An OT Account of Moroccan Arabic Prosody*

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Abstract

After an examination of the minimal surface word patterns in Moroccan Arabic, the paper argues for the existence of the category minimal prosodic word in this language (min[PrWrd]). Thus a review of a standard account of syllabification in MA adopting the schwa ephenthesis theory is demonstrated to lead to the recognition of such a category, which, among other things, observes the universal bimoracity requirement. It is demonstrated that the different surface patterns can be obtained within an Optimality Theory framework using universal prosodic constraints such as Ft-Bin, No-Coda and Onset. While hollow and weak roots, on the one hand, and geminates on the other, can be accounted for independently, sound triliteral roots present a challenge for the adoption of a unified min[PrWrd] in MA. This is because whereas verbs and adjectives show an invariant template structure, (non-derived) nouns vary depending on their segments sonority, which can be shown to derive in general from the H-NUC constraint. Whatever the invariant template verbs and adjectives abide by, it is shown to be respected also by other non-concatenatively derived words in MA. This lends more support to its role in the morphology of the language.

Key words: Moroccan Arabic, phonology, morphology, prosody, Optimality Theory

*Editors’ Note: This paper has been in circulation as a manuscript for many years. That is why we decided to publish it in its original form in order to make it accessible to interested researchers

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1 Introduction

Is it possible to have within the same language two syllabification systems each operating within classes of word categories? It is exactly this issue that the present paper basically addresses within an Optimality Theory framework (McCarthy and Prince, 1994; Prince and Smolensky, 1993), taking as an example Moroccan Arabic (MA), which manifests different syllabification strategies for verbs and adjectives as opposed to nouns.

The paper is organized in the following way. Section 1 is a brief critique of a standard account of syllabification in MA adopting the schwa epenthesis theory. In section 2, a bird-eye view of the minimal surface word patterns is demonstrated to lead to the recognition of the category minimal prosodic word in MA (min[PrWrd]), which, among other things, observes the universal bimoracity requirement. Section 3 deals in more details with the different surface patterns and how they can be obtained within an OT framework using universal prosodic constraints such as Ft-Bin, No-Coda and Onset. While hollow and weak roots, on the one hand, and geminates on the other, can be accounted for independently, sound triliteral roots present a challenge for the adoption of a unified min[PrWrd] in MA. This is because whereas verbs and adjectives show an invariant template structure, (non-derived) nouns vary depending on their segments sonority, which can be shown to derive in general from the H-NUC constraint. Whatever the invariant template verbs and adjectives abide by, it is shown to be respected also by other non-concatenatively derived words in MA. This lends more support to its role in the morphology of the language.

2 Syllable structure in MA and the schwa problem

A distinctive aspect of MA phonology is the elusive nature of the schwa which any account of syllabification would have to take into consideration. The descriptive generalization is that the schwa never occurs in an open syllable ((Benhallam, 1980)), which gives rise to interesting alternations, often described as metathesis, in case suffixation of a V-initial morpheme leaves a schwa in an open syllable for example:

(1) drəb “hit” dərb-u “they hit”
    drəb-na “we hit” drəb-t-ək “I hit you”

A theory of schwa epenthesis is advanced by Benhallam (1980, 1981, 1987), who assumes that all schwas are epenthetic, and that their insertion is forced by a syllable structure assignment algorithm (SSAA). The SSAA proceeds in four steps, in left-to-right direction:

(2) a. Create a core syllable out of a sequence CV:

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  C
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1The transcription of the consonants adopted in this paper is the following: labial stop: b; labial fricative: f; labial nasal: m; alveolar stop: t, d; alveolar fricative: s, z; alveolar nasal: n; alveolar liquid: l, r; palatal fricative: ʃ, ӡ; palatal glide: j; velar stop: k, g; velar glide: w; uvular fricative: x,y; pharyngeal fricative: h, ɬ; laryngeal fricative: h. Emphatics are capitalized. The full vowels are transcribed phonemically /i, u, a/.
b. Assign the structure of a syllable to a sequence of two non-assigned consonants, with a dummy neuclus (to be filled later with a schwa):

![Syllable Structure Diagram]

c. Coda rule: Assign a post-neuclus non-assigned consonant as coda to the preceding syllable:

![Coda Rule Diagram]

d. Assign any stranded consonants as margin to the onset, and under some circumstances to the coda:

![Stranded Consonants Diagram]

For example, words such as drəbtek “I hit you”, drəbtina “you hit us”, and dərb-u-k “they hit you” are syllabified as in (3) below:

