On the Internal Structure of Tashlhiyt Berber Triconsonantal Roots

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This article examines the internal structure of triconsonantal roots in Tashlhiyt Berber. It is proposed that these roots have a binary-branching head-complement structure, built upon the sonorant and the segment immediately to its left. Evidence for this structure is provided by the imperfective formation. It is argued that only roots that display such a structure undergo gemination in the imperfective. This permits an account for a number of forms that are traditionally ascribed to lexical idiosyncrasy, including verbs that are made up entirely of obstruents and those whose only sonorant is in initial position.

Keywords: roots, imperfective, Tashlhiyt Berber, phonology, morphology

According to the traditional view, the lexicon[1] of the Afroasiatic languages consists mainly of triconsonantal roots (see, e.g., M. Cohen 1947:58, D. Cohen 1972, 1988, Chaker 1990). Many of these roots are said to be historically derived from earlier biconsonantal roots (see MacDonald 1966, Diakonoff 1970, Weil 1979, Tobin 1990, Zaborski 1991, Elmedlaoui 1994) or to contain certain specific consonants,[2] which Ibn Jinni (d. 1002) called ''almoutlaqat'' in the case of Classical Arabic. Moreover, they obey phonological constraints that limit the kind of segments they contain. Thus, for instance, adjacent gutturals are prohibited in a single root (see Greenberg 1955).

Berber and Semitic, more particularly Classical Arabic, converge on these properties. They diverge, however, on the nature and the arrangement of segments in the root. Specifically, in Classical Arabic a root may consist entirely of voiceless obstruents (see examples in (1)), whereas in Tashlhiyt Berber each triconsonantal root contains at least one sonorant, most often preceded by an obstruent.[3]

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1 In the sense of ''lexical items.''

2 /l, r, n, m, b, f/. Most of them are sonorants. The labials /f, b/ probably result from a well-known phonetic change in Semitic by means of which $m \rightarrow b \rightarrow f/p$ (see Moscati et al. 1964:24).

3 Out of 220 roots listed in the appendix, 17 are made up entirely of obstruents. They are discussed in section 3.5.

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(1) *Classical Arabic*

√kʃf	kaʃaf	'pull away'
√kfs	kafas	'be bandy-legged'
√ksf	kasaf	'be or become dark'

The analysis will focus on this particular property that differentiates Tashlhiyt Berber and Classical Arabic roots. The aim is to show that many of the verbal triconsonantal roots in Tashlhiyt Berber are basically binary, in that only two of their segments are constrained. In section 1, I give an overview of the notion of ''root'' in Afroasiatic languages as opposed to Indo-European languages. In section 2, I present the relevant Tashlhiyt Berber data. In section 3, I put forward a hypothesis about the internal structure of Tashlhiyt Berber triconsonantal roots. I propose that roots of this kind have a binary-branching head-complement structure built upon the sonorant and the consonant to its left. In section 4, I examine biconsonantal roots. In section 5, I provide evidence from the imperfective formation in favor of the binary-branching head-complement hypothesis: I argue that only verbs that display such a structure geminate a consonant in the imperfective, and the way this gemination is achieved depends on how the root is structured internally. This proposal challenges earlier syllable-based accounts of the phenomenon (see Dell and Elmedlaoui 1988, 2002, Jebbour 1999, Bensoukas 2001), making the role of the syllable redundant in determining the geminating consonant in the verb.

1 What Is in a Root?

1.1 The Segmental Content of the Root

A recurring question in Berber derivational morphology relates to the role of the root in word formation processes. Several scholars have challenged the various attempts to define this object: What is a root made of? What is its role in word formation processes?

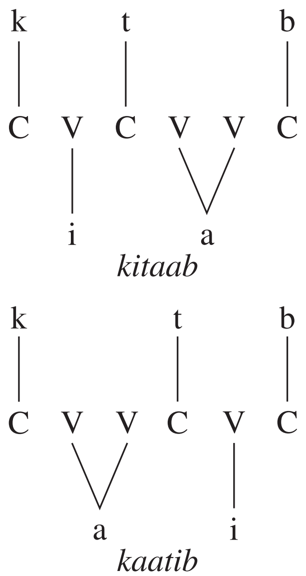
In Indo-European languages, the root is roughly considered to be the smallest meaningful lexical unit that a set of items have in common. This lexical unit is assumed to contain both consonants and vowels. For example, the items *reason*, *reasoning*, and *reasonable* share the root *reason* whereas *receive*, *deceive*, *perceive*, and *conceive* share the root *ceive*, which never occurs by itself.[4] In contrast, in the overwhelming majority of works on Semitic linguistics, semantically related words are described as sharing a common root that consists entirely of consonants. Within the autosegmental phonology program, root consonants have acquired a morphological status expressed through multi-tiered representations where the root lies on a distinct tier (see McCarthy 1979, 1981). Associated with vocalic melodies and affixes to specific templates, they form words.[5] For example, the Classical Arabic root √*ktb* 'write' associated with the vocalic melody *i-a* to the template CVCVVC derives the form *kitaab* 'book', which contrasts with the form *kaatib* 'writer'

[4] This is called a *cranberry* morpheme in reference to *cran-*, which is a kind of bound morpheme that can neither be assigned a specific meaning nor function as an independent word (see Aronoff 1976, Spencer 1991).

[5] In Semitic morphology, roots relate to patterns. This is called *root-and-pattern morphology* (see McCarthy 1979, 1981, and subsequent works).

derived by associating the same root with the inverse melody *a-i* to the template CVVCVC. This is shown in (2).

(2) a. b.



Additional arguments from word games and secret languages support the idea of root consonantism and its relevance in word formation processes.[6] For example, McCarthy (1981:379, 1991: 12) has pointed out the ability of word game users to extract and manipulate the consonants that form the root. He has noticed that the basic operation that underlies a Bedouin Hijazi Arabic word game consists in extracting and permuting root consonants. A verbal form such as *kuttib* 'write-causative-passive-perfective-3sg.masc' is rendered by one of the following disguised forms: *buttik*, *kubbit*, *tukkib*, *tubbik*, *bukkit*. External evidence from language disorders and speech errors is provided in Prunet, Béland, and Idrissi 2000 and Idrissi, Prunet, and Béland 2008. On the basis of errors made by aphasic patients, the authors argue that ''Arabic roots can be accessed as independent morphological units'' (2000:610). They present a case study of a bilingual Arabic-French aphasic patient who produces more metathesis errors in Arabic than in French. The metathesis errors he produces in Arabic consist in modifying the linear order of root consonants: for example, *ʔiħ-t-imaal* → *ʔiħ-t-ilaam* 'probability', *fuqar-aaʔ* → *furaq-aaʔ* 'poor', *ma-sbaħ* → *ma-ħbas* 'swimming pool'. Further evidence for consonantal roots in Semitic is provided in Prunet 2006.

The contrast between Indo-European and Semitic languages with respect to the notion of ''root'' conveys the traditional opposition between concatenative and nonconcatenative morphologies. In Berber languages, the issue is not so clear-cut, although most scholars (see, e.g., Basset 1929, Cantineau 1950, Galand 1988, Chaker 1990) conceive of the root as the minimal meaningful unit, entirely composed of discontinuous consonants, ordered in a fixed way and bearing a general meaning, while vowels have a grammatical role. On the contrary, other scholars working for the

[6] For alternative views to root-based approaches to Semitic morphology, see among others Bat-El 1994, Ratcliffe 1997, and Ussishkin 1999.

most part within the generative tradition (see Moktadir 1989, Dell and Elmedlaoui 1991, 1992, Dell and Jebbour 1991, Bensoukas 2001)[7] claim that in certain cases consonants and vowels should not be separated, as they share lexical information (see also Kossmann 1997:130). The argument is given with the aorist form, described as an indivisible verbal form in which vowels coexist with consonants (examples follow in (3)), as well as with the high vowel/glide alternation analyzed as the phonetic reflex of the same underlying segment.

