X & X \\ & | \\ & t \end{array}$

Assume for the moment that this picture is essentially correct, and import it into the present analysis. The OCP becomes a constraint ranked above ONSET, violated by adjacent coronals. It is necessary to claim that OCP is violated both when two coronals are immediately adjacent and when they are separated by schwa. Given this system of constraints, [əttlu] now beats *[tədlu], and [əkkərr] beats [əkkərən]:

(28)

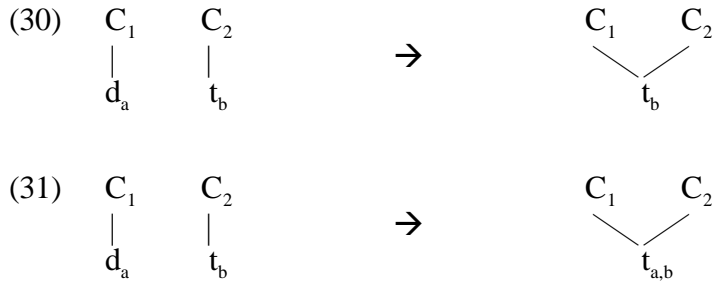
t + dlu	OCP	ONSET
tədlu	*!	
→ əddlu		

(29)

kkɾ + n	OCP	ONSET
əkkərən	*!	
→ əkkərr:		

Clearly, some faithfulness constraints are violated by the winning candidates. Either the input /t/ has no correspondent in [əddlu], or its correspondent has a different value for [voice]; either the input /n/ has no correspondent in [əkkərr:], or its correspondent

has different values for all those features distinguishing [n] from [r]. The relevant constraints must be dominated by OCP. It is not obvious from the surface strings, however, just what those constraints are. Assume a representation like Yip's, in which geminates are distinguished from singleton consonants by association to multiple elements on a skeleton tier. Consider the two sets of representations below:



Subscript indices indicate correspondence relations between elements. In (30), input d_a lacks an output correspondent; MAX(Segment) is violated. In (31), all input elements have output correspondents, so MAX(Segment) is not violated. Output $t_{a,b}$, however, corresponds to multiple input segments, thus violating UNIFORMITY:

- (32) UNIFORMITY
 No element of the output has multiple correspondents in the input.
 (McCarthy and Prince, 1995)

In addition, since [t] and [d] differ in voicing, IDENT-IO(Voice) is violated.

There is, of course, no difference in pronunciation between the two alternatives. Nevertheless, the decision between the two alternatives has consequences elsewhere in the analysis. These consequences become evident when we look more closely into the nature of the constraint forcing assimilation.

2.8 Limits on assimilation

It is not immediately clear exactly what sequences of segments should be considered to violate OCP. By the definition in (26), OCP is violated by adjacent identical melodic elements. Sequences like [ðθ], however, in which the segments are identical in

some respects but not in all, must incur violations. In addition, certain sequences of identical consonants do not become geminates; under some circumstances [məm] occurs on the surface:

(33) $\theta + x\delta m + m \rightarrow \text{ə}\theta x\delta m\text{ə}m$ not $*\theta x\delta\text{ə}mm$ 'you (m. pl) worked'

compare to

(34) $m\gamma ur + n \rightarrow \text{ə}m\gamma urr$ not $*\text{ə}m\gamma ur\text{ə}n$ 'they (m) got big'
(Penchoen 1973, p. 99)

The OCP as conceived in (26) must be violated here, since [m] is a melodic element identical to [m], but gemination does not take place. We must claim either that the operative constraint is not OCP but some more specific constraint banning only sequences of coronals, or that some other factor forces an OCP violation in cases like (33).

To explain why non-identical sequences like [ðθ] violate OCP, Yip claims that "Berber has a Coronal tier and ... a sequence of two [Coronal] nodes thus violates the OCP in Berber." (78) The adjacent identical elements are not the entire consonants, but sub-elements of the consonants existing on a distinct tier. I interpret Yip's statement as meaning that any sequence of coronal segments will incur a violation of OCP.

A problem here, though, is that not all pairs of coronal segments assimilate. Pairs of obstruents with like stridency assimilate, as do pairs of coronal sonorants⁵. Pairs of coronal obstruents in which one segment is strident and the other is not, however, do not become geminates, nor do pairs of coronals in which one segment is an obstruent and the other is a sonorant:

(35) a. $h\text{ə}\theta ruf$ not $*h\text{ə}rruf/*h\text{ə}ttuf$ 'braid'
(Penchoen 1973, p. 36)
b. $\text{ə}tsal$ not $*\text{ə}ttal/*\text{ə}ssal$ 'she asked'
(Saib 1976, p. 58)

⁵ While I have no examples of assimilation between /l/ and /r/, /lr/ and /rl/ sequences apparently do not occur intermorphemically, and there do not seem to be affixes of the appropriate shape to produce such sequences intramorphemically.

(Note that a singleton [t] occurs in [ətsal]; [θ] regularly becomes a stop before a strident. This point will be discussed later.) If OCP is violated in these cases, then as with [məm] sequences, we must posit some force which prevents the OCP violation from being resolved.

We can explain the failure of gemination in these cases in two different ways. On the one hand, we could claim that all the sequences mentioned above violate OCP, but total assimilation in some cases would lead to unacceptable unfaithfulness to the input. The idea would be that both [ðθ] and [ts] violate OCP, but the input-output pair [ðθ]>[tt] violates only faithfulness constraints ranked below OCP, while the input-output pair [ts]>[tt] violates some faithfulness constraint ranked above OCP. In this view, the *impetus* for assimilation is the same in all these cases, and the sequences differ in their behavior because the *restrictions* on assimilation differ.

On the other hand, we could claim OCP is not the correct constraint. Instead, some more subtle antisimilarity constraint drives assimilation; assimilation is not motivated in the cases where it does not occur. In this view, [ðθ] violates some constraint powerful enough to force assimilation, while [ts] does not. The sequences differ in behavior because the impetus to assimilate does not hold equally for both.

For both alternatives, it is crucial to decide whether assimilated geminates are instances of deletion (as in (30), where an input melodic element has no correspondent in the output) or coalescence (as in (31), where two input melodic elements share a single output correspondent). This difference is important because the two alternatives demand different ways of assessing a geminate's faithfulness to an input cluster. If geminates are formed through coalescence, then a broad antisimilarity constraint violated by any sequence of identical elements is impossible; we would have no way of preventing coalescence in cases like [əθxəðməm]. If geminates are formed by deletion, on the other hand, then the antisimilarity constraint can be violated by all adjacent and identical or sufficiently similar

elements; the failure of [məm] to form a geminate is explained by a highly ranked constraint against deletion of [m].

In the next two sections, I explain these issues in more detail. Below, OCP is considered to work as follows: any two adjacent and identical elements violate OCP, and pairs of coronals violate OCP even when they are non-identical, because they have a representation on a separate Coronal tier on which OCP violations are also assessed.

2.8.1 OCP drives assimilation; assimilation is deletion

Assume also that surface geminates corresponding to underlying nongeminate clusters are the result of deletion rather than coalescence. Thus /d/ in the input /adtru/ has no correspondent in the output [atru]; the output geminate is in correspondence only with input /t/, and MAX(Segment) is violated.

