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Root-and-pattern Morphology Revisited: Verb Stem Bimoraicity and Stem-based Morphology in Moroccan Arabic*

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Cet article remet en cause la notion traditionnelle de la racine et met en exergue l'hypothèse selon laquelle la base de dérivation verbale peut contenir aussi bien des consonnes que des voyelles. Nous présentons trois sortes d'arguments qui soutiennent notre hypothèse de base de dérivation. Le premier argument, lié à la bimoraicité du radical, affirme que les verbes non dérivés doivent obligatoirement contenir exactement deux mores. Cela présuppose l'existence de voyelles sous-jacentes. Le deuxième argument, qui provient de la morphologie flexionnelle, montre que certains processus d'affixation nécessitent une distinction entre radical et mot- deux catégories qui forment deux entités phonologiquement vérifiées. Le troisième argument relève de la forme du causatif que nous proposons d'analyser en tant que processus de réduplication prenant comme base de dérivation une forme correspondant au mot phonologique. Notre analyse s'inscrit dans le cadre de la Théorie de l'Optimalité telle qu'elle est décrite dans les travaux de Prince and Smolensky (1993/2004) et McCarthy and Prince (1993 et seq).

1. Introduction

Since the establishment of the prosodic theory of non-concatenative morphology with McCarthy (1979, 1981), the consonantal root has been assumed to be the basis for any possible analysis of word-formation in Semitic morphology. Within this

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framework, a word is seen to consist of three different morphemes represented on different levels, referred to as tiers: the consonantal root, carrying the basic meaning, the vocalic melody and the prosodic template. This traditional concept of root has been challenged in a number of works dealing with Semitic morphology and providing convincing arguments for alternative analyses. These works fall mainly within two categories: those that assume a stem/word based analysis of word-formation (Heath 1987, Bat-El 1994, Ussishkin 1999, Benmamoun 1999, Schluter 2013, among others); and those that assume a combination of both the root and the stem/word (Ravid 2006, Watson 2006).

Bat-El (1994) and Ussishkin (1999) show that phonological regularities could better be explained by assuming a word-based rather than a root-based approach to verbal morphology of Hebrew. Bat-El (2003) calls for the elimination of the consonantal root and provides evidence from historical changes, claiming that the learning process leads to the construction of words rather than consonantal roots. From a syntactic point of view, Benmaoun (1999) also assumes that important parts of Arabic word-formation are word based rather than root based. He shows that if the imperfective is taken as the unmarked default verb form, a unified analysis of nominal and verbal morphology could be achieved. From a psycholinguistic perspective, and on the basis of the experiments conducted, Schluter (2013) suggests that the word, rather than the root, is the basic unit of speech perception. Schluter claims that the root is not a mental unit but a property of words or relationship among a morphological family.

Other psycholinguistic experiments carried out have reached a different conclusion which supports a root-based approach to morphology. Boudelaa & Marslen-Wilson (2001) present evidence for the lexical storage of the consonant root. The same result is reached by Boudelaa (2014) who considers both the root-based and word-based views and the implications they have for the way Arabic words are accessed and stored in the mental lexicon, and concludes that the Semitic lexicon in general is organized in terms of morphemes which govern spoken and written word recognition processes. Prunet (2006) reviews external evidence bearing on the internal structure of words in Semitic languages and concludes that this evidence favors formal models of morphology that regard the consonantal root as a legitimate morphological unit.

Proponents of a combination of root- and word-based word-formation analyses have also their own evidence for claiming so. Ravid (2006) has shown that Hebrew nominal morphology operates in two different modes: a mode obtained by relating words through their roots and patterns, and is largely responsible for the core nominal lexicon of Hebrew consisting of shorter words; and a second word-level linear mode which uses words as major components for further multiple affixation. Such a view is further corroborated by Watson (2006) who argues, on the basis of linguistic evidence from the semantic and phonological relationships between diminutive verbs and their non-diminutive counterparts, that San’ani Arabic exemplifies both root-based and stem-based types of word formation.

To contribute our own way to the debate on root-based as opposed to stem/word-based morphology, this paper purports first to explore the nature of the root in Moroccan Arabic (henceforth MA), and second to consider whether or not some aspects of the morphology of the language take the root or the stem/word as the base.

The view that the root in MA consists mainly of abstract consonants is discarded, and a new definition of the 'root', based on previous works by Heath (1987) and Al Ghadi (1990/2014) is provided to the effect that the 'root', which will be referred to here as 'base', is seen to consist of both consonants and vowels. The paper addresses the issue, focusing mainly on the nature of epenthesis in trisegmental and quadrisegmental verb bases. The assumption underlying the present work is that while underived verbs on the pattern CCC and CCCC lend themselves to a C-root analysis, other verbs on the pattern CCV, CVCC and CVCV, where V corresponds to one of the full vowels [i, u, a], use a much richer base of derivation other than the traditional consonantal root. Evidence supporting our assumption comes from verb prozodization, namely a constraint having the effect of limiting the size of the underived verb to two moras. It'll be argued that where the verb base is purely consonantal, the only epenthesis available is that which inserts schwa and not a full vowel. This argument is based on the precept that schwa acquires its moraic status only in combination with a following consonant (Bensoukas and Boudlal 2012a, 2012b). The analysis offered is couched within the constraint based framework of Standard Parallel Optimality Theory as sketched in Prince and Smolensky (1993/2004) and McCarthy and Prince (1993a). The paper also calls for a stem/word based approach of two aspects of the verbal morphology of MA: one inflectional, the other derivational. Both the perfective inflectional paradigm and the causative derivation will be analyzed as cases that take the verb stem/word as the base.

The rest of the paper is articulated as follows. Section 2 redefines the MA root and presents the facts. Section 3 introduces briefly Optimality Theory, the framework adopted in the analysis of the verb base. Section 4 looks at the nature of the base and explores how the bimoraicity requirement is achieved. Section 5 provides data that lend support to a stem/word based analysis of two morphological aspects, and finally section 6 concludes the paper.

2. Beyond the Consonantal root

With respect to MA, the first work to challenge McCarthy's non-concatenative root-based approach to morphology is that of Heath (1987). Heath abandoned the multi-tiered representation in favor of a mapping of a base form onto an output form. He adopted a model that dispenses with C-root representations of the type proposed in McCarthy (1979, 1981) and proposed representations of roots that include both vowels and consonants. He redefined the relationship between the input and the output in MA, assuming that it involves two output stem forms which are governed by ablaut changes. Ablaut derivations, or stem-internal derivations, as he calls them, are produced by mapping a stem input onto a predefined output template. Heath (1987) argues that underived stems are linearly represented, obviating the need for special tiers for roots and grammatical segments. Underived stems in this sense serve as input to ablaut transformations that produce derived stems which serve themselves as inputs to further ablaut transformations. For example, the derivation of the active participle in 1 below requires the input form /ʃri/ 'buy', a stem and a word, which is mapped onto the output ablaut template /CaCC/ (p. 95):

(1)

Input: /ʃ r i/
| | |
Output: C a C C[1]

The association of the final stem vowel to a consonant leads to the spelling out of that vowel as a glide which is later taken care of by a vocalization process to yield the disyllabic output [ʃari]. Note in the example chosen above that for Heath verbs traditionally referred to as hollow and weak have an underlying representation with full vowels and that their realization as vowels or glides depends on their syllabic position. The final vowel of the stem [ʃri] shows up as [j] in the derivation of the noun of instance [ʃərja].