The ambiguous status of the root in Berber is actually related to the hybrid morphological operations the language uses. That is, the Berber morphology is a mixture of concatenative and nonconcatenative operations. On the one hand, most scholars agree that words such as *dl* 'cover!', *addal* 'chador', *taduli* 'covering', *amdlu* 'cloud', and *imdl* 'cap' share the root √*dl*. Likewise, *askrz* 'plow', *amkraz* 'plowman', and *tayrza* (← *takrza*) 'plowing' share the root √*krz*. On the other hand, several word formation processes—basically concatenative—are not readily analyzable in terms of a consonantal root. The following verbal forms illustrate the issue:

(3)	*Preterit*	*Imperfective*	*Aorist*	
a.	inkr	nkkr	nkr	'stand up'
	izgr	zggr	zgr	'cross'
	$ik^{w}na$	knnu	knu	'lean'
	ibri	brri	bri	'scratch'
b.	imun	ttmuna	mun	'accompany'
	imatr	ttmatar	matr	'watch, oversee'
	isawl	sawal	sawl	'speak'
	iwala	ttwala	wala	'border on'

By means of a simple discovery procedure, the verbs given in (3a) can be decomposed into discrete morphemes linearly concatenated. Preterit forms consist of three consonants preceded by the 3rd person masculine marker *i*-, while imperfective forms involve the gemination of the medial consonant. In contrast, aorist forms undergo no morphological operation. They merely exhibit the three consonants common to the other two verbal conjugations. The verbs in (3b) involve both concatenated and nonconcatenated morphemes. Apart from aspect and person markers, the remaining morphemes are problematic in that they are neither divisible into smaller meaningful units nor reducible to consonantal roots. The vowels they exhibit are commonly described as being part of the base. Similarly, certain nouns display indivisible bases while in others root consonants are easily extracted. Singular and plural formations illustrate the problem. Singular forms such as *asaru* 'pipe', *asafu* 'torch', and *agrtil* 'plait' fall readily under the root-and-pattern morphology, as they share the same consonantal material as their plural counterparts

[7] Alternative works in the same tradition argue that roots are consonantal in Berber as much as in Semitic (see Idrissi 2001:125–176, Lahrouchi 2004).

isura, *isufa*, and *igrtal*, while their vowels show regular alternations.[8] By contrast, other nouns keep their internal vowels unchanged and form their plurals merely by means of suffixation: for example, (sg) *ikzin* → (pl) *ikzin-n* 'pup', *ayniw* → *ayniw-n* 'palm tree', *argaz* → *irgaz-n* 'man', *abidˤar* → *ibidˤar-n* 'lame person'.

Nevertheless, one noticeable difference remains between Tashlhiyt Berber and Classical Arabic with respect to root structure. In the former language, the consonantal root is surface-true, whereas in the latter, it is an abstract morpheme that never surfaces as such. For instance, in Tashlhiyt Berber the consonants *dl* shared by the items *addal*, *taduli*, *amdlu*, and *imdl* surface as such in the aorist form of the verb meaning 'cover'. Likewise, the consonants *krz* common to the items *askrz*, *amkraz*, and *tayrza* (← *takrza*) form the aorist of the verb meaning 'plow'. On the contrary, in Classical Arabic the consonants *ktb* necessarily combine with vocalic morphemes and templates to form words such as *kataba* 'he wrote', *kitaab* 'book', and *kaatib* 'writer'. Yet some authors (see, e.g., Hammond 1988, McCarthy and Prince 1990) reject the consonantal root in Classical Arabic with arguments that such a morpheme involves a high degree of abstraction and fails to account for transfer phenomena, as when the length of the second vowel in singular forms such as *sultˤaan* 'sultan' and *ʒundub* 'grasshopper' is transferred to the plural forms, in these cases *salaatˤiin* and *ʒanaadib*. Similar criticisms are found in Bat-El 1994, 2003, and Ussishkin 1999 regarding Hebrew.

1.2 Morphological Productivity and Learnability

Morphological productivity can be defined informally as the extent to which a given affix or grammatical process is used in the formation of new words.[9] If consonantal roots exist as such in the lexicon of Tashlhiyt Berber, we expect them to have an active role in word formation. Also, words are expected to be stored in the lexicon once analyzed into a consonantal root plus other grammatical morphemes. This is actually the case in Classical Arabic, where loanwords tend to preserve the original consonantal material. For example, the French words *doublage* 'doubling', *télévision* 'television', *four* / *fourneau* 'oven, stove', and *franciser* 'Frenchify' are adapted as *dablaʒa*, *talfaza*, *furn*, and *farnasa*, respectively. Likewise, the words *nucleus*, *tomatoes*, and *dolphin* are adapted as *nawaat*, *tˤamaatˤim*, and *dalfiin*. Moreover, many of these words

[8] I should note, however, that such formations involve different operations that refer to the traditional distinction in morphological theory between morpheme-based (item-and-arrangement) and word-based (item-and-process and word-and-paradigm) models (see Hockett 1954). The association of consonantal roots to templates belongs to the first type of morphology, and vocalic alternations belong to the second type. A number of criticisms of morpheme-based models note that they fail to account for the problem of melodic transfer found in certain derivations. For example, in the verb-to-noun derivation *bbz* 'to punch' / *ubbiz* 'a punch', *gzzr* 'cut up' / *agzzar* 'butcher' in Berber, the geminated consonant in the verb form also appears in the noun form. According to Dell and Elmedlaoui (2002:55), root-based analyses do not explain why the ''derived forms preserve as much as possible the length of the consonants in the source words.'' On the other hand, word-based models face the problem of arbitrariness of the input. For instance, the decision whether singular *asaru* 'pipe' or plural *isura* is the input to derivation is fairly arbitrary, since the vocalic alternation they display is not sufficient to determine the direction of derivation.

[9] The notion of ''productivity'' in morphology is still under debate. Some authors discuss affix productivity; others talk about productive processes or rules (see Bauer 2001:12, and references therein). Moreover, authors such as Aronoff and Anshen (2001:242) distinguish quantitative and qualitative productivity.

undergo the usual nonconcatenative operations: for example, ‘nucleus’ *nawaat* / *nawawii* ‘nuclear’, ‘dolphin’ *dalfiin* (sg) / *dalaafin* (pl), ‘oven’ *furn* (sg) / *afraan* (pl). On the contrary, in Tashlhiyt Berber, French words such as *gratter* ‘scrape’, *entraîner* ‘train’, *blesser* ‘injure’, and *accélérer* ‘speed up’ are adapted as *grate*, *ttrini*, *blisi*, and *ksiri*, respectively. Their original consonantal and vocalic material is preserved, with some minor phonological adaptations such as vowel raising (*e* → *i*), denasalization (*ã* → *an*), and deletion (*ã* in *entraîner*). The same reasoning holds for neologisms that are derived from other words by means of prefixation or suffixation: for example, in the word *tasnawalt* ‘linguistics’ we find the word *awal* ‘speech, language’. Similarly, the sequence *akal* ‘earth, ground’ is found in the word *tasnakalt* ‘geography’, and the word *tasnaddert* ‘biology’ contains *adder* ‘be alive’ (see Sagarna 1988, Achab 1996, Taïfi 1997).

Another issue regarding the structure of the root in Tashlhiyt Berber is learnability. Much work in phonology has been motivated by the problem of how learnable grammatical systems are (see Dresher 1999). Complex and abstract systems are commonly considered difficult to learn, since they require more decisions from the learner. Some of the authors who reject the consonantal root in Semitic discuss learners’ difficulty with using such an abstract morpheme in word formation, claiming that fully specified words make the learning process easier (see Bat-El 2003:45). In Tashlhiyt Berber, many consonantal roots are surface-true and hence likely to be learned from direct evidence.

In summary, whether Berber roots are entirely composed of consonants or whether they contain vowels as well as consonants is a complex issue still under debate. In this article, the focus is on analyzing triconsonantal verbs that surface with no full vowels and verbs with the following shapes: CCI and CCU.

2 Data

For the purposes of the analysis, a list of 220 native verbs (given in the appendix) was collated from various sources including Dell and Elmedlaoui 1988, 2002, Boumalk 2003, and El Mountassir 2003.[10] The list contains 122 triconsonantal verbs with no full vowels, 72 verbs with CCI and CCU shapes, and 26 biconsonantal verbs. They are sorted into different classes with respect to the kinds of consonants they contain.

The data show that verbal triconsonantal roots in Tashlhiyt Berber obey a set of phonological constraints that limit the nature of the segments they contain.[11] Consider the examples in (4). They are sorted into four classes labeled *OOS*, *OSO*, *SOS*, and *OSS*, where *O* stands for an obstruent and *S* for a sonorant. Of the roots listed in the appendix, 73% belong to these classes.

[10] Loanwords, mostly from Arabic, are not examined here. They behave differently from native words. I return to this issue in section 5.3.