MAX(Segment) therefore ranks below OCP. For cases like [atru] and [əkkərr], this works fine:

(36)

	$a_1 d_2 t_3 r_4 u_5$	OCP	MAX(Segment)
	$a_1 d_2 ə t_3 r_4 u_5$	*!	
☞	$a_1 t_3 r_4 u_5$		*

(37)

	$k_1 r_2 n_3$	OCP	MAX(Segment)
	$ək_1 r_2 ə n_3$	*!	
☞	$ək_1 ə r_2$		*

In forms like [əθxəðməm], there is necessarily a violation of OCP, since [m] occurs twice separated only by a schwa. The failure of gemination to occur here can be explained by expanding MAX(Segment) into a family of MAX constraints protecting particular melodic elements; MAX(m) is ranked above OCP, MAX(t) below it.

(38)

	$\theta_1 x_2 \check{\delta}_3 m_4 m_5$	MAX(m)	OCP	MAX(t)
☞	$\emptyset \theta_1 x_2 \emptyset \check{\delta}_3 m_4 \emptyset m_5$		*	
	$\theta_1 \emptyset x_2 \check{\delta}_3 \emptyset m_5$	*!		

The problem with this picture is that it offers no way to explain why /θs/ does not surface as [s:]. MAX(θ) must rank below OCP, since [θδ] sequences surface as [d:]. No other relevant constraint gives us a way of distinguishing between deletion of /θ/ in *[əssal] (actual form *[ətsal]), which is banned, and deletion of /θ/ in [əddər] ('she descended', from underlying /θ + δr/ — Saib 1976, p. 56), which is required.

The idea that what drives assimilation is the OCP as conceived in (26), then, is incompatible with the idea that geminates are related to underlying clusters by deletion. In the next section, I examine a system in which the OCP constraint drives assimilation, but geminates are formed by coalescence, their deviation from input clusters limited by IDENT-IO constraints holding on correspondence relations between the output geminate and both members of the input cluster.

2.8.2 OCP drives assimilation; assimilation is coalescence

Assume now that geminates are related to underlying nongeminate clusters by coalescence; that is, that the single melodic element in the surface geminate corresponds to two distinct melodic elements in the input.

Any featural difference between the surface geminate and either of the corresponding input consonants incurs a violation of some constraint IDENT-IO(feature). The limitations on what clusters assimilate take the form of different rankings for different IDENT-IO constraints. In the actually occurring input-output pair / $\check{\delta}_1 \theta_2$ / > [t:_{1,2}], the geminate differs from its input correspondent $\check{\delta}_1$ in its value for [voice]⁶. IDENT-IO(voice) must therefore be ranked below OCP.

⁶ And from both input correspondents in its value for [continuant], of course.

In the nonoccurring input-output pair $[\theta_1 s_2] > * [s_{:1,2}]$, on the other hand, the output geminate differs from its input correspondent θ_1 in its value for [strident]. By ranking IDENT-IO(strident) above OCP, we ensure that this assimilation will never occur, even though a surface OCP violation is the result of leaving the cluster as it is.

The difficulty with this picture is that it gives us no way of explaining why $[\text{ə}\theta\text{x}\text{ə}\text{ð}\text{m}\text{ə}\text{m}]$ occurs rather than $*[\text{ə}\text{x}\text{ə}\text{ð}\text{ə}\text{m}]$. Since UNIFORMITY is dominated by OCP and $[\text{m}\text{ə}\text{m}]$ violates OCP, the surface form with a geminate in correspondence with both underlying /m/s should be the winner. No IDENT-IO constraint can force the nongeminate candidate to win, because there is no featural difference between the correspondent consonants. If similarity (in the form of OCP violations) is capable of inducing coalescence, then underlyingly identical segments should always coalesce. The fact that surface sequences of identical consonants are possible seems to demand that we consider surface geminates to be the result of deletion rather than coalescence, since the deletion analysis gives us a way of explaining why some segments should fail to geminate.

We have seen, however, that the deletion analysis is incompatible with a very general OCP constraint violated by all sequences of coronals. If we are to maintain the notion that it is similarity between adjacent consonants that drives assimilation, we must conclude that the constraints motivating assimilation are more specific than OCP; they must demand assimilation of sequences like $[\text{ð}\theta]$ and $[\text{ln}]$, and fail to demand assimilation in cases like $[\theta\text{r}]$ and $[\text{ts}]$.

2.8.3 Variable impetus for assimilation: *SIMILAR&LOCAL

We have seen that while it is necessary to consider total assimilation the result of deletion of a melodic element if we are to explain the failure of $[\text{m}\text{ə}\text{m}]$ to become a geminate, the deletion analysis is incompatible with the notion that sequences like $[\text{ts}]$ and

[θr] violate the antisimilarity constraint driving assimilation. I now propose a more specific antisimilarity constraint, one violated only by certain sequences of coronals, not by all.

In Ayt Ndhir Tamazight, assimilation occurs when adjacent segments are identical in each of three dimensions: place of articulation, stridency, and sonority ("sonority" here referring to the distinction between sonorants and obstruents, not the sonority hierarchy).

When two adjacent segments are identical in all three dimensions, assimilation occurs.

When they are non-identical in any of these three respects, assimilation does not occur.

(39)

	Place of Articulation	Stridency	Sonority	Assimilates:
θ ð	√	√	√	Yes
n l	√	√	√	Yes
n r	√	√	√	Yes
θ r	√	√	*	No
θ s	√	*	√	No
θ f	*	√	√	No

I propose that a constraint *SIMILAR&LOCAL, violated by the cooccurrence of consonants identical in these three respects, drives assimilation in Ayt Ndhir Tamazight.

(40) *SIMILAR&LOCAL(place, strident, sonorant) (*SIMLOC)
 Consonants with the same specification for place, stridency, and sonorancy are not local.

The definition of "local" here is rather particular, but not unjustified. *SIMLOC must be violated both when two segments are immediately adjacent and when they are separated only by schwa. Schwa in Berber is extremely short, and its quality is determined entirely by the nature of the adjacent consonants. If *SIMLOC is grounded in a dispreference for adjacent segments which are auditorily indistinct, the irrelevance of schwa could be considered a result of the fact that such a short and characterless element is little more salient than no element at all. If, on the other hand, *SIMLOC is grounded in a dispreference for similar articulations falling one right after the other, the irrelevance of schwa could be thought a consequence of its near-total lack of articulatory specification,

which prevents it from counting as an intervening element between the articulations on other side. I leave the question open.

The constraint is similar in many respects to a set of constraints proposed by MacEachern (1996, 1997). MacEachern, in an analysis of restrictions on cooccurrence of laryngeal features, proposes a set of constraints violated by the occurrence of similar segments in the same word or morpheme.

- (41) *SIMILARITY
Similar segments should not cooccur. (MacEachern 1997)

Similarity, here, refers to auditory similarity. A *SIMILARITY constraint is violated when two segments are identical with respect to all of a particular set of dimensions of auditory similarity specific to the constraint. MacEachern's *SIMILARITY (6), for example, is violated when segments cooccur which are identical in place of articulation and in VOT; *SIMILARITY (1) is violated when segments cooccur which are identical in aspiration. The set of *SIMILARITY constraints is universally ranked; a given *SIMILARITY constraint X may not outrank a *SIMILARITY constraint Y in one language and be outranked by it in another.

While similar to *SIMLOC, MacEachern's *SIMILARITY is different in significant ways, most dramatically in the fact that *SIMLOC is restricted in its effects to adjacent or nearly adjacent consonants, while *SIMILARITY operates over the domain of an entire word or morpheme, and is violated even by widely separated segments within that domain. Like *SIMILARITY, however, *SIMLOC is conceived as a family of constraints, each referring to different dimensions of similarity. While only one such constraint is discussed here, other dialects of Berber have different assimilation patterns which require different versions of the constraint; a subsequent work will address these issues.