This model considers stems to be the by-products of derivational ablaut. For Heath (1997: 214) each stem is produced by the interaction of an input stem and a template, which consists of pre-specified vowels and consonants. For example the templates for the active and passive participle forms [katəb] and [məktub] he proposed are CaCC and m-CCuC, respectively. These interact with the stem [ktəb] to yield the correct output forms.

Heath's model recognizes what he calls derivational layering; i.e. an innner stem X is the basis of a suffixally derived stem $[X]\text{-}S_1$, which is in turn the source of other suffixally or prefixally stems P_1 $[[X]\text{-}S_1]$, then $[P_1$ $[[X]\text{-}S_1]]\text{-}S_2$, etc…. Heath (1997: 21) claims that in this way, his model "treats languages like MA as not different from other affixing models but none-the-less involves, like the stem-and-pattern model, some fairly intricate phonological subrules."

Another seminal work that questions the traditional consonantal root is that of Al Ghadi (1990/2014). Based on data from the nominal morphology of MA, Al Ghadi

[1] To allow for a unified treatment of sound and weak verb stems, Heath (1987) proposes that verbs such as /ʃri/ could alternatively be mapped onto the template /CaCC/ to give intermediate stem form //ʃarj//, subject to schwa epenthesis to yield the form //ʃarəj//. Heath also assumes a later monophthongization of //əj// to /i/.

presents ample evidence against the strong root-and-pattern hypothesis which grants a morphemic status to templates. According to Al Ghadi, templates in MA consist of simple slots that serve for morphological rule application. Such a stand was dictated by the nature of the language and its roots. He redefined the term root, showing that it may consist of both vowels and consonants instead of consonants only. He proposed the neutral term segment which refers to consonants, vowels and sometimes to features but never the vowel schwa, which he assumes to be epenthetic.

The analysis presented in this paper rests on the concept of roots as conceived of in works such as Heath (1987) and Al Ghadi (1990/2014) and other subsequent work on the grammar of MA such as Bennis (1992), Boudlal (1993, 2001), Rguibi (2001), Imouzaz (2002), to cite a few. In particular we'll consider representative data from bothunderived trisegmental and quadrisegmental verbs.

First consider verb bases that consist exclusively of consonants. We start with quadrisegmental verbs on the pattern CCCC, where schwa splits every sequence of two consonants, including final geminates as shown in 2 below:

(2) Quadrisegmental verbs with consonants only

a-	/ṣṛfq/	ṣəṛfəq	'slap'
	/krkb/	kərkəb	'roll'
	/tṛʒm/	təṛʒəm	'translate'
	/ʒṛʒṛ/	ʒəṛʒəṛ	'trail in dust'
b-	/brgg/	bərgəg	'gossip'
	/ḥnẓẓ/	ḥnẓəẓ	'gaze at'
	/ʕntt/	ʕəntət	'show stubbornness'

Underived trisegmental verbs epenthesize schwa differently. In 3a schwa is epenthesized between the last two consonants in a CCC sequence, whereas in 3b it is epenthesized between the first two consonants in compliance with the geminate integrity constraint (Benhallam 1991, Boudlal 2001)

(3) Verbs with consonants only

a-	/ktb/	ktəb	'write'
	/ḍrb/	ḍrəb	'hit'
	/hṛb/	hṛəb	'flee'
	/brd/	brəd	'get cold'
b-	/ʃdd/	ʃədd	'hold'
	/ʕḍḍ/	ʕəḍḍ	'bite'
	/ʒṛṛ/	ʒəṛṛ	'pull'

Next we consider undervied verbs with both vowels and consonants. In 4a, the items chosen start with an initial consonant cluster and end in a vowel, the nature of which could be either ***i*** or ***a***. In 4b, the verbs presented have a medial vowel showing an ***u~a*** alternation:

(4) Verbs with vowels and consonants

a-	/CCV/	bki~bka	'cry'
	/CCV/	ʒri~ʒra	'run'
	/CCV/	dwi~dwa	'speak'
b-	/CVC/	mut~mat	'die'
	/CVC/	dub~dab	'melt'
	/CVC/	ʃuf~ʃaf	'see'

The ***i~a*** and ***u~a*** alternations exhibited by the items in 4 above could be accounted for by an allomorphy rule (Al Ghadi 19990/2014). The vowel ***a*** appears only in the third person singular and plural of the perfective form of the verb, whereas the vowels ***i*** and ***u*** appear in all the other persons and verb forms.

Quadrisegmental patterns with at least one full vowel are syllabified in two different ways. In verbs with an underlying full vowel in second position, schwa splits the remaining cluster of consonants and forms a syllable on its own, thus resulting in forms on the pattern CV.CəC as in 5a. Verbs with a full prefinal vowel epenthesize schwa between the initial consonant cluster as in 5b:

(5) Verbs with vowels and consonants

a-	/ṣifṭ/	ṣifəṭ	'send'
	/mixl/	mixəl	'rummage
	/surt/	surət	'lock'
	/qulb/	quləb	'trick'
	/ʒulq/	ʒuləq	'send astray (informal)'
b-	/ṣqṣi/~/ṣqṣa/	ṣəqṣi~ṣəqṣa	'ask after'
	/srbi/~/srba/	sərbi~sərba	'hurry up'

Finally, quadrisegmental verbs with two underlying full vowels exist but are mostly loanwords such as those in 6 below:

(6)

/sali/~/sala/	sali~sala	'finish'
/fanti/~/fanta/	fanti~fanta	'fake'
/ʃumi/~/ʃuma/	ʃumi~ ʃuma	'be unemployed'
/ruli/~/rula/	ruli~ rula	'drive'
/fari/~/fara/	fari~fara	'pay'

Having presented the verb bases that will be analysed in section 4, we turn next to briefly present the theoretical framework adopted for the analysis of verb base bimoraicity in MA.

3. Optimality Theory

The analysis offered in this paper is couched within the constraint-based framework of Optimality Theory (OT) (Prince and Smolensky 1993/2004; McCarthy and Prince 1993a, and related works).[2] The OT apparatus consists of GEN, a generator of output candidates, EVAL, which evaluates these candidates to decide which one is optimal, and finally CON, referring to a set of universal constraints ranked on a language particular basis. For illustration, consider the constraint tableau below, where CON consists of Con1 and Con2 in this respective order:

(7)

Candidates	Con1	Con2
☞a. Candidate 1		*
b. Candidate 2	*!	

Violations are marked by an asterisk [*] and a fatal violation is marked by [!]; the optimal candidate is marked by ☞. Con1 dominates Con2 (written as **Con1>>Con2**, represented in the tableau by a solid line separating the two constraints. When no domination holds between the two constraints, Con1 and Con2 are written as **Con1, Con2** and are separated by a dotted line in the constraint tableau.The optimal candidate in this tableau is candidate 1 which violates a low ranked constraint, namely Con2.

In what follows in this section we offer a basic OT analysis of MA syllable structure that treats only aspects related to the theme of the paper. A more detailed analysis of MA within the OT framework is to be sought in works such as Al Ghadi 1994; Boudlal 2001, 2006/2007, 2009, 2010, Rguibi 2001, Imouzaz 2002, El Yamani 2006, Bensoukas & Boudlal 2012a,b.