[11] Tashlhiyt Berber has the following segmental inventory: /t, tˤ, k, kʷ, q, qʷ, b, d, dˤ, g, gʷ, m, n, l, y, w, f, s, sˤ, ʃ, x, xʷ, ħ, z, zˤ, ʒ, ʒˤ, ɣ, ɣʷ, ʕ, h, r, rˤ, i, u, a/.

(4) a. *OOS*

gzm	‘cut’
kʃm	‘enter’
bsr	‘spread out’
zgr	‘cross’
bdr	‘mention, evoke’

b. *OSO*

frd	‘nibble’
krz	‘plow’
krf	‘tie up’
xrb	‘scratch’
smd	‘add’

c. *SOS*

ndˤr	‘squirt’
mgr	‘reap’
lkm	‘arrive’
nkr	‘stand up’
rgl	‘knock’

d. *OSS*

knu	‘lean’
ʒlu	‘lose’
bri	‘scratch’
xmr	‘ferment’
ɣml	‘mold’

The constraints are listed in (5).

(5) a. Each root contains at least one sonorant. Of the roots in the data list, 94% obey this constraint. Counterexamples are roots such as *bdg* ‘be wet’, *bzg* ‘swell’, and *zdɣ* ‘inhabit’.[12]

b. A root may contain at most two sonorants, as in the examples given in (4c) and (4d). Counterexamples such as *rmi* ‘be tired’, *rwi* ‘make dirty’, and *mlu* ‘be limp’ do not exceed 9% of the data.

c. At least one sonorant of each root is preceded by an obstruent. Of the roots in the data list, 82% obey this constraint.

[12] Given the large number of obstruents in the language (the segmental inventory in footnote 11 lists 25 obstruents and 8 sonorants), and assuming that there are no constraints on the segmental content of the root and that every consonant has an equal chance of occurring, we would expect that over half of the CCC roots in the appendix would be of the form OOO, when in fact only 11 are found.

d. The sonorant can appear in the final position of the root (4a) as well as in the medial position (4b).

e. If a root begins with a sonorant, it also ends with a sonorant (4c). In the data list, 17 triconsonantal roots contradict this statement (see classes 5 and 6 in the appendix).

f. If two sonorants are adjacent in the root, then the second sonorant is more sonorous (4d); the pattern is most often of the form [liquid + high vocoid] or [nasal + high vocoid]. Among the data are 8 counterexamples to this constraint, including roots such as *frn* 'sort' and *lmzˤ* 'swallow without chewing' (see classes 4 and 5 in the appendix).

In sum, the sonorant can appear in any position: root-final as in *gzm* 'cut', root-medial as in *frd* 'nibble', or root-initial as in *ngs* 'jostle'. Table 1 summarizes the main constraints stated in (5).

As far as I am aware, such constraints on the segmental composition of triconsonantal roots in Tashlhiyt Berber have not been documented elsewhere. However, Elmedlaoui (1994) suggests, following Ibn Jinni (d. 1002) and Diakonoff (1970, 1988), that in Afroasiatic the sonorants *m*, *l*, and *r* are historically affixes. He gives the following examples (p. 100):

(6)	*Root*	*Tashlhiyt Berber*		*Classical Arabic*		*Hebrew*	
	√gz	gzm	'to cut'	gazam	'to cut'	gazam	'to prune'
				gazar	'to prune'	gazar	'to cut'
	√qd			qardam	'to cut'	qardum	'axe'

He proposes that the sonorants are used to extend roots. He gives further examples with Berber onomatopoeia.

(7)	*Onomatopoeia*	*Onomatopoeia intensified*	*Onomatopoeia superintensified*
	ttaqq	ttr̲aqq	tr̲tl̲l̲aqq
	bbaqq	bbr̲aqq	br̲bl̲l̲aqq
	ddaxx	ddr̲axx	dr̲dl̲l̲axx

These onomatopoeic forms, which commonly mimic friction, explosion, and shock, use sonorants to express intensity or reinforcement.

Table 1
The segmental composition of Tashlhiyt Berber triconsonantal roots

	True for # of items	(%)	Exceptions (%)
At least one S	185	94.38	5.61
At most two Ss	178	90.82	9.18
At least one S preceded by O	161	82.14	17.86
If a root begins with S, it also ends with S	44	72.13	27.87

The following section develops the hypothesis that Tashlhiyt Berber triconsonantal roots are basically binary, in that only two of their segments are constrained. Section 5 shows that certain morphological operations are sensitive to the segmental composition of the root.

3 The Internal Structure of Tashlhiyt Berber Verbal Triconsonantal Roots

3.1 A Binary-Branching Head-Complement Structure

The main idea that emerges from the data discussed in the previous section is that the segmental composition of verbal triconsonantal roots in Tashlhiyt Berber obeys structural and distributional constraints, the foremost being this one:

(8) In Tashlhiyt Berber, each verbal triconsonantal root contains at least one sonorant.

In addition, root consonants are subject to cooccurrence restrictions that are captured in terms of sonority-sensitive dependency relationships between the most sonorous segment in the root and the neighboring segments.[13] Indeed, we notice that a sonorant is often preceded by an obstruent. Moreover, if two sonorants are contiguous, then the second sonorant is necessarily more sonorous, the typical case being a liquid or a nasal followed by a high vocoid (see class 4 in the appendix).

All of these structural and distributional constraints suggest a specific internal organization of the root. The question, then, is how to state a conceptual framework that accounts both for this internal organization and for the cooccurrence restrictions governing root consonants. We need to specify the status of the sonorant and the obstruent in the root and capture the distributional constraints they obey.

I propose that Tashlhiyt Berber triconsonantal roots are internally structured in such a way that only two of their segments are constrained, namely, the sonorant and the consonant immediately to its left.[14] More particularly:

(9) Verbal triconsonantal roots display a binary-branching head-complement structure.[15]

This structure is hierarchical, rendered by means of a tree diagram analogous to those that represent syllabic and syntactic constituencies. The segments that act as the head and the complement share the same node in the tree. The remaining segment—linked to a higher node in the tree—is a *satellite* that occurs indifferently to the left or the right of the head-complement pair (examples follow in (11)).

[13] For the purpose of this analysis, I am assuming the following sonority scale, where segments appear in order of increasing sonority: obstruent < nasal < liquid < glide < vowel (see Clements 1990).

[14] Crosslinguistic evidence for the structuring role of the obstruent-sonorant pattern is provided by the syllable structure of Bella Coola, a Salish language spoken on the central coast of British Columbia. Bagemihl (1991:597) analyzes the reduplication in forms such as *tl'k*^{w} 'swallow' → *tltl'k* 'swallow-continuative' and *tqnk* 'be under' → *tqnqnk* 'underwear' as the result of prefixing a CV syllable to the word, where the sonorant occupies the V position and where CC clusters are of the form obstruent-sonorant.

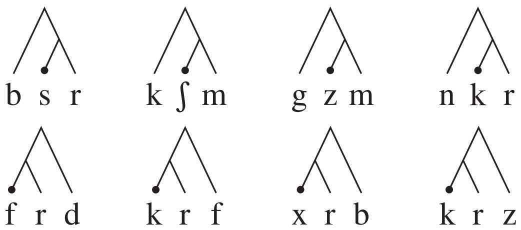
[15] On the notions ''head'' and ''complement'' and the way they are used in phonological theory, see discussions of Dependency Phonology (Anderson 1985, 2002, Anderson and Ewen 1987), Government Phonology (Kaye, Lowenstamm, and Vergnaud 1985, 1990), and Metrical Phonology (Hammond 1984, Prince 1985). The binary-branching head-complement hypothesis is also reflected in the theory of syllable representation developed by Levin (1985): the syllable

In addition, the head and the complement are constrained as follows:

(10) a. The head is located immediately to the left of the most sonorous segment.
b. An obstruent never occurs as the complement.

These constraints imply that the head segment can be initial as in *frd* ‘nibble’ or medial as in *gzm* ‘cut’, but not final.

To illustrate the theoretical devices stated in (9) and (10), some of the roots given in (4) are represented in (11). (The head position is indicated by the dot at the end of the branch.)

(11)


In these examples, the head and its complement obey the constraints stated in (10).

1. The head accommodates the obstruent located immediately to the left of the sonorant (*s* in *bsr*, *ʃ* in *kʃm*, *z* in *gzm*, etc.).
2. The head is initial or medial, but not final.
3. No obstruent appears in the complement position.