Assume, then, that *SIMLOC drives assimilation, and that geminates are related to underlying clusters by deletion (i.e. one member of the input cluster has no correspondent in the output). Like OCP, this gives the correct result for [attru] and [əkkərr]:

(42)

	$a_1d_2t_3r_4u_5$	*SIMLOC	MAX(d)
	$a_1d_2\text{ə}t_3r_4u_5$	*!	
☞	$a_1t_3r_4u_5$		*

(43)

	$k_1r_2n_3$	*SIMLOC	MAX(n)
	$\text{ə}k_1r_2\text{ə}n_3$	*!	
☞	$\text{ə}k_1\text{ər}_2$		*

The consonants [d] and [t] are identical in place of articulation, stridency, and sonority, as are the consonants [r] and [n]; *SIMLOC is therefore violated by *[adətru] and [əkkɾən]. The fact that [ts] and [θr] clusters do not assimilate is no longer problematic, since the difference in stridency in one case and sonority in the other prevent a *SIMLOC violation.

The failure of the two [m]s in [əθxəðməm] to become a geminate is explained, as before, by the ranking of MAX(m) above *SIMLOC:

(44)

	$\theta_1x_2\check{\delta}_3m_4m_5$	MAX(m)	*SIMLOC	MAX(d)
☞	$\text{ə}\theta_1x_2\text{ə}\check{\delta}_3m_4\text{ə}m_5$		*	
	$\theta_1\text{ə}x_2\check{\delta}_3\text{ə}m_5$	*!		

This version of the analysis seems to account for all the Ayt Ndhir Tamazight data. As noted above, different assimilation processes exist in different dialects of Berber, and different versions of *SIMLOC are needed to account for the various patterns.

2.9 Geminate inseparability revisited

Recall that there was a difficulty in explaining why [əkkɾəm] occurs rather than *[kəkrəm]; since [əkkɾəm] violates ONSET and *[kəkrəm] does not, we would expect that an epenthetic vowel occur inside rather than before the geminate. It was suggested that some constraint or principle violated by the breakup of an underlying geminate, ranked above ONSET, could be invoked:

(45)

	kkrm	(Geminate Inseparability)	ONSET
	kəkrəm	*!	
☞	əkkrəm		*

Given that we must propose *SIMLOC in any case to account for the occurrence of non-underlying geminates in certain surface forms, a specific mechanism forbidding the breakup of an underlying geminate is unnecessary. The sequence [kək] violates *SIMLOC, since [k] is identical in place, sonorancy, and stridency to [k]. The result of dividing a geminate, then, is a sequence that is phonotactically undesirable. Ranking *SIMLOC above ONSET will give us the correct result:

(46)

	kkrm	*SIMLOC	ONSET
	kəkrəm	*!	
☞	əkkrəm		*

Note that the fact that some MAX constraints are ranked above *SIMLOC is irrelevant in these cases. Even if the result of geminate breakup is a sequence like [məm] that would, if both segments were underlying, fail to become a geminate, the geminate will be preferred; since it is underlyingly a geminate, surfacing as a geminate does not involve any deletion.

2.10 Conclusions

I have presented an analysis of Berber in which the distribution of schwa is controlled entirely by two constraints, one demanding that syllables have simple margins and the other banning schwa from open syllables. I have shown also that the behavior of geminates in Berber, both derived and underlying, is a consequence of two factors: the acceptability of geminate codas (as opposed to nongeminate multiconsonantal codas) and a restriction on the cooccurrence in sequence of similar consonants. Geminate inseparability in Berber is shown to be an illusion requiring no explanation specific to itself; the constraint

against sequences of similar consonants makes the result of geminate breakup less phonotactically desirable than preservation of the geminate on the surface.

In the second half of the thesis, I discuss sections of the pattern where the generalizations made above break down: exceptional clusters formed by affixation and under other morphologically conditioned circumstances.

3 Exceptional Clusters

3.1 Introduction

In Ayt Ndhir Tamazight and in other Berber languages, certain affixes create clusters which deviate from the normal epenthesis pattern. Two such cases are shown below in a paradigm copied from Saib (1976), showing the the past conjugation of the verb /xǝm/ 'to work'. Surface forms are given on the left; the same forms are shown without schwa on the right.

(47)		<u>Singular</u>		<u>Plural</u>		<u>Singular</u>		<u>Plural</u>
	1	xǝmǝx	1	nǝxǝm	1	xǝm-x	1	n-xǝm
	2	θǝxǝmǝ	2m	ǝθxǝmǝm	2	θ-xǝm-ǝ	2m	θ-xǝm-m
			2f	ǝθxǝmemθ			2f	θ-xǝm-m-θ
	3m	ixǝm	3m	xǝmen	3m	i-xǝm	3m	xǝm-n
	3f	θǝxǝm	3f	xǝmenθ	3f	θ-xǝm	3f	xǝm-n-θ

(Saib 1976, p. 131)

When /-x/ is attached to /xǝm/ in the first person singular, the result is a word conforming to the regular pattern of schwa distribution. When /-ǝ/ is attached, however, no schwa occurs before the affix, resulting in a word-final cluster. The θ suffix in third person feminine plural forms likewise forms an otherwise illegal cluster with the preceding [m] or [n].

The ability to form a word-final cluster is a morphological property, not just a phonological property. Except in the biconsonantal roots considered later, root consonants do not form exceptional clusters, even when consonants that cluster as affixes are involved. (Bader 1985, p. 234; Saib 1976 p. 134) As an affix, [ǝ] forms a word-final cluster; as part of a root, it does not:

(48) ǝssǝngǝǝ 'to pulverize' (Saib 1976, p. 134)

Various explanations for the phenomenon have been proposed, most analyses holding that whether an affix forms clusters or not is a lexical fact of some sort. In Bader

(1984), the syllabification rules which drive epenthesis refer specifically to particular affixes, assigning them to positions within the syllable such that schwa will never be inserted before them. Dell and Tangi (1992) propose that certain affixes are lexically specified as extrametrical with similar effects. Kossman (1995) and Saib (1976) both hold that the appearance or nonappearance of schwa before an affix reflects the underlying presence or absence of a schwa in that position.

In this section, I examine the ways in which some of these notions could fit into the analysis of epenthesis already presented. As I will show, underlying differences in the presence or absence of schwa are insufficient in themselves to explain the surface pattern.

3.2 Underlying schwas

Saib and Kossmann both claim that those affixes which do not form word-final clusters contain underlying schwas, while those affixes which do form clusters lack them. The first and second person verb suffixes shown above, then, have the underlying representations in (49):

- (49) a. -əx
 b. -ǝ

In the first section, we saw that the distribution of schwa is in general determined entirely by *ə]_σ and *COMPLEX; we have claimed that *COMPLEX must outrank DEP(ə). If this view is maintained, then the underlying presence or absence of schwa in these forms is irrelevant. Whether or not schwa occurs before these affixes, since the absence of schwa would result in a word final cluster, a schwa should be inserted:

(50)

	θ + xǝm + əǝ	*ə] _σ	*COMPLEX	DEP(ə)
*☞	əθxəǝmǝǝ			**
	θəxǝǝmǝ		*!	**

(51)

	θ + xðm + ð	*ə] _σ	*COMPLEX	DEP(ə)
*→	əθxəðməð			***
	θəxðəmð		*!	**

Saib solves this problem by claiming that schwa is never inserted before a word-final consonant. He gives the epenthesis rule in (52):

(52) $\emptyset \rightarrow ə / _ \text{CCV}$

Since schwa is never inserted before a word-final consonant, schwa will appear before a monoconsonantal suffix only if it is underlying.