To satisfy syllable structure in MA, the constraint MAX, which militates against deletion of any kind, is never violated (McCarthy and Prince 1995). Also unviolated is the constraint ONS, requiring syllables to have onsets. This suggests that contrary to Moroccan Amazigh (Bensoukas & Boudlal 2012a,b), ONS dominates both Align-L, a constraint requiring left alignment of the stem and the prosodic word (McCarthy and Prince 1993b), and DEP, a constraint banning epenthesis of any kind (McCarthy and Prince 1995). We assume the existence of

[2] OT refers to works by Prince & Smolensky (1994/2004), McCarthy & Prince (1993a), which later developed into what came to be known as Harmonic Serialism (McCarthy 2016).

the No-Coda constraint which should rank below DEP to avoid epenthesis at the expense of coda. Finally we assume that both Align-L and DEP are not ranked with respect to each other.

The tableau below, taken from Bensoukas & Boudlal (2012b), assesses candidates for the input /ataj/ 'tea', where the form [ʔataj], with glottal stop epenthesis, emerges as optimal:

(8)

/ataj/	ONS	MAX	DEP	Align-L	No-Coda
☞a- ʔa.taj			*		*
b- a.taj	*!				*
c- ʔa.ta		*!	*		
d- ta		*!*			

Next case we consider is a form on the pattern /CVCC/, where the sequence of consonants is syllabified as a schwa syllable. For such forms we need the addition of the constraint Parse-Seg, which requires that all segments belong to syllables (Prince and Smolensky 1993/2004). The effect of this constraint, which we assume to be undominated in MA, is to force epenthesis between strings of unsyllabified consonants as shown from the output participial form [katəb] 'writing' in the tableau below. The dots mark syllable boundary:

(9)

/katb/	ONS	MAX	Parse-Seg	DEP	No-Coda
☞a- ka.təb				*	*
b- ka.tb			**!		
c- kat.b			*!		*

The same constraints are needed to account for words on the pattern /CCC-V/. The constraint Parse-Seg forces schwa epenthesis between the initial clusters of consonants as shown in the output candidate referring to the noun of instance [kətba] 'writing':

(10)

/ktb-a/	ONS	MAX	Parse-Seg	DEP	No-Coda
☞a- kət.ba				*	*
b- kt.ba			**!		
c- ktəb.a	*!			*	*

Both tableaux show the undominated nature of three constraints in MA: ONS, MAX and Parse-Seg. These are ranked at the top of the ranking scale.

The next cases we consider require additional constraints that bear on the main argument in this paper: the effect of the bimoraicity constraint imposed on underived verb bases in MA.

4. The nature of the verb base

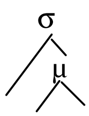
In this section, we explore the nature of the underived verb base serving for morphological analysis. In particular we'll try to find out what the verb base really consists of. Is it the consonantal root or is it some other phonological form that consists of both consonants and vowels? A look at the data in 2 above lends support to the C-root based approach to morphology since these verbs consist of purely consonantal verb bases serving as input to derived phonological output forms. However, this postulate is contradicted by the existence of verb bases that consist of vowels that appear in forms that are morphologically related to the base (e.g. 4 and 5 above).

Given this state of affairs, two solutions arise. The first is to assume that prosodic structure in MA is lexical, entailing that underived verb bases come with underlying vowels, including the vowel schwa. However, such a solution cannot be justified independently, at least when it comes to schwa, which has been shown to be epenthetic and therefore predictable (Benhallam 1989/1990, Al Ghadi 1990/2014, Boudlal 1993, 2001, Rguibi 2001, Imouzaz 2002, among others). The second solution, which is adopted in this work, is to assume the existence of a C-root base of derivation but that this assumption is weakened by the existence of verb bases that consist of both vowels and consonants. Evidence for this assumption comes from what Boudlal (2001) refers to as verb bimoraicity, encoded in terms of a constraint requiring that underived verb bases correspond to two moras in their output form. In particular, we advance arguments showing that the language resorts to three different ways to achieve the requirement: first, through schwa epenthesis when the verb base is purely consonantal; second, through consonant moraification and/or schwa epenthesis; and third, through epenthesis and full vowel syllabification.

4.1. Bimoraicity as schwa epenthesis

The syllabification of quadrisegmental verbs on the pattern CCCC presents a case that requires more constraints than those introduced up to 10 above. In these verbs, schwa is epenthesized between each pair of consonants to yield the output form CəCCəC. In accordance with the propo sal made in Bensoukas (1994) and adopted for MA in Boudlal (2001) and Bensoukas and Boudlal (2012a,b), schwa syllables consist of a single branching mora that both schwa and the following coda consonant share as shown in (11):

(11)



C ə C

The structure in (11) shows that schwa syllables have to have codas, a fact which suggests that the No-Coda constraint is ranked below DEP.

We also adhere to the proposal made in Boudlal (2001), Dell and Elmedlaoui (2002), and Shaw, Gafos, Hoole, and Zeroual (2009) that the onset in MA (and also the coda, I believe) consists of a simple consonant. This means that complex margins must be banned, an effect ensured by undominated *Complex constraint. The interaction of *Complex with DEP is shown in the tableau below for the output form [ṣəṛfəq]. No ranking is needed between *Complex and Parse-Seg.

(12)

/ ṣṛfq /	*Complex	Parse-Seg	DEP	No-Coda
☞a- ṣəṛ.fəq			**	**
b- ṣṛəfq	**!		*	**
c- ṣṛ.fəq		**!	*	*

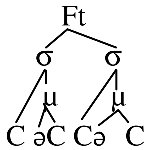
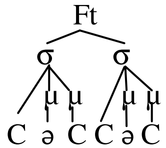
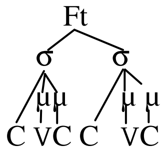
The behavior of schwa in quadrisegmental verb bases points to the fact that there is a preference for disyllabic words, something that could be ensured by the constraint FT-BIN proposed in Prince & Smolensky (1993/2004), which stipulates that feet must be binary, consisting of either two syllables or two moras. In fact many Semitic languages show this preference for disyllabicity. Bat-El (1994, 2003) and Ussishkin (2005, 2006) show that most modern Hebew verbs are disyllabic.

A look at the quadrisegmental verbs given in 5above shows that these verbs come with at least one full vowel underlyingly and as such there is no way to satify FT-BIN except by making recourse to default vowel epenthesis. When the underlying form of these verbs is purely consonantal as in 1 above, recourse is made to double schwa epenthesis to fill in the syllabic nuclei required for the satisfaction of FT-BIN. A vowel other than schwa can also be epenthesized, but would never give a correct output due to mora overweight. Because of this overweight, Boudlal (2001), in his analysis of verb prosodization, argues that this effect on the size of the 'root'can be captured by theprosodic constraint Verb Base=[μμ] (henceforth VB=[μμ]), requiring that the verb be exactly bimoraic.[3]

To show how the constraint VB=[μμ] interacts with other constraints already seen, consider an input form such as /CCCC/ which must be realized as a sequence of two light syllables. This result is obtained through schwa epenthesis, as shown in (13).

[3] Instead of verb base, Boudlal (2001) uses the appellation verb root, which I think is inappropriate given the line of arguments developed in this paper.

(13)

/CCCC/	VB= [μμ]	DEP	No-Coda
☞a. 		**	**
b. 	**!	**	**
c. 	**!	**	**

Note that even if we assume an underlying representation with full vowels, or an underlying representation with more than 4 consonants in conformity with Smolensky's (1996) richness of the base, the output will always have to be the form CəCCəC. To illustrate how this works out in MA, we'll have to add two more constraints that need to be ranked below VB=[μμ], namely MAX-C and MAX-V, militating against deletion of input consonants or vowels. The two constraints need not be ranked with respect to each other.