(3) UR /drb-t-k /drb-ti-na dərb-u-k
by (1a) - drb.ti.na dr.bu.k
by (1b) d.rΔb.t k dΔr.ti.na .dΔr.bu.k
by (1c) - - .dΔr.buk
by (1d) .dΔr.b.tΔk .dΔr.b.t.na -
PR dərb.tək dərb.ti.na dər.buk

The main advantage of the SSAA is that it provides a reasonable explanation for the schwa distribution in MA, and adequately accounts for its non-occurrence in open syllables\(^2\). However, there are a number of problems both conceptual and empirical. Conceptually, apart from the general limitations of rule-based approaches as compared to constraint-based ones, directionality of syllabification is not a desirable tool; the OT account proposed in this paper dispenses with both rules and directionality, and is therefore superior. Rules are dispensed with in favor of constraints, and directionality is derived from interaction of constraints, in particular the No-Coda constraint. Empirically, the SSAA fails to

\(^2\)The alternative approach that schwas are underlying and then get deleted if they are in open syllables can be made to work technically, but fails to explain why open schwa syllables should be disallowed given their occurrence in other languages. Furthermore it would need an epenthesis rule anyway to account for the reappearance of the schwa elsewhere. Epenthesis does not suffer these limitations: schwa insertion arises from (universally) disallowed syllable structures.
account for at least two clear sets of data. These data concern all roots containing geminates and sound triliteral nouns.

Concerning the geminates behavior, what is by now referred to as the Geminate Integrity is also observed in MA. Benhallam (1981) arrived to the generalization that geminate clusters can be broken by morphological rules but not by phonological ones (schwa epenthesis). This has been taken as evidence that morphological rules precede phonological ones, and in later theoretical models that syllabification applies post-lexically. There is no way, however, to encode this exceptional behavior of geminates in the SSAA. The OT account given here incorporates the geminate integrity idea readily in the form of a violable constraint (Section 3.2.2.).

While the SSAA accounts for such nouns as those in (4b), it fails to predict the schwa locus in those in (4a).

(4) a. kəlb (∗kləb) “dog” b. ʕgəz “laziness”
gəns (∗gnəs) “race” ʕmər “lifespan”

To account for these nouns one would have either to list them in the lexicon as exceptions or else speculate something like change of directionality of syllabification. Observationally, these nouns generally abide by the sonority hierarchy. The problem, however, is how to obtain two different kinds of syllabification in the language: on the one hand, syllabification of verbs and adjectives operating on timing slots independently of the phonetic content of the segments, and on the other, the syllabification of nouns which is purely derivable from the sonority properties of the segments. Although the OT account given here does not provide a conclusive solution to this problem, it at least points to the direction such a solution would have to take within OT.

3 Prosodic Word in MA

A close examination of all major class category words in MA reveals the absence of words of the form either CV or CəC. Secondly all non-concatenatively affixed words fall minimally in one of the patterns (5c-h):

(5) impossible and possible minimal surface word-patterns
   a. *CV       b. *CəC
   c. CVC       d. CəCC
   e. CCV       f. CCəC
   g. CVCV      h. CəCCəC

Any account of MA prosody should minimally account for these observations, and ideally derive them from independent principles.

Let’s suppose that the minimal MA PrWrd abides by the (universal) bimoracity requirement, where bimoraicity is realized on a foot which is either monosyllabic (6a) or disyllabic (6b):
Our task is to reduce the surface patterns in (5c-h) to the either of the structures (6a) or (6b), and if possible provide an explanation for the nonexistence of surface words with a CV or CəC structure (5a-b), on the one hand, and on the other, to seek further justification for the postulation and need for min[PrWrd] in MA.

Apparently the only surface patterns that readily satisfy (6a) or (6b) are CVC, CCəC, CVVC, and the starred pattern CəC. Where the foot is monosyllabic, the only way the second mora could be realized is through the coda since vowel length is non-distinctive in MA. Thus we have the following structures, where the mora dominates either a vowel or coda consonant:

(7)

\[
\begin{array}{cccc}
\text{a.} & \text{W} & \text{b.} & \text{W} \\
\text{F} & \text{F} & \text{F} & \text{F} \\
\sigma & \sigma & \sigma & \sigma \\
\mu & \mu & \mu & \mu \\
\text{C} & \text{V} & \text{C} & \text{C} \\
\end{array}
\]

However, all this implementation of min[PrWrd] successfully achieves is the exclusion of CV as a possible word. It at least fails in two respects: ruling out CəC as a possible word, and including CCV as a possible word. The best (and only way) to exclude CəC is simply to consider it as monomoraic. If we adopt the schwa epenthesis theory, this would not be surprising at all. Let’s assume then that the epenthetic schwa is non-specified at the phonological level, but is simply a dummy kind of nucleus, and that furthermore, this dummy segment together with the following consonant are dominated by a single mora. A CəC syllable is represented then as (8):