This approach has two problems. First, if it is claimed that epenthesis never occurs before a word-final consonant, it follows that any schwa before a word-final consonant is underlying. Yet except for words with nonclustering suffixes (and the verbs discussed in Section 3), word-final CC clusters do not occur in surface isolation forms. If schwa before C# is always underlying, then the fact that in general, it always occurs must be treated as an accident; a regular pattern in the lexicon that lacks any explanation in the phonology.

A more serious problem arises when we consider words in phrasal contexts rather than in isolation. As we have seen, generalizations about the distribution of schwa hold at the level of the phrase, not the level of the individual word; within a phrase, schwas present in the isolation form will be absent, and schwas absent in the isolation form will be present, to permit the entire phrasal string to satisfy *ə]_σ and *COMPLEX.

Yet schwa never occurs before a clustering affix, even when the affix is the first consonant of a CCV string at the level of the phrase. I have not found data of the relevant type for Ayt Ndhir Tamazight; an example is available from Kabyle, in which the pattern and the problem are fundamentally the same:

(53) θəqʃiʃθ θəbbi aqʃiʃ 'the girl pinched the boy' (Bader 1984, p. 125)

It is not enough, then, to say that the difference between clustering and nonclustering affixes reflects a difference between the underlying presence of absence of

schwa, since schwa fails to occur even when the epenthesis rule should insert it. Some factor must actively forbid the insertion of schwa before the clustering affixes.

Kossmann's proposal runs into similar problems. In this analysis, schwa is inserted by the following rule:

(54) $\emptyset \rightarrow \text{ə} / \text{C}(:)_ \text{C}(:)$ unless this would give rise to a sequence $[\text{əCV}]^7$

This rule applies before any affixes are attached; schwa will thus not occur before any suffix unless it is underlyingly present. When a vowel-initial suffix is attached, this triggers "resyllabification," which presumably involves both a rule deleting schwa before CV and a reapplication of rule (54).

Since in this analysis the epenthesis rule does apply before word-final consonants, it does not require that the otherwise general occurrence of schwa in that position be treated as accidental. It faces the same difficulty as Saib's analysis, however, when epenthesis in phrasal contexts is considered. Even if the epenthesis rule applies to individual forms only before affixation, since it must apply again to the entire phrasal string, there is no explanation for the failure of schwa to be inserted before the clustering affixes. Once again, we require some force that actively prevents epenthesis before the clustering affixes.⁸

In the next section, I propose that the force in question is a constraint demanding that affixes be immediately adjacent to their associated stems. This constraint outranks *COMPLEX, and is thus satisfied even at the cost of allowing word-final clusters.

⁷ " $|\text{CC}| \rightarrow |\text{CeC}|$ sauf si cela donne lieu à une succession $|\text{ecV}|$ " Kossmann (1995), p. 73. C stands for a geminate or singleton consonant, c for a singleton consonant.

⁸ One could propose that *COMPLEX is violated only by word-internal complex codas, and is not violated by word-final codas even when they are followed by a consonant belonging to another word. Data not yet presented (see section 3.4) contradicts this hypothesis; certain biconsonantal verb roots form word-final clusters in isolation or at the end of a phrase, and presumably must lack an underlying schwa before the last consonant. Yet when these words occur within a phrase, a schwa is inserted between the consonants when the next word begins with a consonant.

3.3 Affixes and alignment

Where suffixation leads to a word-final cluster, the suffix is immediately adjacent to the associated stem; were an epenthetic schwa inserted before the suffix, suffix and stem would be nonadjacent. As such, I propose that what prevents epenthesis in these cases is an Alignment constraint (McCarthy and Prince 1993) demanding suffix-stem adjacency:

- (55) ALIGN(Suffix, L, Stem, R)
The left edge of a suffix coincides with the right edge of a stem.

Observe that this constraint is satisfied by [θəxðəmð], but not by *[əθxəðməð]:

- (56) θəxðəm][ð əθxəðm]ə[ð

Ranked above *COMPLEX, ALIGN(Suffix, L, Stem, R) (henceforth simply ALIGN) produces the correct result:

(57)

	θ + xðm + əð	ALIGN	*COMPLEX
	əθxəðməð	*!	
☞	θəxðəmð		*

Since ALIGN bans epenthesis before suffixes, the underlying presence or absence of schwa before a suffixal consonant determines the presence or absence of schwa in the surface form. If the first person suffix has the underlying form /-əx/, the schwa does not produce an ALIGN violation.

Given this mechanism to prevent epenthesis before affixes, we have an explanation for the pattern. The powerful constraints on the distribution of schwa, *ə]_σ and *COMPLEX, neutralize any underlying distinction between schwa and Ø in most situations. Here, where ALIGN prevents *COMPLEX from having an effect, the underlying presence or absence of schwa can have an effect on the surface form.

This leaves certain facts unexplained, though it is not clear whether they demand a phonological explanation. If the property of being a nonclustering suffix derives from the property of having an underlying initial schwa, and the property of being a clustering affix derives from lacking such a schwa, then a certain lexical regularity lacks explanation: in

some dialects, the clustering affixes are all coronal obstruents (indeed, in Ayt Ndhir Tamazight, all coronal obstruents are clustering affixes). While it is not out of the question that this pattern could be accidental, regularities in another exceptional portion of the pattern, the biconsonantal verb roots, suggest that it may have a phonological explanation.

In the next section, I discuss the exceptional biconsonantal verb roots, and propose an explanation which involves different levels of constraint violation for different complex codas. Later, I discuss the implications of these constraints for the affixal pattern.

3.4 Biconsonantal verb roots and final clusters

A particular set of biconsonantal verbs stems have the form əCC when they occur unsuffixed in isolation or before a pause.

- | | | | |
|------|------------------|------------|---------------------------------|
| (58) | ənχ | 'to kill' | |
| | əds | 'to laugh' | (Bader 1984, p. 16) |
| | əzð ⁹ | | (Nait-Zerrad 1994, p. 186, 245) |

Other biconsonantal verb stems exist whose isolation forms vary freely between CəC and əCC. According to Bader (p. 53), all verbs of this type have sonorants as their first consonant¹⁰:

- | | | | |
|------|---------|----------------------|---------------------|
| (59) | ənz/nəz | 'to be on sale' | |
| | əns/nəs | 'to spend the night' | |
| | ərχ/rəχ | 'to burn oneself' | (Bader 1984, p. 52) |

⁹ No gloss available; Nait-Zerrad provides conjugations but no glosses.

¹⁰ Kossman (1995) disagrees, claiming that [zəd] and [əzd] are both possible forms of the same word. Kossman's account is based on Dallet's (1982) dictionary (Kossman 1995, p. 76), and this claim is evidently based on the fact that Dallet gives both variants at the start of the entry for this verb. It is not clear, however, whether the fact that both forms are listed should be taken to indicate that both are possible surface isolation forms; note that depending on the surrounding context, any CC verb stem can occur as CəC or əCC, and it may be this sort of allomorphy that Dallet's entry intends to indicate. The situation is, however, unclear; other verbs claimed by Bader to vary freely in isolation between CəC and əCC are listed with no variant forms by Dallet. A difference in dialects (Dallet discusses At Mangellet) may be at issue. Where there is contradiction between Kabyle sources I have generally followed Bader.