(14)

i- /CVCCVC/	VB= [μμ]	MAX-C	MAX-V	DEP	No-Coda
☞ a- $CəC^{μ}.CəC^{μ}$			**	**	**
b- $CV^{μ}C^{μ}.CV^{μ}C^{μ}$	**!				**
ii- /CCCCC/					
☞ a- $CəC^{μ}.CəC^{μ}$		*		**	**
b- $C^{μ}.CəC^{μ}.CəC^{μ}$	*!			**	**

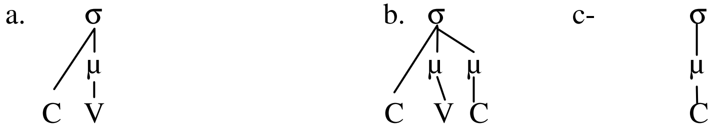
The ranking given above will always favor a bimoraic form with two light syllables. In 14.i, the output form resorts to deletion of the input full vowels because they are far too many for the constraint VB= [μμ]. Instead, it resorts to schwa epenthesis, thus satisfying the bimoraicity requirement at the expense of a low ranked constraint, namely DEP. In 14.ii, the optimal candidate deletes one of the input consonants to satisfy VB=[μμ]. Keeping the input consonant results in an excess of moras and therefore a violation of VB=[μμ] . Even if we don't grant a moraic status to that extra consonant, we'll end up with a complex margin, something that the language does not allow.

4.2. Bimoraicity as consonant moraification

The next verbs we consider are those on the pattern CCC and CCV, which are challenging in more than one respect given our prosodic constraint about verb bases. First CCC, which contains no vowel, resorts to epenthesis to parse its consonants into syllables. The only available spot we have for epenthesis is either between the first and second consonants, or between the second and the third consonants of the verbs. In both cases, there is room for a single vowel only, providing a single mora. The second category of verbs has an underlying full vowel that counts as a single mora and is like the first category in need of a second one to satisfy the VB=[μμ] constraint.

Schwa epenthesis in trisegmental verbs consisting exclusively of consonants gives either CCəC or CəCC, with CCəC being the optimal output in sound verbs and CəCC in geminated verbs. To understand epenthesis in these verbs, we need to make a distinction between two syllable types: major and minor syllables (Boudlal 2001). A major syllable (Maj-σ) is headed by schwa (11 above) or a full vowel (15a, b); a minor syllable (Min-σ) is dominated by a consonantal mora (15c) and as such incurs a violation of the markedness constraint *Min-σ.

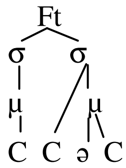
(15)



Since complex margins are banned in MA, the first consonant sequence in verbs on the pattern CCəC and the final consonant sequence in verbs on the pattern CəCC are assigned as minor syllables and are therefore moraified. What triggers consonant moraification in such verbs is our prosodic constraint VB=[μμ] requiring that the verb base be exactly bimoraic. One might assume that the constraint VB=[μμ] is simply an instantiation of the FT-BIN observed at the moraic level (McCarthy and Prince, 1993a). However, this is not true since FT-BIN imposes a lower bound and requires that the minimal word be bimoraic and does not impose an upperbound, whereas VB=[μμ] imposes a minimality and a maximality requirement on underived verbs.

To ensure epenthesis before the final consonant in non geminated verbs consisting of a CCC sequence, we also assume a constraint of the alignment type (McCarthy and Prince 1993b) dubbed Align-R-Maj-σ, requiring that the right edge of the stem be aligned with the right edge of a major syllable. The representation of verbs on the pattern CCəC adopted in this work is as follows:

(16)



The constraints needed to account for epenthesis in /CCC/ verb bases and their respective ranking are given below:

(17)

VB=[μμ], Parse-seg, *Complex, Align-R-Maj-σ » DEP » *Min-σ » No-Coda.

For ease of exposition, moraic structure will be given only when it bears on the argument. We also simplify the constraint tableaux and eschew to include all of the constraints listed in 17. The tableau below shows constraint interaction for the different candidates of the output [ḍṛəb]:

(18)

/ḍṛb/	VB=[μμ]	Align-R-Maj-σ	DEP	*Min-σ
☞a- ḍ$^{\mu}$.ṛəb$^{\mu}$			*	*
b- ḍəṛ$^{\mu}$.b$^{\mu}$		*!	*	*
c- ḍṛəb$^{\mu}$	*!		*	

The optimal candidate resorts to consonant moraification (i.e. violation of *Min-σ) to satisfy VB=[μμ]. Candidate 18b does the same thing but falls short because of aligning a minor syllable at the right edge of the stem. Finally candidate 18c avoids a minor syllable at the expense of unviolated VB=[μμ] and *Complex. Note also that a form such as [ḍ$^{\mu}$.ṛəb$^{\mu}$], satisfying the constraint VB=[μμ], forces the consonant [ḍ] to be moraic, thus violating a constraint Prince and Smolensky (1993/2004) call H-NUC, which considers C-nuclei to be less harmonic than V-nuclei. However, with words on the pattern CCC (and also words on the pattern CCV down below), the only way to satisfy VB=[μμ] is by assigning a mora to the first consonant, thus violating H-NUC and subsequently *Min-σ. We assume that *Min-σ and H-NUC are not ranked with respect to each other.

The same analysis can be extended to account for the behavior of verb son the pattern CCV. Given the constraint ranking above, these verbs should not pose any problem. Remember that these verbs come with a single vowel underlyingly, and therefore the only way for them to satisfy the constraint VB=[μμ] is via the moraification of the first element of the intial cluster as shown in the tableau below for the candidates of /ʃra/:

(19)

/ʃra/	*Complex	VB=[μμ]	DEP	*Min-σ
☞a- $ʃ^μ.ra^μ$				*
b- $.ʃra^μ.$	*(!)	*(!)		
c- $ʃ.ra^μ$		*!		*
d- $ʃə^μ.ra^μ$			*!	

Given that a verb must conform to exactly two moras, one might wonder whether verbs on the pattern CCV cannot surface as $Cə^μ.CV^μ$ instead of $C^μ.CV^μ$, all things being equal. The constraint ranking given above will rule out this output on the basis of its violating DEP. A look at other data in MA shows that the constraint DEP alone cannot decide the fate of the optimal candidate. For example the input /safr-tu/ 'you traveled' has two competing output forms, i.e. [sa.fər.tu] and [saf.rə.tu]. Both these forms tie at DEP and a constraint breaking this tie imposes. To do that Bensoukas and Boudlal (2012a) assume that the output form *[saf.rə.tu] is ruled out because it violates the constraint $*[Cə^μ]_σ$, which bans schwas in open syllables.[4]In fact the constraint they propose is *ə/μ which bans the association of schwa with a mora. For them, schwa associates with a mora only when there is a following consonant which shares the mora with the schwa.

To wrap it up, the behavior of initial and final consonant clusters in underived trisegmental verbs points out to the fact that the only way to satisfy the constraint VB=[μμ] is by assigning a moraic status to a member of the cluster, exactly as shown in 18 and 19 above.

4.3. Bimoraicity as schwa epenthesis and full vowel syllabification

The third case we consider is that of quadrisegmental verbs on the pattern CVCC or CCCV whose output scenarios should now be predictable. Given the constraints presented so far, the only way to satisfy the prosodic constraint VB= [μμ] is by epenthesizing schwa between each pair of consonants, giving rise to either CəCCV or CVCəC.