Before we examine the structure of the remaining roots in (4), namely, those of the form OSS, let us consider some aspects of the hierarchical structures displayed in (11). We need to motivate the head and complement constituency, and its relevance in accounting for the cooccurrence restrictions on the roots. Particularly, we want to know why the obstruent is assigned the head function. The following section provides some answers to these questions.

3.2 Headedness

It is generally assumed that headedness is an essential function and that each grammatical constituent must be headed. It is also assumed that certain elements display particular properties that allow them to act as heads. In syllabic structures, for instance, the nucleus is assumed to be the head of the syllable, essentially because it is the only obligatory constituent. A syllable may

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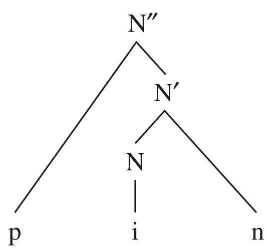
is viewed as a projection of the nucleus (N). The coda is defined as the complement of N, and the onset is the specifier of the syllable. To use *pin* as an example:

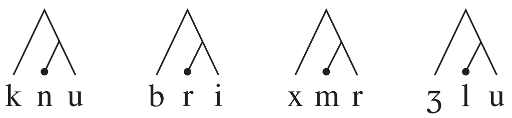
(i)


indeed be onsetless, codaless, or both, but it must have a nucleus. That is to say, it must be headed.[16] Similarly, in syntactic constituencies, heads are most often the obligatory elements, as opposed to complements, which are optional. For instance, the verb is assigned the head function in part because it can form a verb phrase by itself.

Within root structure, we expect head elements to behave similarly to their counterparts in syntactic and syllabic structures. That is, we expect an obstruent that functions as a head to be able to occur without its complement (i.e., sonorant), just as a syllabic or syntactic head sometimes occurs without its complement. If there are any monoconsonantal words in Tashlhiyt Berber, their roots should be made up exclusively of obstruents. And indeed, the very few Tashlhiyt Berber monoconsonantal roots are all made up of obstruents: for example, *kk* 'pass', *g* 'be', *ʃʃ* 'eat', and *f* 'give'. Obstruents and sonorants are undeniably essential for roots to be well structured; most often they cooccur in bi- and triconsonantal roots, but only obstruents occur in monoconsonantal roots.[17]

3.3 Sonorant-Headed Roots

A sonorant occurs in head position when it is followed by a more sonorous segment, as illustrated in (12).

(12)


Roots of the form OSS are common in Tashlhiyt Berber. Of the triconsonantal roots in the data list, 21% belong to this class. Most of them end with a high vocoid. Their head is assigned to the medial sonorant by virtue of (10a). The roots that end with a nasal plus a liquid also assign the head function to the medial consonant (*xmr*, *ɣml*, *gʷmr*, and *ħml* are the only examples found in class 4 in the appendix), while those that end with a liquid plus a nasal, such as *krm* and *frn*, assign the head function to the initial segment (7 roots in class 4 are of this type).

Roots of the form SSS (the data in the appendix contain 7 roots of this type) all assign the head function to the medial sonorant, except *rwl* 'run away', whose head is in initial position.

3.4 Left-Headed Structures

The examples in (11) and (12) show that all verbal triconsonantal roots in Tashlhiyt Berber are basically binary,[18] in that only the head and its complement are constrained. Their binary-branching structure locally determines their cooccurrence restrictions. Indeed, the phonological con-

[16] In almost all languages, vowels are the uncontroversial heads, taking priority as nuclei over other segments. In certain languages, however, consonants may be syllabic if none of the neighboring segments are vowels. Tashlhiyt Berber, English, and certain Slavic languages are of this type.

[17] Language acquisition data show a tendency for children to reduce obstruent-sonorant clusters to obstruents: for example, English *flowers* → [faʊwɚ], *sleep* → [sip], *frog* → [fa:g] (see Pater 2002:353); French *clé* → [ke] 'key', *clown* → [kʊɲ], *train* → [kɛ] (see Rose 2000:132). Keeping the obstruent in the output can thus be seen as an argument for the role of such a segment in the sound structure of words.

[18] Quadriconsonantal verbs also support the binary-branching head-complement hypothesis. Most of them are reduplicated biconsonantal roots: for example, *brbr* 'boil', *frfr* 'beat with wings', and *durdr* 'be unable to hear'.

straints they obey are limited to the inferior node in the tree. As a consequence of this binary structure, the remaining position in the root—the one that is linked to the superior node in the tree—is free to accommodate any kind of segment, obstruents (e.g., *b* in *bsr*) as well as sonorants (e.g., *n* in *nkr*). It also acts as a satellite of the head-complement pair, as it occurs at the far left or the far right of the tree.

In addition, an important property emerges from the tree-based structures given in (11) and (12): the head is systematically located on the left branch of the inferior node in the tree. This is a notable outcome of the analysis, comparable to similar proposals for syntactic structures (see the Linear Correspondence Axiom proposed by Kayne (1994)).[19]

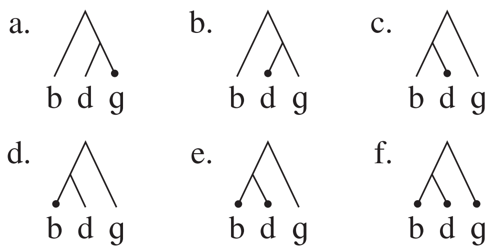
3.5 Problematic Data

Data that contradict the constraints in (9) and (10) are of two types:

1. Roots in which the only sonorant is initial as in *ngs* 'jostle, shove', *rkz* 'dance', and *nfd* 'be stirred up' (13 roots in the data in the appendix are of this type; see class 6); and
2. Sonorantless roots such as *bdg* 'be wet', *bzg* 'swell', and *bxs* 'discredit oneself' (the appendix contains 16 roots of this type, of which 11 are triconsonantal and 5 biconsonantal; see classes 8 and 12).

Roots of both types are problematic with respect to the constraints in (10). The former are able to assign the head function neither to their initial nor to their medial consonant, as their only sonorant appears in initial position. The latter cannot be decomposed into a binary-branching head-complement structure, since we would need to determine which segments among the three sonority-equal radicals are the head and the complement. The examples in (13) illustrate the problem.

(13)



Structures (13a) and (13c) are prohibited by virtue of the assumption that the head always precedes its complement. Structures (13b) and (13d) are problematic because nothing in the analysis allows *b* and *d*—sonority-equal segments—to be the head and the complement. The remaining structures, (13e) and (13f), are ill formed because they are multiheaded.

[19] Within syntactic structures, the Linear Correspondence Axiom universally states that syntactic constituents are left-headed. That is, the head always precedes its complement.

We will return to these examples in section 5.3. Now, let us examine the internal structure of biconsonantal roots. These roots will prove crucial to the analysis, as we expect them to be composed of a head and its complement.

4 Biconsonantal Roots

The way we have accounted for the internal structure of triconsonantal roots inevitably leads us to examine the structure of biconsonantal roots. Indeed, having proposed that triconsonantal roots display a binary-branching head-complement structure built upon the sonorant and the consonant immediately to its left, the remaining segment being a satellite, we expect biconsonantal roots to be simply triconsonantal roots minus the satellite segment. That is, we expect them to contain nothing but the head and its complement.

The data given in the appendix contain 26 biconsonantal roots, of which 13 are of the form obstruent-sonorant, 6 are of the form sonorant-obstruent, 2 are obstruentless, and 5 are sonorantless. Let us examine first the behavior of OS roots, which represent 50% of the biconsonantal roots listed in the appendix. Examples are given in (14) in aorist, imperfective, and preterit conjugations.

(14)	*Aorist*	*Imperfective*	*Preterit*		
			3sg.masc	*1sg*	
	gn	ggan	gn	gn-ɣ	'sleep'
	fl	ffal	fl	fl-ɣ	'leave, let'
	dˤr	ttˤar	dˤr	dˤr-ɣ	'fall'
	gl	ggal	gl	gl-ɣ	'bust'

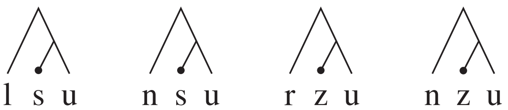
Roots of this type readily fall in with the binary-branching head-complement analysis. Their head function is assigned to the obstruent, the sonorant being its complement. In *gn*, for instance, *g* is the head and *n* its complement. Likewise, in *fl* the first consonant is the head and the second is the complement. In addition, the morphological properties that these roots' verbal forms show in the imperfective and preterit conjugations support the idea that they are true biconsonantals, as opposed to verbs of the form SO, which seem to be underlyingly more complex. The examples in (15) illustrate the behavior of the latter verbs.