Biconsonantal roots from a third set always occurs as CəC in isolation:

- (60) məð 'parvenir à'
 wəθ 'to hit' (Kossman 19985, p. 76; Bader 1984 p. 47)
 ɣəz (Nait-Zerrad 1994, p. 54, 64)

The examples of əCC forms given by Bader and Kossman all have velar or coronal obstruents, voiced or voiceless, as the second member. In Nait-Zerrad's list of stems, all əCC verbs have a velar or coronal obstruent as their second consonant, and all velar or coronal obstruents in the Kabyle inventory are represented except θ, ʃ, and ʒ. A nonexhaustive search did not produce any biconsonantal roots of either type with final ʃ or ʒ. /CC/ roots with any nonvelar/noncoronal or nonsonorant final C never occur as əCC in isolation. Note that while all əCC verbs have a coronal or velar obstruent as their second consonant, not all verbs with such a final consonant occur as əCC, as shown in (60).

The same sequences which form clusters in (58) and (59) are broken up by epenthesis in triconsonantal or larger verb roots:

- (61) a. əðs 'rire'
 əɣðəs 'isoler' not *ɣəðs
 b. əzg 'aller à'
 əβzəg 'etre vetu' not *βəzg
 (Kossman 1995, p. 77)

In Ath-Sidhar Rifian, according to Dell and Tangi (1992), all biconsonantal verb roots whose second consonants are coronal obstruents, and apparently no others, occur as [əCC].

3.4.1 The motivation for clusters

I have claimed that the markedness constraints *ə]_o and *COMPLEX account for the distribution of schwa except where ALIGN interferes. Clearly, any verb of the form [əCC] violates *COMPLEX, as well as the presumably universal ONSET.

The occurrence of such forms cannot be explained simply in terms of phonotactic constraints. Neither the present constraints on the distribution of schwa, nor any reasonable system of markedness constraints, will prefer [əCC] to [CəC], however the constraints are ranked. Those forms which surface as [əCC] must therefore do so because [əCC] is more faithful, whether to the input or to some output form with which it stands in correspondence, than [CəC] would be, and the relevant faithfulness constraint or constraints outrank *COMPLEX.

In the next two sections, I examine two possible analyses of the pattern. One holds that it is the presence of underlying schwa that leads to the surface clusters; the faithfulness constraint in question is MAX(ə). The other holds that the clusters occur because this allows the forms in question to more closely resemble corresponding instantiations of the morpheme elsewhere in the paradigm; the faithfulness constraint that would be operative in this analysis is less easy to discern.

3.4.2 Underlying schwa

Kossman (1995) proposes that those verbs which surface as [əCC] do so because the schwa is underlying. The epenthesis rule cannot insert schwa between the consonants because this would lead to a sequence əCV. Thus [ənz] has the underlying representation /ənz/, while [ɣəz] has the underlying representation /ɣz/ or /ɣəz/.

Such an explanation could work in the present analysis if MAX(ə) is ranked above *COMPLEX:

(62)

	əðs	MAX(ə)	*COMPLEX
☞	əðs		*
	ðəs	*!	

(63)

	ɣz	MAX(ə)	*COMPLEX
	əɣz		*!
☞	zɛɣ		

(64)

$\gamma\partial z$	MAX(∂)	*COMPLEX
$\partial\gamma z$	*!	*
$\gamma\partial z$		

The problems, however, are numerous. In phrasal environments, many forms lack schwas in certain positions where a schwa occurs in the isolation form. To recap: imagine that the underlying form of [əxðəm] is identical to the isolation surface form: /əxðəm/. When /əxðəm/ appears before a vowel-initial word within a phrase, the positions of schwa change, and the word surfaces as [xəðm].

(65) $\partial_1 x \partial \partial_2 m \rightarrow x \partial_E \partial m \text{ a...}$ (∂_E = epenthetic)

If both $*\partial]_\sigma$ and *COMPLEX rank above MAX(∂), the correct form is predicted:

(66)

$\partial_1 x \partial \partial_2 m \text{ a...}$	$*\partial]_\sigma$	*COMPLEX	MAX(∂)
$x \partial_E \partial m \text{ a...}$			**
$\partial_1 x \partial_E \partial \partial_2 m \text{ a...}$	*!		
$\partial_1 x \partial m \text{ a...}$		*!	*
$\partial_1 x \partial \partial_2 m \text{ a...}$	*!*		

Underlying ∂_2 must be deleted to prevent a violation of $*\partial]_\sigma$; an epenthetic schwa must therefore be inserted to prevent a violation of *COMPLEX; this in turn makes it necessary to delete underlying ∂_1 to prevent a violation of $*\partial]_\sigma$.

If MAX(∂) outranks *COMPLEX, an underlying representation like /əxðəm/ is impossible; the initial schwa would be preserved, even if this requires a surface CCC cluster to arise:

(67)

$\partial_1 x \partial \partial_2 m \text{ a...}$	$*\partial]_\sigma$	MAX(∂)	*COMPLEX
$x \partial_E \partial m \text{ a...}$		**!	
$\partial_1 x \partial_E \partial \partial_2 m \text{ a...}$	*!		
$\partial_1 x \partial m \text{ a...}$		*	*!
$\partial_1 x \partial \partial_2 m \text{ a...}$	*!*		

The consequence of ranking MAX(ə) above complex is that we must claim that schwa just happens to be absent from underlying representations in all those positions where it must sometimes be deleted to prevent *COMPLEX violations. This pattern in the lexicon would have no explanation in the phonology, and would have to be considered entirely accidental.

Furthermore, the fact that no triconsonantal or larger verbs surface in isolation with final clusters requires that while verbs of the shape /əCC/ occur in the lexicon, verbs of the shape /CəCC/ do not. Verbs like [əγðəs] exist; verbs like [γəðs] do not. If we attribute clusters in biconsonantal verbs solely to the preservation of underlying schwa, this fact is simply an accidental regularity in the lexicon. Furthermore, the fact must be treated as accidental that in Kabyle, all biconsonantal verbs which form clusters end in velar or coronal obstruents; the nonexistence of isolation forms like *[əlf] and *[əsn] is an unexplained accident.

In the next section, I ignore the first difficulty and propose a solution to the second problem, the fact that only coronal and velar obstruents form such clusters. I claim that CC# and CCC clusters are forbidden not by the monolithic *COMPLEX, but by a set of more specific constraints on the possible segmental contexts of various consonants. The constraint forbidding [s] from occurring in the context C__# is less highly ranked than that forbidding [n] in the same context; while MAX(ə) outranks the first, it is outranked by the second. In this fashion, the absence of forms like *[əlf] and *[əsn] is explained as the consequence of constraints on surface strings, rather than as an accident.

3.4.3 The segmental contexts of consonants

Recall that all the Kabyle verbs which form final clusters end with velar or coronal obstruents, and that all the Ath-Sidhar Rifian verbs which form final clusters end with coronal obstruents. Recall also that all the Kabyle affixes which form final clusters are

coronal or velar obstruents, and all the Ath-Sidhar Rifian and Ayt Ndhir Tamazight affixes that form final clusters are coronal obstruents.

I propose that this is not accidental, but the result of a variable restriction on the possible environments of consonants. CCC and CC# clusters are banned not by *COMPLEX, but by a set of constraints V-ADJ(X):

- (68) V-ADJ(X)
A consonant of category X is adjacent to some vowel.

Two kinds of categories are relevant, place of articulation and sonorancy. The specific constraints necessary here are as follows:

- (69) a. V-ADJ(sonorant)
A sonorant consonant is adjacent to some vowel.
- b. V-ADJ(voice)
a voiced consonant is adjacent to some vowel.
- c. V-ADJ(coronal)
A coronal consonant is adjacent to some vowel.
- d. V-ADJ(velar)
A coronal consonant is adjacent to some vowel
- e. V-ADJ(labial)
A labial consonant is adjacent to some vowel.
- etc.