Consider the tableau below for an illustration of the different output forms of the input /CCCV/:

[4] The constraint against having schwas in open syllables was first proposed in Benhallam (1989/1990) and later in other works such as Al Ghadi 1990/2014, 1994; Boudlal, 2001, 2006/2007, Rguibi (2001), and Imouzaz (2002), to cite a few.

(20)

/ṣqṣa/	*Complex	VB=[μμ]	DEP	*Min-σ
☞a- ṣəq^{μ}.ṣa^{μ}			*	
b- ṣ^{μ}.qṣa^{μ}	*!			*
c- ṣə^{μ}.qə^{μ}.ṣa^{μ}		*!	**	

Notice that candidate 20c can also be ruled out because of the high ranked constraint *ə/μ against single association of schwa to a mora.

One final case of quadrisegmental verb bases that is worth mentioning here is that of a very limited number of verbs on the pattern CVCV such as /sali/~/sala/ 'finish' given in 6 above. These verbs are disyllabic with both syllables being light, conforming to the constraint VB=[μμ]. Cases like these raise yet another issue related to the nature of the input. Is the underlying representation of a verb stored along with its prosodic structure or is the latter acquired as a result of constraint interaction?

The constraints developed here make it clear that the prosodic make-up of underived verbs is predictable. They all have to have two moras and as such any form deviating from this norm is illicit. Such is the claim partially made in Benhallam (1989/1990), who proposes a Syllable Structure Algorithm Assignment to account for Schwa epenthesis in words on the pattern CCəC, complemented by an underlying template specifying the placement of schwa in words on the pattern CəCC. Al Ghadi (1990/2014) suggests something along the same lines for verbs but takes a different position for nouns. He assumes that nominal schwa epenthesis is governed by sonority constraints while the syllabification of verbs abides by a prosodic template.

To sum up, we have shown in this section that the C-root as an organizing morphological entity is weakened by the existence of verb bases with underlying vowels that contribute to verb bimoraicity. We have also seen that in the absence of bases with vowels, the bimoraicity constraint is satisfied through consonant moraification or schwa epenthesis. We turn next to show how the morphology of MA uses a base of derivation other than the C-root, namely the stem/word.

5. Stem-based evidence from Verb morphology

Support to the view saying that the input of verb derivation is the stem and not the consonantal root comes from two phenomena: (i) the verb inflectional paradigm, or what is commonly referred to in the literature as cyclic schwa syllabification (Benhallam 1989/1990, Al Ghadi 2014, Boudlal 2009) as opposed to non-cyclic schwa syllabification; second, it also comes from verb derivation, namely the causative form.

5.1. Cyclic and non-cyclic schwa syllabification

For illustration of how syllabification operates in verb bases with consonants only, consider the examples in 21 below taken from Boudlal (2009: 163)

(21) Verb stem + subject marker

ḍṛəb 'hit'		kərkəb 'roll'
ḍṛəb-t	1sg.	kərkəb-t
ḍṛəb-ti	2sg.	kərkəb-ti
ḍṛəb	3sg. masc.	kərkəb
ḍəṛb-at	3sg. fem.	kərkb-at
ḍṛəb-na	1pl.	kərkəb-na
ḍṛəb-tu	2pl.	kərkəb-tu
ḍəṛb-u	3pl.	kərkb-u

When consonant-initial affixes (i.e. -C and -CV) are introduced, schwa is epenthesized between the second and third consonants of the root in trisegmental verbs (CCəC) and between each pair of consonants in quadrisegmental verb roots (CəCCəC). However, when vowel-initial affixes are introduced (i.e. -V, -VC), schwa is placed before the second consonant of the root in trisegmental verbs (CəCC), and only between the first pair of consonants in quadrisegmental roots (CəCCC).

What interests us here in particular is why an underlying trisegmental verb sequence such as /CCC-C/ surfaces as [CCəC-C] and not [CəCC-əC] (e.g. [ḍṛəb-t] 'I hit'as opposed to *[ḍəṛbət]) and an underlying quadrisegmental verb on the pattern /CCCC-C/ surfaces as [CəCCəC-C] but not [CəCCC-əC] (e.g. [kərkəb-t] "I rolled" but not *[kərkb-ət]).

Assuming a C-root analysis allows for the generation of the correct output. The input to a form such as [ḍṛəbt] is in this case /ḍṛb-t/, which corresponds to the underlying representation and is syllabified as a string of four segments, all of which are consonants, leading to a double epenthesis of schwa much like the quadrisemental verbs in 2 above. The constraints needed are DEP and *Min-σ, both of which need to be dominated by Align-R, requiring that the right edge of the verb align with the right edge of the syllable. The interaction of the constraints is shown in the tableau below exposing the competing candidates obtained from the C-root base /ḍṛb-t/:

(22)

/ḍṛb-t/	Align-R	DEP	*Min-σ
☞a- ḍ.ṛəb.t		*	**
b- ḍəṛ.bət	*!	**	

By having recourse to the epenthesis of two schwas, the form in 22b incurs a fatal violation of the constraint Align-R. Note that in the data in 21 above, the only forms that violate Align-R are those whose affixes are vowel-initial (i.e. [ḍəṛbu], [ḍəṛbat], for example) to secure a higher ranked constraint, namely ONSET.

Although the C-root analysis to the verb inflectional paradigm seems to yield the correct output as witnessed by the tableau in 22, it cannot be defended in verb forms that do not exhibit cyclic schwa syllabification. These verb bases concern primarily trisegmental input forms on the pattern /CCC-C/ that surface as [CəCC-əC] but not *[CCəC-C] and quadrisegmental forms on the pattern /CCCC-C/ that surface as [CəCCC-əC] but not *[CəCCəC-C]. Consider the examples below where a pronominal enclitic of the form C, V and CV attaches to the verb stems [ḍṛəb] and [kərkəb]:

(23) Verb stem + object marker

ḍəṛbə-k	he hit you	kərkbə-k	he rolled you
ḍəṛb-u	he hit him	kərkb-u	he rolled him
ḍṛəb-na	he hit us	kərkəb-na	he rolled us

For an output form such as [ḍəṛbək] from the input /ḍṛb-k/, the constraints at our disposal so far interact to yield the candidates in the tableau below:

(24)

/ḍṛb-k/	Align-R	DEP	*Min-σ
☜ a- ḍ.ṛəb.k		*	**
b- ḍəṛ.bək	*!	**	

As shown here, assuming the base to be the C-root makes the wrong prediction as to the output form. Instead of the output [ḍəṛbək], the form obtained is *[ḍṛəbk], not because of the constraints proposed but because the morphology of MA needs to make a distinction between stem-based and word-based affixation.