(15)	*Aorist*	*Imperfective*	*Preterit*		
			3sg.masc	*1sg*	
a.	ls	lssa	lsa	lsi-ɣ	'wear'
	ns	nssa	nsa	nsi-ɣ	'overnight'
	rzˤ	rzzˤa	rzˤa	rziˤ-ɣ	'break'
	nz	nzza	nza	nzi-ɣ	'be sold'
b.	knu	knnu	kʷna	kʷni-ɣ	'lean'
	rku	rkku	rka	rki-ɣ	'be dirty'
	ʒlu	ʒllu	ʒla	ʒli-ɣ	'lose'
	gnu	gnnu	gʷna	gʷni-ɣ	'sew'

The verbs in (15a) behave similarly to the CCU verbs in (15b), in that they geminate the medial consonant in the imperfective and use the vowels *a* and *i* in the preterit 3sg.masc and 1sg, respectively (-*ɣ* being the 1sg morpheme marker). In contrast, the verbs in (14) form their imperfective by geminating the initial consonant and infixing the vowel *a*, while their preterit merely consists of the two radicals.

On the basis of these similarities, Iazzi (1991) has suggested that verbs like those in (15a) contain an underlying vocalic segment that has only one distinctive feature, namely, [+ vocalic]. According to Iazzi, this underlying vowel stands for an ancient segment that went out of use, revealing a state of the language where a vowel, probably *u*, occupied the final position of the verb. Certain Berber varieties still use the vowel *u* in the preterit 3sg.masc: for example, *i-nsu* 'overnight' in the Snous, Menacer, and Ouargla varieties, *i-lsu* 'wear' in the Ghadames variety, *i-rzˤu* 'break' in the Seghroushen, Snous, Menacer, Ouargla, and Ghadames varieties, and *i-nzu* 'be sold' in the Menacer and Ouargla varieties (see Basset 1929[2004:64]).

Following Iazzi's proposal, and given the morphophonological similarities mentioned above,[20] I assume that verbs like those in (15a) are underlyingly trisegmental, of the form SOU. This allows them to fall in line with the analysis of SOS roots; their head and complement functions are assigned to the last two segments, while the initial consonant is a satellite segment. The examples in (16) illustrate the proposal.

(16)


Sonorantless roots such as *ks* and *zdˤ* are sorted into two groups with respect to the morphophonological properties of verbal forms. The data in the appendix contain only 5 roots of this type, listed in (17).

(17)

	Aorist	*Imperfective*	*Preterit* *3sg.masc*	*1sg*	
a.	zdˤ	zzadˤ	zdˤa	zdˤi-ɣ	'mill, grind'
	sɣ	ssaɣ	sɣa	sɣi-ɣ	'buy'
	ɣz	qqaz	ɣza	ɣzi-ɣ	'hollow'
b.	ks	kssa	ksa	ksi-ɣ	'graze'
	fk	akka	fka	fki-ɣ	'give'

[20] Further evidence for the structure of biconsonantal verbs lies in learners' ability to make generalizations about the underlying form of words. Given (a) the surface form of the verbs in (15a), particularly the fact that they all geminate the medial consonant, and on the basis of (b) crosslinguistic evidence (in Classical Arabic, for instance, the forms *kaana* 'he/it was', *maata* 'he died', and *daara* 'he turned' are analyzed as being underlyingly trisegmental, of the form *kwn*, *mwt*, and *dwr*) and (c) statistical factors specific to the language (for all verbs that end with a vowel in the aorist, that vowel is *u* or *i*), we can assume that Tashlhiyt Berber learners analyze these verbs as being underlyingly trisegmental.

The morphological properties of the verbs in (17a) are paradoxical: these verbs share similarities both with verbs of the form SO like *ls* 'wear' and with verbs of the form OS like *fl* 'leave'. On the one hand, they use the vowels *a* and *i* in the preterit 3sg.masc and 1sg, respectively, just like SO verbs. On the other hand, they geminate the initial consonant and infix the vowel *a* between the two radicals, just like OS verbs. In contrast, the verbs in (17b) geminate the second consonant and add the vowel *a* in the imperfective, and they use the vowels *a* and *i* in the preterit 3sg.masc and 1sg, respectively, just like CCU verbs. Hence, the root structure of the verbs in (17b) is taken to be OOU, where the last two segments stand for the head and the complement, similar to the structure of the verbs in (15a). The structure of the verbs in (17a) remains problematic. Their form in the preterit, particularly the fact that they use *a* in the 3sg.masc and *i* in the 1sg, suggests that they are underlyingly trisegmental, containing the vocoid *U* in third position. Their form in the imperfective, in turn, indicates that they are merely biconsonantal.

The remaining biconsonantal verbs in the data, *ml* 'show' and *nu* 'be cooked', are of the form SS (see class 11 in the appendix). On the basis of the constraint in (10a), they are assigned a binary-branching structure where the first sonorant is the head and the second is its complement.

The next section examines one of the most productive morphological mechanisms in Tashlhiyt Berber verb conjugation: gemination in the imperfective. The binary-branching head-complement hypothesis turns out to play a central role in the derivation of the imperfective, determining both the class of verbs that undergo gemination and the segment that geminates in the verb.

5 Geminated Imperfectives

As a process used to form the imperfective, gemination operates on verbs containing no more than three consonants, without initial or medial vocoids. It has been treated in numerous studies, including Chaker 1973, 1984, Chami 1979, Boukous 1987, Cadi 1987, Dell and Elmedlaoui 1988, 1991, 2002, Jebbour 1996, 1999, Bensoukas 2001, Lahrouchi 2001, and Louali and Philippson 2004. Dell and Elmedlaoui's account, probably the most influential, rests entirely on syllabic arguments. The authors present the process as evidence in favor of their syllabic algorithm (Dell and Elmedlaoui 1985).

In this section, I first discuss Dell and Elmedlaoui's account. I then adduce arguments for the relevance of root structure in accounting for this formation. It develops that gemination as an imperfectivizing mechanism is sensitive to the internal organization of segments in the root: all and only verbs that contain at least one sonorant in a noninitial position, and hence are analyzable into a binary-branching head-complement structure, undergo gemination in the imperfective.

5.1 ''Geminate the Onset'' (Dell and Elmedlaoui 1988, 1991, 2002)

Dell and Elmedlaoui's syllabic account of gemination in the imperfective is based on the assumption that ''the segment which is geminated in the imperfective stem is that segment which is syllabified as an onset by Core Syllabification in the basic stem'' (1988:11). The following examples (from Dell and Elmedlaoui 2002:118) illustrate the hypothesis:

(18)

	Preterit	*Imperfective*	
	k$\underline{\text{r}}$z	kkrz	'plow'
	x$\underline{\text{n}}$g	xxng	'strangle'
	m$\underline{\text{r}}$z	mmrz	'wound in the head'
	$\underline{\text{ʒ}}$.b$\underline{\text{d}}$	ʒbbd[21]	'draw'
	$\underline{\text{r}}$.k$\underline{\text{s}}$	rkks	'hide'
	$\underline{\text{x}}$.s$\underline{\text{i}}$	xssi	'extinguish'

The underlined segments in the first column mark syllable nuclei. The period indicates the syllable boundary. In the first three verbs, it is the first consonant that is the onset; in the other three, it is the second consonant. Accordingly, in the imperfective the first three verbs geminate the initial consonant and the second three verbs geminate the medial consonant.

Dell and Elmedlaoui's analysis relies entirely on the information provided by their syllabification algorithm. This algorithm states that in Imdlawn Tashlhiyt Berber any segment can act as a syllable nucleus if it is the most sonorous segment in the syllabification domain:[22] for instance, *n* is the syllable nucleus in *xng* because it is more sonorous than *x* and *g*. In *rks*, *r* is the nucleus of the first syllable, while the remaining segments form another syllable where *s* is the nucleus and *k* the onset.