In all dialects, V-ADJ(sonorant) ranks above both ALIGN and MAX(ə). The ranking of the place-specific V-ADJ constraints with respect to ALIGN and Max(ə) varies according to the dialect. In Ath-Sidhar Rifian, only biconsonantal verb roots ending in coronal obstruents form final clusters; MAX(ə) outranks V-ADJ(coronal), but not V-ADJ(velar) or V-ADJ(labial). In Kabyle, only biconsonantal verb roots ending in coronal or velar obstruent form final clusters; MAX(ə) outranks both V-ADJ(coronal) and V-ADJ(velar).

This explains why form like [əðs] exist, while forms like *[əsn] do not. An input like /əðs/ will surface as [əðs] and an input like /ðəs/ will surface as [ðəs]; but both an input like /əsn/ and an input like /sən/ will surface as [sən].

(70)

	əðs	V-ADJ (sonorant)	MAX(ə)	V-ADJ (coronal)
☞	əðs			*
	ðəs		*!	

(71)

	əsn	V-ADJ (sonorant)	MAX(ə)	V-ADJ (coronal)
	əsn	*!		
☞	sən		*	

Recall, however, that there were two problems with the notion that the presence or absence of underlying schwa determines whether or not a biconsonantal verb forms a final cluster. The question of why only verbs ending in coronal or velar obstruents form final clusters is answered by attributing the dispreference for complex codas to V-ADJ rather than *COMPLEX. The other question is still unanswered: why do only biconsonantal verbs form final clusters?

3.4.4 The shapes of stems

Berber verbs are usually described as having a number of different stem shapes, each used in the construction of a certain set of conjugations. All the examples I have given of biconsonantal verbs so far have shown the "unmarked" (or "Zero-form" or "aorist") stem, used in the construction of imperative and future forms. (Bader 1984, p 16; Penchoen 1973 p. 28)

The unmarked stem of a verb and the perfect or preterite stem can be related to each other in a number of different ways. For many verbs, there is no difference between the unmarked and the perfect stems; [əxðəm], for example, has the same shape in both the

unmarked and the perfect stems; the consonants /xǝm/, with no vowels but contextually determined schwa.

The biconsonantal verb stems lacking nonschwa vowels fall into two classes. For some, the perfect stem contains a vowel after the second root consonant, alternating between [i] and [a] depending on person and gender. For others, the perfect stem is identical to the unmarked stem, containing no additional segmental material other than contextually determined schwa. I will refer to verbs of the first type as i-stems and verbs of the second type as Ø-stems. An example of each in the past tense conjugation is shown below.

(72)	/gr/: Ø-stem	/sw/: i-stem
1	grəγ	swiγ
2	təgrəd	təswid
3m	igər	yəswa
3f	tgər ¹¹	təswa
1p	ngər	nəswa
2p m	təgrəm	təswam
2p f	təgrəmt	təswamt
3p m	grən	swan
3p f	grənt	swant

(Naït-Zerrad 1994, p.64, 185)

Of the 14 [əCC] verbs listed in Naït-Zerrad's index of Kabyle verbs, 11 are i-stems, as are all of the few [əCC] forms given by Penchoen (1973). All of the i-stem verbs listed by Naït-Zerrad that have coronal or velar obstruents as their final consonants are of the [əCC] type.¹²

Note in (72) that in the i-stem verb, the root consonants form a contiguous string throughout the paradigm, while in the Ø-stem verb, the consonants are sometimes adjacent,

¹¹ Naït-Zerrad does not indicate initial epenthesis and does not, for most obstruents, distinguish between the fricative and stop allophones. Glosses, likewise, are not provided.

¹² From the category "i-stems" I exclude those forms which add a final [i/a] in the perfect but also change in some other way, such as by geminating one of the root consonants.

sometimes separated by schwa. I propose that it is this fact which causes the [əCC] verbs to form final clusters; the clusters allow the contiguity relationship which is present throughout the perfect paradigm to be maintained in the bare form of the unmarked stem.

My claim will be that the unmarked stem is in correspondence with the perfect stem, and that a constraint demanding that contiguity relationships be identical between strings in correspondence forces the final cluster. The first problem is deciding what, exactly, is in correspondence with what.

3.4.5 Correspondence with the perfect stem

Imagine that the correspondence relationship at issue holds between the unmarked stem and some output form constructed on the perfect stem. For [əCC] verbs, the correct result is obtained no matter what perfect output form is selected as the corresponding form; in all surface perfect forms of i-stems, the consonants of the root are adjacent. The constraint NO INTRUSION(perfect/unmarked), a specific version of the general constraint O-CONTIG proposed by McCarthy and Prince (1995) demands identity of contiguity relationships between two forms:

- (73) NO INTRUSION(perfect/unmarked)
 The portion of the unmarked stem standing in correspondence forms a contiguous string.
(McCarthy and Prince 1995, p. 123)

NO INTRUSION is violated when an element not present in the perfect stem is present between the root consonants in the unmarked stem. Thus the perfect/unmarked pair in (a) violates the constraint, while (b), (c), and (d) do not:

(74)		Perfect	Unmarked	
	a.	...fk...	fək	Violates NO INTRUSION
	b.	...fk...	fk	Does not violate NO INTRUSION
	c.	...fək...	fək	Does not violate NO INTRUSION
	d.	...fək...	fk	Does not violate NO INTRUSION

Ranked above V-ADJ(coronal) and V-ADJ(velar), NO INTRUSION will force a word-final cluster for i-stems ending in coronal or velar obstruents:

(75)

	fk	NO INTRUSION	V-ADJ (velar)
☞	əfk		*
	fək	*!	

3rd person singular feminine perfect: θəfka

The 3rd person singular perfect form is arbitrarily selected here as the form in correspondence, but any other perfect form would give the same result. No perfect form of an i-stem has schwa between the root consonants; a schwa between the root consonants in the imperfect violates NO INTRUSION no matter which perfect form is taken as the correspondent.

The same is not true of the Ø-stem verbs. The perfect conjugation of [wəθ] is identical to that of [gər] in (72). In those surface forms with suffixes, the root consonants are adjacent; in those without suffixes, the consonants are non-adjacent. The failure of [wəθ] to cluster is only explained if the unmarked stem is in correspondence with one of the non-suffixed perfect forms; otherwise, NO INTRUSION will demand a final cluster in this case, too.

(76)

	wθ	NO INTRUSION	V-ADJ (coronal)
	əwθ		*!
☞	wəθ		

3rd person singular feminine perfect: əθwəθ

(77)

	wθ	NO INTRUSION	V-ADJ (coronal)
*☞	əwθ		*
	wəθ	*!	

3rd person plural masculine perfect: əwθən

We could capture the pattern, then, by claiming that unmarked forms of a verb are in correspondence with the 3rd person singular perfect surface form, and that the constraint NO INTRUSION, which demands that if segments in that perfect form are adjacent, their correspondent in the unmarked form be adjacent too, is ranked above V-ADJ(coronal) and V-ADJ(velar).

The obvious objection to such an account is the complete arbitrariness of positing a correspondence relationship between the unmarked stem of a verb and some particular perfect output form. Why should such a relationship exist with one particular output form rather than some other, since no perfect output form is more basic than any other in any obvious way?

Let us consider instead the possibility that the unmarked stem is in correspondence with *all* instantiations of the perfect stem. An unmarked stem form like [əfk] or [gər] is in correspondence not just with the 3rd person singular perfect form, but with every output form in the perfect paradigm.

Both NO INTRUSION and its sister constraint NO SKIPPING constrain the form of the unmarked stem.