The difference between schwa placement in [ḍṛəbt] as opposed to [ḍṛəbək] reflects two different modes of affixation patterns: affixation to the stem and affixation to the word. Boudlal (2001) derives syllabification of the types in 22 and 24 from the interaction of constraints requiring identity between a simple base form and its morphologically related output form through a transderivational correspondence (McCarthy 1995, 1997; Benua 1997, 1997; Kenstowicz 1996; Kager 1996). The author proposes, after Selkirk (1999), that correspondence has to refer to whether or not the base is a stem or a word. He distinguishes output output constraints of the type O-O$_{stem}$ANCHOR (σ, σ, Initial) and O-O$_{word}$ANCHOR (σ, σ, Initial), requiring correspondence between the intial segments of the derived stem/word output form and the base form. Therefore, words such as [ḍṛəbt] and [kərkəbt], exemplifying cases of affixation to the stem, could be derived by comparing them to the simple base forms [ḍṛəb] and [kərkəb], which are themselves independent phonological words, and not by comparing the suffixed forms to the input verb 'roots' /ḍṛb/ and /krkb/. In order to rule out a potential output candidate such as *[ḍəṛbət] or *[krəkbət], O-O$_{stem}$ ANCHOR (σ, σ, Initial) must dominate the markedness constraint *Min-σ, which penalizes minor syllables as shown in the following tableau for the optimal candidate [ḍṛəbt]:

(25)

[[ḍ.ṛəb] $_{stem}$-t]	O-O$_{stem}$ ANCHOR (σ, σ, Initial)	*Min-σ
☞ a- ḍ.ṛəb.t		*
b- ḍəṛ.bət	*!	
c- ḍṛəbt	*!	*

The base form has two syllables: a minor syllable followed by a major one, both of which are observed in the morphologically derived output form. The optimal output shows that it is more important to respect the constraint O-O$_{stem}$ ANCHOR (σ, σ, Initial) and keep the left edges of the stem when the suffix is added than to avoid a minor syllable. Both candidates 25b and 25c violate the constraint requiring left anchoring of the initial segments in the derived output and the simple base form. In 25b, the initial segment of the second syllable in the affixed forms (i.e. the segment [b]) does not correspond to the initial segment of the second syllable in the simple base form (i.e. the segment [ṛ]). Candidate 25c, which also violates undominated *Complex, does not have a correspondent of the base second syllable and as such falls short of the constraint O-O$_{stem}$ ANCHOR (σ, σ, Initial).

In the case of the output [ḍəṛbək], the relevant constraint needed is O-O$_{word}$ ANCHOR (σ, σ, Initial), which should rank below *Min-σ since double epenthesis of schwa does not preserve the initial position of the base syllables of the input word as shown below:

(26)

[[ḍ.ṛəb] $_{stem}$] $_{word}$-k]	O-O$_{stem}$ ANCHOR (σ, σ, Initial)	*Min-σ	O-O$_{word}$ ANCHOR (σ, σ, Initial)
a- ḍ.ṛəb.k		*	
☞ b- ḍəṛ.bək			*

Candidate 26a is ruled out because it violates *Min-σ. The optimal candidate spares that markedness constraint but instead violates the lower ranked O-O$_{word}$ ANCHOR (σ, σ, Initial) because the initial segment of the second syllable in the affixed form (i.e. the segment [b]) does not correspond to the initial segment of the second syllable in the base form (i.e. the segment [ṛ]).

Since O-O_{stem} ANCHOR (σ, σ, Initial) dominates *Min-σ and *Min-σ dominates O-O_{word} ANCHOR (σ, σ, Initial), we therefore conclude that O-O_{stem} ANCHOR (σ, σ, Initial) dominates O-O_{word} ANCHOR (σ, σ, Initial), by transitivity. This ranking predicts that faithfulness should appear in cases of affixation to stem but not in cases of affixation to word. While this prediction is partially true and allows for a clear distinction between cases like [ḍṛəbt], where stem faithfulness is satisfied, and [ḍəṛbək], where word faithfulness is sacrificed, it cannot be generalized to account for all the paradigms, especially the cases involving vowel-initial affixes such as those in 21 and 23 above. When a vowel-initial affix is attached to a verbal form, be it a stem or a word, its syllabic configuration changes and as such both O-O_{stem} and O-O_{word} faithfulness constraints are violated. This points to the fact that ONSET must dominate both O-O_{stem} ANCHOR (σ, σ, Initial) and O-O_{word} ANCHOR (σ, σ, Initial).

The second piece of evidence supporting a stem/word based account to some aspects of MA morphology comes from the causative, a derivational process to which we turn in the next section.

5.2. The causative

The causative form, derived by geminating the second segment of the verb base, presents further evidence on the need to consider the verb stem/word as the base for verb derivation. Let us first consider the examples in 27 below:

(27)

	Verb stem	**Causative**	**Verb Gloss**
a.	ktəb	kəttəb	‘write’
	tləf	tələf	‘lose’
	wləd	wəlləd	‘give birth to’
	bki	bəkki	‘cry’
	dwi	dəwwi	‘speak’
b.	ʃuf	ʃəwwəf	‘see’
	gul	gəwwəl	‘say’
	fiq	fəjjəq	‘wake up’
	ṭiħ	ṭəjjəħ	‘fall down’

Two observations need to be made about the data given in 27. First, it is always the second segment of the verb stem which is copied. Second, the causative shape is invariably CəCCəC, where the medial consonants could be glides as well as true consonants. Third, all the causative forms in 27 resort to a double epenthesis of schwa to yield a disyllabic output, consisting of two light syllables, a fact which shows that our prosodic constraint VB=[μμ] is at play even in derived verb forms.

According to Bennis (1992), the causative is obtained from the verb ‘root’ by the prefixation of $\sigma_{\mu\mu}$ to a prosodically circumscribed syllable which is either CV or CəC as in 27a (e.g. <k>təb/kəttəb and <b>ki/bəkki), or the suffixation of $\sigma_{\mu\mu}$ to a minimal CV syllable as in 27b (ʃu<f>/ʃəwwəf and fi<q>/fəjjəq).[5] This affixation is obligatorily accompanied by left-to-right or right-to-left spreading of the second segment of the base and this to satisfy a template requiring that the causative consist of two syllables. This circumscription analysis accounts for all the cases of the causative in the language, but by taking the verb ‘root’ as an input, the analysisfails to recognize that causative forms such as [kəttəb] and [bəkki] have more affinities with the stems [ktəb] and [bki] than with the consonantal roots posited (i.e. /ktb/ and /bkI/.

While we do not espouse the circumscription analysis in Bennis (1992), we do believe that it constitutes evidence against a C-root account of the causative. Bennis departs from a base of derivation that has been fully prosodized; in other words, an independent stem/word. It is part of this stem/word (the circumscribed syllable (CV or CəC) that serves as an input to the causative.

The analysis offered in this paper is drawn from Boudlal (2001) and assumes that the causative is another case of a stem-based morphological process. In particular, building on a proposal made in Imouzaz (2002), Boudlal considers the causative to involve partial reduplication of the verb base and posits a number of constraints to account for the items given in (27). The first of these constraints is ALIGN-E (Stem, PWd) formulated by Nelson (1998) within McCarthy and Prince’s (1993) Alignment Theory, requiring that the left and right edges of the stem must correspond to the left and right edges of the prosodic word. This constraint forces infixation of a reduplicative morpheme, exactly as is the case in MA causative forms and prevents total reduplication of the base, thus forcing violation of MAX-BR, requiring that all the elements of the base have correspondents in the reduplicant. The constraint ALIGN-E (Stem, PWd) must dominate MAX-BR since only a single segment of the base is reduplicated in the data in 27 above. It also has to dominate another constraint, proposed in McCarthy and Prince (1995), demanding that the left edge of the reduplicant correspond to the left edge of the base, namely L-ANCHOR-BR.

With these three constraints, let us proceed by showing how the causative form is obtained. The constraint tableau in 28 shows how the constraints developed above interact to give the output form [kəttəb] from the input /RED, ktəb/. For clear exposition, the reduplicant is underlined:

[5]Contrary to Bennis (1992) who claims that schwa syllables are heavy, Boudlal (2001) assumes that the causative involves affixation of a monomoraic rather than a bimoraic syllable in accordance with the claim made in works such Al Ghadi (1990/2014), Bensoukas and Boudlal (2012a, b) that the vowel schwa and the following consonant are dominated by a single mora.