Dell and Elmedlaoui's analysis of geminated imperfectives accounts for almost all of the data. This is not surprising, as the overwhelming majority of triconsonantal verbs contain at least one sonorant, which most often is the nucleus (of the roots in the appendix, 94% display this property). The issue is quite different when one considers that the presence of sonorants in the root is not a coincidence; they have an essential function, and all and only verbs that have at least one sonorant in a noninitial position form their imperfective by means of gemination. Within Dell and Elmedlaoui's syllabic algorithm where all consonants, including obstruents, may occur as nuclei, we expect that any verb that meets the conditions listed in Dell and Elmedlaoui 1988[23] automatically undergoes gemination, regardless of the nature of the consonant that occurs in its onset position. More specifically, we expect sonorantless verbs to form their imperfective by means of the same process as verbs that contain sonorants. But according to Dell and Elmedlaoui (1988:11), ''not all geminable verbs resort to gemination in the imperfective but most of them do'' and ''the distribution of the geminating verbs among the geminable verbs seems to be a matter of lexical idiosyncrasy.'' As Dell and Elmedlaoui do not find geminating verbs entirely made of obstruents, they give hypothetical examples to illustrate the predictions of their hypothesis. They suppose that the verbs **bxs*, **zɣk*, and **sxf*, if they were attested in Imdlawn Tashlhiyt Berber, would form their imperfective by geminating their initial consonant, leading to **bbxs*,

[21] In the varieties of Tashlhiyt Berber described in Boumalk 2003 and El Mountassir 2003, as well as in my own variety, the verb *ʒbd* forms its imperfective as *ʒbud*.

[22] Dell and Elmedlaoui (2002:76) assume the following sonority scale, where segments are ranked in decreasing order of sonority: *a* > high vocoids > liquids > nasals > fricatives > stops.

[23] Dell and Elmedlaoui (1988:11) draw up a list of conditions that each verb in Imdlawn Tashlhiyt Berber should satisfy in order to undergo gemination: ''a. the basic stem contains three segments none of which is a geminate; b. if the basic stem contains a vowel, that vowel must be the last segment.''

**zzɣd*, and **ssxf*, respectively.[24] However, verbs entirely made up of obstruents do actually exist in Tashlhiyt Berber: for example, *k^{w}fs* 'sow', *bzd^ʕ* 'urinate', *bzg* 'swell', and *bdg* 'be wet' (further examples are given in class 8 in the appendix). Their imperfective forms are not **kk^{w}fs*, **bbzd^ʕ*, **bbzg*, and **bbdg*, as Dell and Elmedlaoui's analysis predicts; rather, they are *ttk^{w}fas*, *ttbzd^{ʕ}ad^ʕ*, *ttbzag*, and *ttbdag* (see, e.g., Boumalk 2003, El Mountassir 2003). In addition to verbs of this kind, there are verbs in which the only sonorant is initial, such as in *rkz* 'dance', *ngs* 'jostle, shove', *rqs* 'jump', and *nɣd* 'refine' (see class 6 for further examples). Within Dell and Elmedlaoui's syllabic algorithm, these verbs are syllabified as follows: *r̲.kz̲*, *n̲.gs̲*, *r̲.qs̲*, and *n̲.ɣd̲* (syllable nuclei are underlined). To form their imperfective, they should geminate the medial consonant that occurs in the onset, leading to **rkkz*, **nggs*, **rqqs*, and **nɣɣd*. Again, the imperfective forms of these verbs, at least in those varieties of Tashlhiyt Berber that are described in Boumalk 2003 and El Mountassir 2003, as well as in my own variety, use the prefix *tt-* and the infix *-a-* instead of geminating the medial consonant.

In summary, Dell and Elmedlaoui's syllable-based analysis fails to explain why only verbs that contain at least one sonorant in a noninitial position undergo gemination. Their analysis does not explain why sonorantless verbs such as *k^{w}fs*, *bzg*, and *bzd^ʕ*, and verbs in which the only sonorant is initial, form their imperfective by means of affixation rather than gemination. In the next section, I argue that the distribution of the geminating verbs among the geminable verbs is a matter of root structure rather than lexical idiosyncrasy; the presence of at least one sonorant in the root determines the process that the verb undergoes in the imperfective.

5.2 ''Geminate the Head''

The examples given in (4) are repeated in (19), along with their imperfective forms.

(19)		√	*Imperfective*	
	a.	*OOS*		
		gzm	gzzm	'cut'
		kʃm	kʃʃm	'enter'
		bsr	bssr	'spread out'
		zgr	zggr	'cross'
		bdr	bddr	'mention, evoke'
	b.	*OSO*		
		frd	ffrd	'nibble'
		krz	kkrz	'plow'
		krf	kkrf	'tie up'
		xrb	xxrb	'scratch'
		smd	ssmd	'add'

[24] Dell and Elmedlaoui (1988:16n22) claim that the verbs *bxs* 'discredit oneself' and *dff* 'punch', which are actually attested in Imdlawn Tashlhiyt Berber, do not form their imperfective by means of gemination.

c.	*SOS*		
	nd^{ʕ}r	ntt^{ʕ}r	‘squirt’
	mgr	mggr	‘reap’
	lkm	lkkm	‘arrive’
	nkr	nkkr	‘stand up’
	rgl	rggl	‘knock’
d.	*OSS*		
	knu	knnu	‘tilt’
	ʒlu	ʒllu	‘lose’
	bri	brri	‘scratch’
	xmr	xmmr	‘ferment’
	ɣml	ɣmml	‘mold’

An examination of these examples shows the following patterns:

1. Each verb geminates one consonant in the imperfective.
2. The geminated consonant varies from one category of verbs to the other: the verbs in (19b) geminate the first consonant, while the remaining geminate the second consonant.
3. Gemination never involves the third root consonant.
4. A sonorant does not geminate in the imperfective, except when immediately followed by another sonorant as in the examples in (19d).

Among all Berber varieties, Tashlhiyt is the only one where gemination in the imperfective is unfixed: it involves the initial or the medial segment in the root. The challenge, then, is to explain how the geminated segment is determined. A further look at the verbs in (19), and more particularly their root structure, leads to the following generalization:

(20) The segment that is geminated in the imperfective is the one that appears in the head position of the root.

Therefore, the difference between verbs that geminate the initial consonant and those that geminate the medial consonant lies in that the former are head-initial and the latter head-medial. That is, the verbs in (19b) display the structure (($\underline{\text{x}}$x)x), and the remaining ones the structure (x($\underline{\text{x}}$x)), the underlined segment being the head and the segment to its right the complement.

Biconsonantal verbs of the forms OS, SO, and OO also obey the rule in (20). The first type geminates the initial consonant, as it is in the head position (e.g., *gn* → *ggan*). The other two, analyzed as underlyingly trisegmental (of the form SOU or OOU), geminate the medial consonant, as expected.

So far, our analysis makes the same predictions as syllable-based analyses. This is not surprising since the verbs examined so far in this section all contain at least one sonorant in a noninitial position. The difference between the present approach and the syllable-based approaches arises in the analysis of verbs such as *bdg* ‘be wet’ and *rkz* ‘dance’, which syllable-based approaches count as regular verbs that should undergo gemination. As shown in the following section, the behavior of these verbs in the imperfective, particularly the fact that they do not undergo gemination, is a matter of root structure rather than lexical idiosyncrasy.

5.3 Nongeminating Verbs

Some of the so-called nongeminating verbs form their imperfective by means of *tt-* prefixation and *-a-* infixation, rather than by gemination. Examples are given in (21).

(21)		*Aorist*	*Imperfective*	
	a.	bdg	ttbdag	'be wet'
		bzdˤ	ttbzdˤadˤ	'urinate'
		bzg	ttbzag	'swell'
		bxs	ttbxas	'discredit oneself'
		zdg	ttzdag	'purify'
		zdɣ	ttzdaɣ	'inhabit'
	b.	rqs	ttrqas	'jump'
		rkz	ttrkaz	'dance'
		nɣʷz	ttnɣʷaz	'blink eye'
		nɣd	ttnɣad	'refine'
		ngs	ttngas	'jostle, shove'
		mʃdˤ	ttmʃadˤ	'comb'

The verbs in (21a) are made up entirely of obstruents, and those in (21b) have their only sonorant in initial position. At first sight, it is puzzling why such verbs do not undergo gemination in the imperfective. Within Dell and Elmedlaoui's syllable-based analysis, these verbs should geminate the initial or medial consonant, whichever one appears in onset position. For instance, the verb *bzg* should form its imperfective as **bbzg*, and *rkz* should lead to **rkkz*, according to Dell and Elmedlaoui (1988, 2002). But, if we look carefully at these verbs' segmental composition, and if we accept the view that for any verbal root to undergo gemination, it must be internally structured according to the proposed analysis, then we understand why the above verbs behave differently. Since the verbs in (21) are not analyzable into a binary-branching head-complement structure, similar to that of the verbs that contain at least one sonorant in a noninitial position, they do not undergo gemination in the imperfective.