- (78) NO SKIPPING(perfect/unmarked)
 The portion of the perfect form standing in correspondence forms a contiguous string.
 (McCarthy and Prince, 1995 p. 123)

NO SKIPPING is violated when a schwa is present between the root consonants in the perfect form, but omitted in the unmarked form. Thus the perfect/unmarked pair in (a) violates NO SKIPPING, while the pairs in (b), (c), and (d) do not:

(79)		Perfect	Unmarked	
	a.	...wəθ...	wθ	Violates NO SKIPPING
	b.	...wθ...	wθ	Does not violate NO SKIPPING
	c.	... wəθ ...	wəθ	Does not violate NO SKIPPING
	d.	... wθ ...	wəθ	Does not violate NO SKIPPING

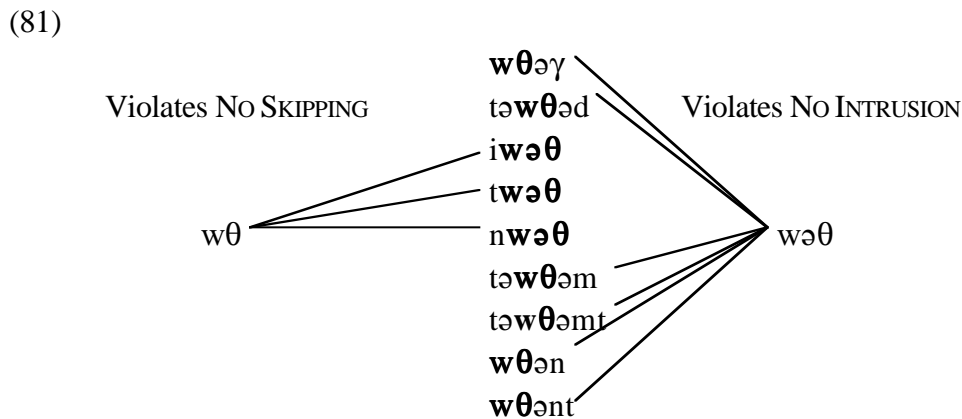
Since in the perfect forms of i-stem verbs, the string containing the root consonants always contains only the root consonants unseparated by schwa, NO INTRUSION is violated when the unmarked stem of an i-stem contains schwa. Since NO INTRUSION outranks the relevant V-ADJ constraints, final clusters are tolerated in the unmarked form of i-stems:

(80)

	fk	NO SKIPPING	NO INTRUSION	V-ADJ (velar)
☞	əfk			*
	fək		*!	

String in perfect always **fk**

In Ø-stem verbs, on the other hand, the string containing the root consonants contains only the root consonants in some perfect forms (e.g. əwθen), but contains schwa between the root consonants in others (e.g. əθwəθ). Since the unmarked form is in correspondence with all forms in the perfect paradigm, every candidate output for the unmarked form violates either NO SKIPPING or NO INTRUSION:



Some perfect forms of Ø-stems contain schwa, while others do not. An unmarked form with schwa, then, will never violate NO SKIPPING, but will violate NO INTRUSION with respect to those perfect forms lacking schwa. An unmarked form without schwa, on the other hand, will never violate NO INTRUSION, but will violate NO SKIPPING with respect to

those perfect forms lacking schwa between the root consonants. If NO SKIPPING outranks NO INTRUSION, the winner in such cases will be the form with schwa, as shown in (82).

(82)

wθ	NO SKIPPING	NO INTRUSION	V-ADJ (coronal)
əwθ	*!		
wəθ		*	

String in perfect sometimes **wθ**, sometimes **wəθ**

These correspondence relationships and this ranking of constraints predict that two conditions must be true for a verb to form a final cluster: the verb must be an i-stem, and it must end with a velar or coronal obstruent. This conforms, though not perfectly, to the pattern actually observed in Kabyle. This analysis also provides an explanation for why only biconsonantal verbs form final clusters, while triconsonantal verbs ending with the same sequences of consonants do not. No triconsonantal verb forms the perfect by adding a final vowel; thus, for verbs that lack a nonschwa vowel between their final consonants, the perfect paradigm will include both forms in which the final consonants are adjacent and forms in which they are separated by schwa. Since NO SKIPPING outranks NO INTRUSION, in all such cases the form without a final cluster will be preferred.

We might wonder whether different rankings of these constraints will produce bizarre or unattested patterns. Reranking NO SKIPPING and NO INTRUSION with respect to the V-ADJ constraints will reduce or expand the set of verbs which form final clusters. If NO INTRUSION ranks below V-ADJ(velar), for example, only i-stems ending in coronal obstruents will form clusters; Berber dialects do in fact vary in this way, with the set of Ath-Sidhar Rifian clustering verbs being confined to those ending with coronal obstruents. To my knowledge, no dialects permit final clusters ending with anything other than a velar or coronal obstruent.

Reversing the ranking of NO SKIPPING and NO INTRUSION has a more interesting consequence. Since i-stems never violate NO SKIPPING, the reranking will be irrelevant to them; as long as NO INTRUSION outranks certain V-ADJ constraints, i-stems ending with the consonants protected by those V-ADJ constraints will form final clusters.

Ø-stems, however, will behave differently with this ranking. NO INTRUSION is violated when a schwa that is present in some perfect form is absent from the unmarked form; NO SKIPPING is violated when a schwa that is absent from some perfect form is present in the unmarked form. Since for Ø-stems, the perfect paradigm includes both forms in which schwa intervenes between the root consonants and forms in which the root consonants are adjacent, every candidate violates one constraint or the other; but if NO SKIPPING outranks NO INTRUSION, then the winning candidate, where no other constraints interfere, will be one in which no schwa occurs between the consonants.

(83)

wθ	NO INTRUSION	NO SKIPPING	V-ADJ (coronal)
əwθ		*	
wəθ	*!		

String in perfect sometimes **wθ**, sometimes **wəθ**

The result, then, is that both i-stems and Ø-stems will form final clusters if the V-ADJ constraints permit; all biconsonantal roots with a final consonant of the appropriate sort will form clusters.

While adequate data is not available to me, Dell and Tangi's brief (1992) discussion suggests that this is in fact the pattern of Ath-Sidhar Rifian. They state that "all the /CC/ verbal radicals ending in a coronal obstruent" (134) form final clusters. If the verbal morphology of Ath-Sidhar Rifian is such that all /CC/ verbs, or all /CC/ verbs ending in coronal obstruents, are i-stems, then the pattern is compatible with either ranking of NO SKIPPING and NO INTRUSION. If, however, as seems more likely some /CC/ verbs are i-stems and some are not, as in other Berber dialects, then the pattern is exactly that predicted by ranking NO SKIPPING over NO INTRUSION and both over V-ADJ(coronal): the unmarked

form of a CC verb will form a final cluster if its final consonant is a coronal obstruent, regardless of whether or not it is an i-stem.

Note that this ranking will still correctly predict that triconsonantal and larger roots do not form final clusters. Consider a verb like [əβzəg], 'etre vetu'. The perfect conjugation of the verb is as follows:

(84) /βzg/

1	βəzgəγ
2	əθβəzgəð
3m	yəβzəg
3f	θəβzəg
1p	nəβzəg
2p m	əθβəzgəm
2p f	əθβəzgəmθ
3p m	βəzgən
3p f	βəzgənθ

The relevant string occurs sometimes as [βzəg], sometimes as [βəzg]. Any schwa in the unmarked form, then will violate NO SKIPPING, since any schwa will fail to have a correspondent in at least some perfect forms. Likewise, the absence of schwa either before or after z will incur a violation of NO INTRUSION.