(28)

k.təb, RED	ALIGN-E (Stem, PWd)	L-ANCHOR-BR	MAX-BR
☞ a. kət.təb		*	***
b. kət.bəb		**!	***
c. kəb.təb		**!	***
d . kət.bək.təb	*****!		
e. kək.təb	**!		**

The optimal candidate in 28 satisfies top ranked ALIGN-E (Stem, PWd) but violates both L-ANCHOR-BR and MAX-BR by virtue of the fact that the reduplicant copies the second segment of the base and not the first and also because the reduplicant is only one single segment of the base. Candidates 28b and 28c fail because of L-ANCHOR-BR. Candidate 28d is ruled out because the reduplicant copies all of the base segments, thus fatally violating ALIGN-E (Root, PWd) and also the bimoaraicity requirement. Finally, candidate 28e left-anchors the base and the reduplicant and is, therefore, excluded because of ALIGN-E (Stem, PWd). It could also be excluded on the basis of an independently motivated constraint against having geminates in the first syllable of a prosodic word (Boudlal 2001).

Verbs whose medial segment is a high vowel geminate this segment and surface as CəjjəC or CəwwəC. Given that the output needs to satisfy the bimoracity requirement, the high vowel of the stem surfaces as a glide accompanied by schwa epenthesis. For example, from the input stem /ʃuf/, candidates such as [ʃufʃuf] and [ʃufəf] would be ruled out. The first because it violates ALIGN-E (Stem, PWd) by virtue of total reduplication of the base; the second because it copied the third segment of the base and as such incurs a fatal violation of L-ANCHOR-BR. The optimal candidate [ʃəwwəf] wins over all the other candidates although it violates DEP by resorting to schwa epenthesis. Note here that the input medial high vowel has been realized as the corresponding glide to allow for the output to surface as a disyllabic word. In order to account for the high vowel/glide alternation, we assume, following Rosenthall (1994), that a high vowel is associated to a mora, whereas a glide is directly associated to a syllable node. The realization of an underlying high vowel as a glide or an underlying glide as a high vowel results in a change of featural specification of the input. Thus an output such as [ʃəwwəf] violates IDENT-IO [cons] constraint demanding preservation of featural identity in the input/output mapping. The violation is allowed to secure a higher ranked constraint, namely IDENT-BR [cons], which requires that the base featural specification for [cons] must be preserved in the reduplicant.

Let us see how the two IDENT [cons] constraints interact to favor [ʃəwwəf] over other competing candidates:

(29)

ʃuf, RED	IDENT-BR [cons]	IDENT-IO [cons]
☞ a. ʃəwwəf		*
b. ʃu.wəf	* !	*
c. ʃu.wəf	* !	
d. ʃəw.uf	* !	

All the losing candidates fail because of high ranked IDENT-BR [cons], either because the reduplicant is a high vowel and the base is a glide (29b) or vice versa (29c-d). Note further that candidates 29d can also be ruled out on the basis of violating an undominated constraint, namely ONSET. Another candidate that is worth considering is *[duwub], which resorts to w-epenthesis to satisfy the ONSET constraint. Although the candidate satisfies both IDENT-BR [cons] and IDENT-IO [cons] by virtue of the fact that the reduplicant has a correspondent in the base, we think it must be ruled out exactly because of the constraint on verb bimoraicity.[6]

6. Conclusion

This paper has explored the nature of the verb base in MA, with a view to showing that underived verb bases cannot be analyzed within the strong root-and-pattern hypothesis because of the existence in the language of verbs that consist of both vowels and consonants. The first piece of evidence comes from the constraint VB=[μμ], requiring that underived verb bases be exactly bimoraic. In particular, the paper has tried to show how the bimoraicity requirement in underived verb bases is achieved in both purely consonantal verbs and verbs that consist of consonants and vowels. It has been shown that our prosodic constraint VB=[μμ], coupled with other constraints on syllable structure, yield the desired output: a stem with exactly two moras. It has also been shown that to satisfy the prosodic requirement, MA resorts to three different strategies: Schwa epenthesis, consonant moraification and a combination of full vowel and schwa syllabification.

The view that the consonantal root is basic in the morphology of MA has been abandoned, at least in some aspects of verb morphology. Evidence supporting this claim has been advanced by considering two different phenomena: the first from inflectional morphology and the second from derivational morphology. We have shown that the perfective verb inflectional paradigm, which presents a case of cyclic syllabification, is better analyzed as a case taking the verb stem as an input rather than the purely consonantal verb root. We have shown that in the more complex cases, if the stem is taken as an input, a morphologically derived output form such as [ḍrəbt] from the simple base input form [ḍrəb] would follow from the interaction of two major constraints: O-O$_{stem}$ ANCHOR (σ, σ, Initial)and *Min-σ.

[6]Boudlal (2001) assumes that that the causative form is governed by a prosodic constraint which requires that the output form consist exactly of an iambic foot of the type LL.

In the case of affixation to the word, we have shown that an output form such as [ḍərbək] sacrifices word faithfulness to secure the markedness constraint against minor syllables.

The second piece of evidence supporting the claim that the stem rather than the consonantal root is basic comes from the causative, a derived verb form. We have shown that the causative is better analyzed as a case of reduplication which takes the stem as the base and in which the relation between the base and the reduplicant is regulated by output constraints.

References

Al Ghadi, A. (1994), « An OT account of Moroccan Arabic prosody », Ms. University of Delaware.

Al Ghadi, A. (1990/2014), *Moroccan Arabic plurals and the organization of the lexicon*, Publications of the Faculty of Letters, Rabat.

Basri, H., Broselow, E., Finer D., &Selkirk E. (1998), « Morphologically grounded affix classes: the case of Makassarese », Ms. State University of New York at Stony Brook, NY and University of Massachusetts at Amherst, MA.

Bat-El, O. (1994), « Stem modification and cluster transfer in modern Hebrew », *Natural Language and Linguistic Theory* 12, pp. 571-596.

Bat-El, O. (2003), « The fate of the consonantal root and the banyan in optimality theory », *Recherches Linguistiques de Vincennes*, pp. 31-60

Benhallam, A. (1989/1990), « Moroccan Arabic syllable structure », *Langues et Littératures* 8: 177-191, Faculté des Lettres, Rabat.

Benhallam, A. (1991), « On Geminates in Moroccan Arabic », *Linguistica Communicatio*, Publications de la Faculté des Lettres de Fès.

Bennis, S. (1992), *La formation du causatif en arabe marocain*, Mémoire de D.E.S., Faculté des Lettres, Rabat.

Benmamoun, E. (1999), « Arabic morphology: The central role of the imperfective », *Lingua* 108, 175-20.

Bensoukas, K. (1994), *Tashlhit agentive nouns: An Optimality-theoretic approach*, D.E.S. Thesis, Faculté des Lettres, Rabat.

Bensoukas, K. & Boudlal, A. (2012a), « The prosody of Moroccan Amazigh and Moroccan Arabic: Similarities in the phonology of schwa », In T. Borowsky, S. Kawahara, T. Shinya and M. Sugahara (eds.), *Prosody Matters: Essays in Honor of Lisa Selkirk,* London: Equinox Publishing, pp. 3-42.