However, a few exceptions remain. The verbs *nʃf* 'scrape', *nsdˤ* 'gush', *lqʒ* 'crush', and *lbʒˤ* 'squash' display the same segmental composition as the verbs in (21b). Nevertheless, they undergo gemination in the imperfective, leading to *nʃʃf*, *nssdˤ*, *lqqʒ*, and *lbbʒˤ*, respectively. Similarly, the verbs *bks* 'fasten', *stɣ* 'split', and *ftk* 'sprain' form their imperfective by means of gemination, though they are made up entirely of obstruents.

Finally, a word must be said about verbs that begin with a sibilant. Given their segmental makeup, they should undergo gemination in the imperfective. For instance, verbs such as *skr* 'do', *sgl* 'bury', *stl* 'weigh', *stɣ* 'crack, fissure', *sli* 'touch', and *sxn* 'dip, dunk' should geminate their medial consonant, as it should be assigned the head function. Instead, they form their imperfective by infixing *a* between the last two consonants. This is apparently due to the fact that Tashlhiyt Berber speakers analyze these verbs as if they were derived forms, divisible into a causative morpheme *s*- plus a verbal root. It is indeed a known fact that the causative forms do not undergo gemination in the imperfective. Rather, they systematically use the infix -*a*-: for example, 'arrive' *lkm* (aorist) → *lkkm* (imperfective) / *sslkm* (causative aorist) → *sslkam* (causative imperfective); 'lean' *knu* (aorist) → *knnu* (imperfective) / *ssknu* (causative aorist) → *ssknaw* (causative imperfective); 'sleep' *gn* (aorist) → *ggan* (imperfective) / *sgn* (causative aorist) → *sgan* (causative imperfective).

Nongeminating verbs also include borrowed verbs, mainly from Arabic. They form their imperfective by means of *tt*- prefixation rather than by gemination. For example, the verbs *xdm* 'work', *ftl* 'roll (cigarette)', *ħkm* 'judge', and *nʒm* 'escape' form their imperfectives as *ttxdam*, *ttftal*, *ttħkam*, and *ttnʒam*, not **xddm*, **fttl*, **ħkkm*, and **nʒʒm*.

5.4 Summary of the Analysis of Geminated Imperfectives

Among the verbs that resist syllable-based analyses of gemination in the imperfective are those that are made up entirely of obstruents and those whose only sonorant is in initial position. On the basis of syllable judgment alone, verbs such as *bzg* 'swell' and *rkẓ* 'dance' should form their imperfectives as **bbzg* and **rkkẓ*. The analysis advocated here tackles the problem in terms of root rather than syllable structure. It is proposed that only roots that contain at least one sonorant in a noninitial position, and hence are analyzable into a head-complement structure, in line with the proposal made in section 3, undergo gemination in the imperfective. Moreover, the decision as to which consonant geminates depends on where the head is located: head-initial roots such as *frd* 'nibble' geminate the initial consonant, and head-medial roots such as *gẓm* 'cut' geminate the medial consonant. *Bzg*-like and *rkẓ*-like verbs behave as they do in the imperfective because they lack the appropriate structure.

As a direct consequence of the structure proposed, the role of the syllable becomes redundant in selecting the geminating consonant in the verb. Gemination as an imperfectivizing mechanism targets the head of the root rather than the onset of the syllable.

6 Conclusion

In this article, it was argued that triconsonantal verbs in Tashlhiyt Berber obey a set of structural and distributional constraints that limit the nature and the position of segments in the root. Then it was proposed that the root displays a binary-branching head-complement structure, where only two segments are constrained: those that are assigned the head and complement functions. Evidence for this hypothesis was provided by the imperfective formation: it was argued that (a) only verbs that contain at least one sonorant in a noninitial position, and hence display a head-complement structure, geminate one consonant in the imperfective, and (b) the segment that geminates is the one that is the head of the root. This allows us to account for a number of forms that are traditionally ascribed to lexical idiosyncrasy, including verbs that are made up entirely of obstruents and those whose only sonorant is in initial position.

Appendix: Data

This appendix lists 220 verbal roots. They are sorted into 12 classes depending on the kind and number of consonants they contain. Attention is drawn to the distribution of sonorants and obstruents in the root (*S* stands for a sonorant and *O* stands for an obstruent). Each root is assigned a binary-branching head-complement structure, built upon the most sonorous segment and the segment immediately to its left (for convenience, the head segment is underlined). The imperfective formation is presented as evidence for this structure. The segment that geminates in the imperfective is the one that appears in head position.

In the first class of roots (O<u>O</u>S), the underlined obstruent is the head and the following sonorant its complement. These roots form their imperfective by geminating the head segment, namely, the obstruent immediately to the left of the sonorant.

1 O<u>O</u>S

√	*Imperfective*	
bdr	bddr	'mention'
bdu	bddu	'start'
bdˁu	bddˁu	'divide'
bgu	bggu	'pierce'
bsi	bssi	'melt, dissolve'
bsr	bssr	'spread'
bxl	bxxl	'be stingy'
bzr	bzzr	'pluck (feathers)'
dˁfr	dˁffr	'follow'
dħi	dħħi	'push'
fsi	fssi	'melt, dissolve'
fsr	fssr	'spread'
fsu	fssu	'vegetate'
ftl	fttl	'roll'
ftu	fttu	'walk, go'
gzi	gzzi	'vaccinate'
gzm	gzzm	'cut'
gzr	gzzr	'slaughter (animal)'
ʒdr	ʒddr	'burn'
kʃm	kʃʃm	'enter'
kʷti	kʷtti	'remember'
kbu	kbbu	'pierce'
kdˁu	kddˁu	'smell'
kti	ktti	'blaze up'
sdl	sdal	'cocoon, sit on'
sdu	sddu	'be side by side with something'
skr	skar	'do'

sti	stay	‘choose’
stl	stal	‘weigh’
sɣi	sɣay	‘oblige’
sɣl	sɣal	‘measure’
sˤdr	sˤdar	‘lay’
xsi	xssi	‘be extinct’
xsr	xssr	‘be damaged’
xtl	xttl	‘feint’
xzr	xzzr	‘look nastily’
zbi	zbbi	‘hasten’
zdi	zday	‘join’
zdm	zddm	‘gather firewood’
zdr	zddr	‘lower’
zgr	zggr	‘go across’
zhr	zhhr	‘blaze up’
zˤbr	zˤbbr	‘prune’
ɣʷbn	ɣʷbbn	‘lash’
ħʃu	ħʃʃu	‘stick, shove’
ħbu	ħbbu	‘hide’
ħsrˤ	ħssrˤ	‘stop’
ħsu	ħssu	‘learn’

Roots of the form OSO assign the head and complement functions to the first two segments. Their imperfective is formed by means of gemination: they all geminate the first consonant, which is in head position.

2 OSO

√	*Imperfective*	
frd	ffrd	‘nibble’
frg	ffrg	‘enclose’
frʃ	ffrʃ	‘deceive’
frk	ffrk	‘guess’
frs	ffrs	‘be sharp’
ʃrk	ʃruk	‘share’
kʷms	kkʷms	‘tie into a neat bundle’
kʷmz	kkʷmz	‘scrape’
kls	kkls	‘slash (meat)’
kms	kkms	‘hold in the hand’
knd	kknd	‘dupe’
krdˤ	kkrdˤ	‘comb’
krf	kkrf	‘tie’
krs	kkrs	‘tie’

krz	kkrz	‘plow’
qlb	qqlb	‘knock out’
qrs^{ʕ}	qqrs^{ʕ}	‘reopen (wound)’
slɣ	sluɣ	‘cork’
smd	ssmd	‘add’
srd^{ʕ}	srud^{ʕ}	‘lodge a complaint’
srg	ssrg	‘have a miscarriage’
srs	srus	‘put down’
x^{w}mʒ	xx^{w}mʒ	‘scratch’
xld^{ʕ}	xxld^{ʕ}	‘mix’
xng	xxng	‘choke’
xrb	xxrb	‘scratch’
zlf	zzlf	‘singe’
ɣns^{ʕ}	ɣɣns^{ʕ}	‘lose a bad habit’
ɣrd^{ʕ}	ɣɣrd^{ʕ}	‘lie down’
ɣrs	qqrs	‘slaughter’
hrʃ	hhrʃ	‘feel slightly ill’
hrd	hhrd	‘eat entirely’
ħlb	ħħlb	‘eat (liquid food)’
ħrʃ	ħħrʃ	‘be rough’
ħrg	ħħrg	‘burn’

Roots that begin with a sonorant and end with a sonorant are also subject to the head-complement analysis. Their imperfective is obtained by geminating the medial consonant, which is in head position.