I will anticipate the claims of the next section, and state now that in addition to V-ADJ, a stricter constraint on consonantal environments be posited. V-ADJ is violated whenever the consonant in question fails to be adjacent to a vowel; that is, in any of the environments P__C, C__C, or C__P, P indicating pause. Clusters are tolerated prepausally that are not tolerated before a consonant; an additional and higher-ranked constraint banning consonants from the environment C__C is therefore necessary.

To return to the matter at hand: since [z] cannot be interconsonantal, the only possible surface forms for the unmarked stem of this verb are [əβzəg] and [βəzg]. Since both forms violate both NO INTRUSION and NO SKIPPING, the contiguity constraints do not

decide between them; the decision is made by the V-ADJ constraints alone. Since [əβzəg] violates V-ADJ(velar) while [βəzɡ] does not, [əβzəg] is the winner:

(85)

	bzɡ	NO SKIPPING	NO INTRUSION	V-ADJ (velar)
	βəzɡ	*	*	*!
☞	əβzəg	*	*	

String in perfect sometimes **βəzɡ**, sometimes **βzəg**

Whatever the rankings between these constraints, then, we have an explanation for the difference between biconsonantal verb stems and others.

Several issues remain unresolved by this analysis. The existence of a few [əCC] verbs in Kabyle that are not i-stems is not predicted by this account; I have no explanation for them at present. The free variation reported for the bare forms of certain /CC/ verbs, and the (possible) fact that all such verbs have a sonorant first consonant, is likewise unexplained.

3.4.6 C__Pause versus C__C

These word-final clusters arise only when the verbs occur in isolation or before a vowel-initial word; when they occur before a consonant-initial word, the final clusters are not tolerated:

- (86) a. rəz θifərfərθ / *ərz θiferferθ 'break the kite'
 b. ðəs fəllas / *əðs fəllas 'laugh at him'

(Bader 1984, p. 53)

The V-ADJ constraints penalize any consonant which is not next to a vowel, but make no distinction between adjacency to another consonant and adjacency to a pause. To explain why these clusters are tolerated only prepausally, we must propose another family of constraints on consonantal environments, one making the less strict demand that a consonant not be flanked on both sides by consonants.

- (87) *INTERCONSONANTAL(X)
A consonant of category X is not interconsonantal.

The constraint must, obviously, make no distinction between neighboring consonants within the same word and neighboring consonants belonging to another word.

For all consonants, *INTERCONSONANTAL(X) must rank above NO INTRUSION, since no matter what their final consonant is, verbs never occur as [əCC] before a consonant-initial word. As noted at the end of the previous section, this ranking of the *INTERCONSONANTAL constraints also ensures that triconsonantal and larger verbs behave correctly in isolation forms.

The clustering affixes are insensitive to the distinction between a consonantal neighbor and a pause; no schwa occurs before the suffixal θ in [θaqj_ifθ] whether the word is followed by a pause, a consonant, or a vowel. For those consonants forming affixal clusters, then, *INTERCONSONANTAL(X) must rank below ALIGN.

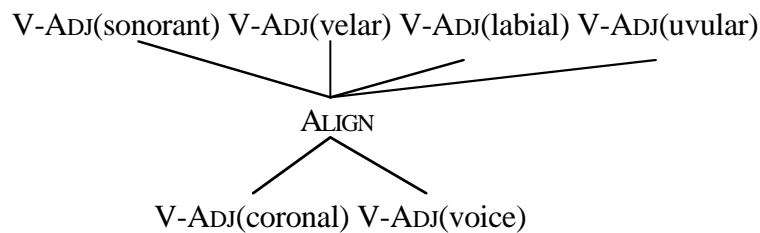
3.5 Clustering affixes revisited

Across Northern Berber dialects, the clustering affixes are predominantly coronal obstruents. Saib (1976) reports that two suffixes in Ayt Ndhir Tamazight form exceptional clusters: /-θ/ and /-ð/. Data in Penchoen (1973, pp. 26-27) suggests that the 2nd person masculine direct and indirect object clitic /ʃ/ and the third person indirect object clitic /s/ also form such clusters. In Kabyle, according to Bader (1984), /-θ/ forms word-final clusters, but /-ð/ does not; both are cognate to the Ayt Ndhir Tamazight suffixes. The direct object clitics θ , ts, and k (3rd person masculine, 3rd person feminine, and 2nd person respectively) also form word-final clusters. In Ath-Sidhar Rifian, according to Dell and Tangi (1992), a number of suffixes and clitics of this sort exist, all coronal obstruents. While a full list is not given, /-ð/ (cognate with the Ayt Ndhir Tamazight and Kabyle suffixes) is specifically excluded.

I have proposed that different constraints restrict the segmental context of different consonants. This notion gives us a way of explaining the regularities in the class of clustering suffixes; if no V-ADJ constraint but V-ADJ(coronal) is ranked below ALIGN, then only coronals can be clustering affixes; whether a noncoronal consonant has an underlying initial schwa or not, a schwa will occur in that position on the surface where the phonotactic constraints demand it.

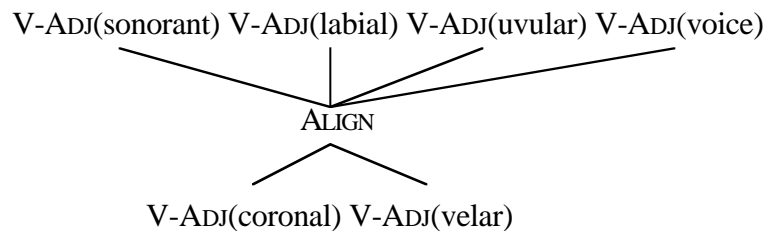
The Kabyle and Ayt Ndhir Tamazight patterns are predicted by the rankings below:

(88) Ayt Ndhir Tamazight:



Voiced and voiceless coronal obstruents can be clustering affixes

(89) Kabyle:



Voiceless velar and coronal obstruents can be clustering affixes

These rankings will ensure that a distinction between schwa-initial and non-schwa-initial suffixes is possible only for affixes whose consonants are protected by V-ADJ constraints ranking below ALIGN. . Whether schwa is present or absent in the underlying

representation of, for example, a monoconsonantal sonorant suffix, a schwa will be present if necessary to make the suffix vowel-adjacent and absent otherwise.

Note, however, that this system does not make the clustering properties of a suffix entirely predictable; an distinction between schwa and Ø before a suffix whose consonant is protected by a low-ranked V-ADJ constraint will survive on the surface. Such a distinction occurs in Kabyle and Ath-Sidhar Rifian; the plural imperative suffix θ does not cluster, while the feminine suffix θ does.

- (90) əwθəθ 'you (pl) hit'
θamʃisθ 'cat (fem)' (Bader 1985, pp. 234-235)

A more satisfactory explanation of the affixal clustering which makes use of notions of Paradigm Uniformity may unnecessary the claim that affixal schwas are phonemic. I postpone an analysis of this sort for another time.

3.6 Conclusion

I have shown that the patterns of deviation from the general epenthesis pattern are governed both by morphological conditions and phonological conditions. Constraints on affixal alignment and on the phonological resemblance between different forms in the same verbal paradigm compel exceptional consonant clusters, while phonological conditions on consonantal environment limit the extent to which the morphological demands can be satisfied.

A fully satisfactory explanation for the affixal pattern is yet to be devised; a phonemic schwa of extremely limited distribution, which would perhaps be absent from the ideal solution, is still necessary in some cases. It is possible, however, that phonemic schwa may be necessary in any case; a limited set of nouns of Arabic origin, not discussed here, also contain schwa in otherwise surprising locations.

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