Bensoukas, K. & Boudlal, A. (2012b), « An Amazigh substratum in Moroccan Arabic: the phonology of schwa », In K. Bensoukas (ed.), *Issues in Amazigh Linguistics* », *Langues et Littératures* 22 : pp. 179-221, Faculté des Lettres, Rabat.

Benua, L. (1997), *Transderivational identity: Phonological relations between words*, Ph.D. dissertation, Amherst, MA: University of Massachusetts at Amherst, Rutgers Optimality Archive 259.

Boudlal, A. (1993), *Moroccan Arabic glides: A lexical approach*, D.E.S. Thesis, Faculté des Lettres, Rabat.

Boudlal, A. (2001), *Constraint interaction in the phonology and morphology of Casablanca Moroccan Arabic,* Doctorat d'État thesis, Mohammed V University, FLHS, Rabat, Available at http://roa.rutgers.edu, ROA#650.

Boudlal, A. (2006/2007), « Sonority-driven schwa epenthesis in Moroccan Arabic », In K. Bensoukas and A. Boudlal (eds.), *Languages and Linguistics* 18&19: 59-81.

Boudlal, A. (2009), *The prosody and morphology of a Moroccan Arabic dialect: An Optimality-theoretic account*, Saarbrüchen, Germany: VDM Verlag Dr. Müller.

Boudelaa, S. (2014), « Is the Arabic mental lexicon morpheme-based or stem-based? Implications for spoken and written word recognition », In E. Saiegh-Haddad, R. M. Joshi (eds.), *Handbook of Arabic Literacy, Literacy Studies* 9,Springer Science & Business Media, Dordrecht.

Boudelaa, S. & Marslen-Wilson, W. D. (2001), « Morphological units in the Arabic mental lexicon », *Cognition* 81: 65-92.

Dell, F. &Elmedlaoui, M. (2002), *Syllables in Tashlhiyt Berber and in Moroccan Arabic,* Kluwer, Dordrecht.

El Yamani, S. (2006), *Stress assignment in Rabati Moroccan Arabic: An Optimality-theoretic account*, Doctoral dissertation, Faculté des Lettres, Rabat.

Heath, J. (1987), *Ablaut and ambiguity: phonology of a Moroccan Arabic dialect*, Albany: State University of New York Press.

Heath, J. (1997), « Moroccan Arabic phonology », In A. S. Kaye (ed.) *Phonologies of Asia and Africa (including the Causasus)*, Winona Lake, Indiana, EISENBRAUNS, pp. 205-217.

Imouzaz, S. (2002), *Interaction des contraintes dans la morphologie non-gabaritique de l'arbe marocain de Casablanca: Temoignages pour la Théorie de l'Optimalité*, Thèse d'Etat, Faculté des Lettres de Ben M'Sik, Casablanca.

Kager, R. (1996), « Surface opacity of metrical structure in Optimality Theory », In B. Hermans and M. van Oostendorp (ed.) *The Derivational Residue in Phonology*, Tilburg, Holland, Rutgers Optimality Archive 207.

Kenstowicz, M. (1996), « Base-identity and uniform exponence: Alternatives to cyclicity », In J. Durand and B. Laks (eds.), *Current Trends in Phonology: Models and Methods*, pp. 363-94. Manchester, England: European Studies Research Institute, University of Salford, Rutgers Optimality Archive 103.

McCarthy, J. (1979), *Formal problems in Semitic phonology and morphology*, Ph.D.dissertation, MIT, Cambridge, MA.

McCarthy, J. (1981), « A Prosodic theory of nonconcatenative morphology », *Linguistic Inquiry* 12, pp. 373-418, Cambridge, MA: MIT.

McCarthy, J. (1995), « Extensions of faithfulness: Rotuman revisited », Ms. Amherst, MA: University of Massachusetts at Amherst, Rutgers Optimality Archive 110.

McCarthy, J. (1997), « Faithfulness and prosodic circumscription », In J. Dekkers, F. van der Leeuw and J. van de Weijer (eds.), *The Pointing Finger: Conceptual Studies in Optimality Theory*, Amesterdam: HIL.

McCarthy, J. (2016), « The theory and practice of Harmonic Serialism », In J. J. McCarthy & J. Pater (eds.) *Harmonic Grammar and Harmonic Serialism*, London: Equinox Publishing.

McCarthy, J. &Prince A. (1993a), *Prosodic morphology I: Constraint interaction and satisfaction,* Ms. University of Massachusetts, Amherst and Rutgers University, Available at http://roa.rutgers.edu, ROA# 482.

McCarthy, J. & Prince A. (1993b),« Generalized alignment », In G. Booij and J. van Marle (eds.),*Yearbook of Morphology*, pp. 79-153,Dordrecht: Kluwer.

McCarthy, J. & Prince A. (1995), « Faithfulness and reduplicative identity », In J. Beckman, L. W. Dickey, and S. Urbanczyk (eds.), *University of Massachusetts Occasional Papers in Linguistics* 18*: Papers in Optimality Theory*, pp. 249-384, Amherst, MA: GLSA publications, Rutgers Optimality Archive 60.

Nelson, N. (1998), « Right anchor, aweigh », Ms. New Brunswick: NJ: Rutgers University, Rutgers Optimality Archive 284.

Prince, A. & Smolensky P. (1993/2004), *Optimality Theory: Constraint interaction in generative grammar*, Malden, MA, and Oxford, UK: Blackwell, (Revision of 1993 technical report, Rutgers University Center for Cognitive Science, Available at http://roa.rutgers.edu, ROA#537.

Prunet, J-F. (2006), « External evidence and the Semitic root », *Morphology* (2006) 16:41–67.

Ravid, D. (2006), « Word-level morphology: A psycholinguistic perspective on linear formation in Hebrew nominal », *Morphology* 16, pp. 127–148.

Rguibi, S. (2001), *Phonological variation and change in Moroccan Arabic: Thecase of the Tazi dialect*, Doctoral dissertation, Mohammed V University, Faculty of Letters, Rabat.

Rosenthall, S. (1994), *Vowel-glide alternation in a theory of constraint interaction*, Ph.D. dissertation, Amherst, MA: University of Massachusetts at Amherst.

Schulter, K. T. (2013), *Hearing words without structure: Subliminal speech priming and the organization of the Moroccan Arabic lexicon*, Doctoral dissertation, University of Arizona.

Selkirk, E. (1999), « Morphologically governed output-output constraints in a noncyclic Optimality Theoretic grammar: Evidence from the Makassar languages », Ms. Paper presented at Sophia University, Tokyo.

Shaw, J., Gafos, A., Hoole, P., and Zeroual, C. (2009), « Syllabification in Moroccan Arabic: evidence from patterns of temporal stability », *Phonology* 26: 187-215.

Smolensky, P. (1996), « The initial state and richness of the base », Ms. University of Colorado at Boulder, Rutgers Optimality Archive 154.

Ussishkin, A. (1999), « The inadequacy of the consonantal root: Modern Hebrew denominal verbs and output-output correspondence », *Phonology*, 16, 401–442.

Ussishkin, A. (2005), « A fixed prosodic theory of nonconcatenative Templatic morphology », *Natural Language & Linguistic Theory* 23, pp.169–218.

Ussishkin, A. (2006), « Semitic morphology: Root-based or word-based? », *Morphology* 16, pp. 37-40.

Watson, J. C. E. (2006), « Arabic morphology: diminutive verbs and diminutive nouns in San'ani Arabic », *Morphology* 16, pp. 189–204.