3 SOS

√	*Imperfective*	
ldi	lddi	‘pull’
lgr	lggr	‘knock’
lkm	lkkm	‘arrive’
mdi	mddi	‘trap’
mdu	mddu	‘lose weight’
md^{ʕ}i	mdd^{ʕ}i	‘taste’
md^{ʕ}l	mtt^{ʕ}l	‘bury’
mgr	mggr	‘harvest’
msi	mssi	‘be tepid’
msl	mssl	‘plug’
mzi	mzzi	‘mill, grind’
nʒm	nʒʒm	‘remain unharmed’
ndr	nddr	‘suffer’
nd^{ʕ}r	ntt^{ʕ}r	‘squirt’

ndu	nddu	‘strain’
nd^{ʕ}u	ntt^{ʕ}u	‘jump’
nfi	nffi	‘jostle, shove’
nfr	nffr	‘blow one’s nose’
ngi	nggi	‘flow’
nkr	nkkr	‘stand up’
nsr	nssr	‘graze’
ntl	nttl	‘take shelter’
nzl	nzzl	‘prick’
rbu	rbbu	‘carry to the back’
rdm	rddm	‘demolish’
rd^{ʕ}l	rtt^{ʕ}l	‘borrow’
rgl	rggl	‘knock’
rgm	rggm	‘insult’
rkm	rkkm	‘rot’
rku	rkku	‘be dirty’
rzu	rzzu	‘crawl’
rz^{ʕ}i	rzz^{ʕ}i	‘thread’
rz^{ʕ}m	ttruz^{ʕ}um	‘open’
r^{ʕ}ʃm	r^{ʕ}ʃʃm	‘mark’
rʕi	rʕʕi	‘mix’

The roots in class 4 all show a binary-branching structure where the medial sonorant is the head and the following sonorant the complement. In the imperfective, they geminate the medial sonorant. The forms that begin with a sibilant behave like causative forms in the imperfective, using vowel insertion rather than gemination.

4 OS̲S

√	*Imperfective*	
bnu	bnnu	‘build’
bri	brri	‘scratch’
d^{ʕ}lu	d^{ʕ}llu	‘soak’
dri	dray	‘miscarry’
dru	drru	‘eat together’
frn	ffrn	‘sort’
fru	frru	‘refund a debt’
g^{w}mr	g^{w}mmr	‘fish’
gli	glli	‘push’
g^{w}mi	g^{w}mmi	‘read slowly’
gnu	gnnu	‘sew’
gru	grru	‘collect’
ʒlu	ʒllu	‘lose’

k^wli	k^wlli	'tint, blacken'
kmi	kmmi	'smoke'
knu	knnu	'lean'
kri	krri	'shrink'
krm	kkrm	'be dried out'
kru	krru	'rent'
sli	slay	'touch'
sni	snay	'sign'
sri	sray	'scratch'
srm	srum	'cut'
trm	ttrm	'shimmy down'
xlu	xllu	'destroy, be insane'
xmr	xmmr	'ferment'
$z^ʕ$li	$z^ʕ$lay	'put aside'
zlm	zlum	'glance'
zri	zray	'pass, go'
zru	zrru	'delouse'
zwu	zwwu	'dry'
$z^ʕ$lm	$zz^ʕ$lm	'peel'
$z^ʕ$wi	$z^ʕ$wwi	'be left-handed'
ɣlu	ɣllu	'be expensive'
ɣml	ɣmml	'mold'
ɣmu	ɣmmu	'dyed'
$ɣ^w$li	aqq^wlay	'go up, climb'
ħml	ħmml	'enjoy'
ħri	ħrri	'be soft, supple'
ħrm	ħħrm	'ignore'

Very few roots in Tashlhiyt Berber are of the form SSO. Only four roots are listed in class 5, three of which form their imperfective by means of affixation. The first two roots assign their initial sonorant to the head position; the other two resist the head-complement structure, as their most sonorous segment is in initial position.

5 SSO

√	*Imperfective*	
lmd	ttlmad	'learn'
$lmz^ʕ$	$ttlmaz^ʕ$	'swallow without chewing'
mrg	ttmrag	'be ashamed'
mrz	mmrz	'wound in the head'

The roots listed in class 6 are not analyzable in terms of head-complement structure, since the only sonorant they contain is in initial position. Apart from *lbʒ*^{ʕ} and *nsd*^{ʕ}, they all use affixation rather than gemination to form the imperfective.

6 SOO

√	*Imperfective*	
lbʒ^{ʕ}	lbbʒ^{ʕ}	‘squash’
lqʒ	lqqʒ	‘crush’
mʃd^{ʕ}	ttmʃad^{ʕ}	‘comb’
nfd	ttnfad	‘be stirred up’
ngd^{ʕ}	ttngad^{ʕ}	‘drown’
ngs	ttngas	‘jostle, shove’
nʃf	nʃʃf	‘scrape’
nsd^{ʕ}	nssd^{ʕ}	‘gush’
nɣd	ttnɣad	‘refine’
nɣ^{w}z	ttnɣ^{w}az	‘blink eye’
rk^{w}s	ttrk^{w}as	‘hide’
rkz	ttrkaz	‘dance’
rqs	ttrqas	‘jump’

Roots that are made up entirely of sonorants assign the head function to the segment that immediately precedes the most sonorous segment. Their imperfective is formed by means of gemination.

7 SS̲S

√	*Imperfective*	
lwi	lwwi	‘be relaxed, soft’
mlu	ttmlu	‘be limp, flabby’
nru	nrru	‘defeat’
rmi	rmmi	‘be tired’
rwi	rwwi	‘make dirty, mix’
rwl	rwwl	‘run away’
r^{ʕ}wu	r^{ʕ}wwu	‘remedy’

Class 8 roots are entirely composed of obstruents. They are not analyzable into a head-complement structure and hence undergo affixation rather than gemination in the imperfective.

8 OOO

√	*Imperfective*	
bdg	ttbdag	‘be wet’
bks/biks	ttbikkis	‘fasten’
bxs	ttbxas	‘discredit oneself’
bzd^{ʕ}	ttbzd^{ʕ}ad^{ʕ}	‘urinate’
bzg	ttbzag	‘swell’
dfʃ	ttdfaʃ	‘punch’
ʒbd	ʒbud	‘pull’
k^{w}fs	ttk^{w}fas	‘sow’

stɣ	sttɣ	‘split’
zdg	ttzdag	‘purify’
zdɣ	ttzdaɣ	‘inhabit’

The verbs of class 9 are analyzed as being underlyingly trisegmental of the form CCU. As such, they assign the head function to the obstruent, which they all geminate in the imperfective.

9 SO

√	*Imperfective*	
ls	lssa	‘wear’
ns	nssa	‘overnight’
nz	nzza	‘be sold’
nɣ	nqqa	‘kill’
rz	rzza	‘break’
rɣ	rqqa	‘be lightened, hot’

The biconsonantal roots in class 10 assign the head function to the obstruent, which geminates in the imperfective. Some of these roots behave differently (see section 4 for discussion).

10 OS

√	*Imperfective*	
dl	dllu	‘cover’
d^{ʕ}i	tt^{ʕ}ay	‘drive out’
d^{ʕ}r	tt^{ʕ}ar	‘fall down’
fi	ttfay	‘suppurate’
fl	ffal	‘leave’
gl	ggal	‘bust’
gn	ggan	‘sleep’
kl	klla	‘spend a day’
su	ssa	‘drink’
zu	zwwa	‘be dried’
z^{ʕ}m	z^{ʕ}mma	‘wring’
z^{ʕ}r	z^{ʕ}rra	‘see’
ɣ^{w}i	qq^{w}ay	‘catch’

With respect to their morphological properties, the remaining biconsonantals in classes 11 and 12 behave paradoxically, making it difficult to decide whether they are underlyingly bi- or trisegmental.

11 SS

√	*Imperfective*	
ml	mmal	‘show’
nu	nwwa	‘be cooked’

12 OO

√	*Imperfective*	
fk	akka	'give'
ks	kssa	'graze'
ɣz	qqaz	'hollow'
sɣ	ssaɣ	'buy'
zdˤ	zzadˤ	'mill, grind'

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