(8)

Strikingly, under this assumption, the following prosodic equivalences obtain:

(9)

\[
\begin{align*}
\text{CV} &= \text{CəC} \\
\text{CVC} &= \text{CəCC} \\
\text{CVVC} &= \text{CəCCəC} \\
\text{CCV} &= \text{CCəC}
\end{align*}
\]

There remains one problem for the min[PrWrd] to get through: the patterns CCV and CCəC seem to be sub-minimal. Notice that under the assumption (8), whatever solution is adopted for one pattern carries over to the other. It is indeed surprising that a complex onset should somehow contribute the same
weight as a coda. One way to salvage the situation is to consider the first member of the consonant cluster as part of an initial (degenerate) syllable, where this consonant is accordingly dominated by a mora as in (10):

(10)

The prosodic structures of CCV and CCəC, shown in (11), abide then by (6b), that is a disyllabic (bimoraic) foot, or min[PrWrd]:

(11)

Thus the different patterns in (5) have been shown to abide by the min[PrWrd] constraint. At the same time the non-occurrence of some patterns as possible words has been explained by having recourse to two simple assumptions about mora structure, namely that it can dominate either V or C, here C is a coda (as in standard accounts of mora theory) or else dominate a sequence əC or C, where in the second case the mora forms a degenerate syllable, probably because of the lack of an onset.

Now the category min[PrWrd] itself might be dispensed with if it can be proven that it can be derived from other low-level prosodic constraints, and indeed in the following section this will be proved possible under OT.

4 The prosodic structure of MA within OT

4.1 What universal constraints do and do not do

Within OT, universal ranking of syllables in terms of least to most marked syllable structure is effected by partially ranking the constraints Onset and No-Coda, both of which, among other things, force a CV syllable to be preferred to CVC, V, or VC, as shown in Tableau 1 below.

Now this tableau also includes an additional type of syllable that we have been led to assume for MA in order to allow the category minimal prosodic word to go through, namely a syllable whose only constituent is a mora dominating a C (e). If this syllable is considered to violate Onset, it would be as harmonic as an onsetless V-syllable, but this is undesirable since V-nuclei are universally more harmonious than C-nuclei; hence the inclusion of the additional constraint H-NUC, which ranks C-syllables below V-syllables\(^3\).

\(^3\)It might be the case that such C-syllables do not require an onset at all, and hence the ONSET constraint is inapplicable.
Al Ghadi

Of the patterns in (5), CCV is readily derivable from either the universal constraint Ft-Bin or *Complex-Onset. As shown in Tableau 2, Candidate a violates two constraints: Ft-Bin and *Complex-Onset whereas Candidate b violates neither. Although this candidate violates H-NUC, it is nonetheless the optimal candidate. From this we derive the ranking Ft-Bin, *COMP-Onset » H-NUC.

Tableau 1: Universal ranking of syllable types

<table>
<thead>
<tr>
<th>Candidates</th>
<th>ONSET</th>
<th>H-NUC</th>
<th>No-Coda</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. .CV.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. .CVC.</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>c. .V.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. .VC.</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>e. .C.</td>
<td>(†)</td>
<td>†</td>
<td></td>
</tr>
</tbody>
</table>

Next let’s consider the CVC pattern. As shown in Tableau 3, Ft-Bin is an active constraint, forcing the final C to be moraic: Candidate a is excluded because it is monomoraic. Candidate c is excluded because it violates H-NUC, hence the ranking H-NUC » No-coda. The desired effect of this ranking is that whenever a single consonant follows a vowel, it had better be parsed as a coda than as a syllable on its own. Tableau 3 also shows that it is Ft-Bin rather than –or in addition to –*Complex-Onset which forces bimoraicity.

Tableau 2: [Ft-Bin, *COMP-ONSET]) >> H-NUC

Tableau 3: Ft-Bin >> H-NUC >> NO-CODA

Now let’s consider the more problematic cases involving schwa epenthesis. In principle, epenthetic to them. Although this point is worthy of investigation, I will go on assuming that ONSET is incurred also by these syllables. It would be enough though to simply rank H-NUC above ONSET to have similar results.
segments can be generated anywhere by GEN, but because each epenthetic segment constitutes a violation of *FILL, the fewer there are of such segments, the better. Thus given a form such as /CCC/, the best candidate would be one which incurs only one *FILL violation, that is either [CəCC] or [CCəC]. Notice that apart from a double violation of *FILL, such a form as [CəCəC] would be excluded on independent grounds. Indeed given our assumption (8) that a mora dominates both the epenthetic segment (Δ) and the following consonant, the second syllable of this form would violate ONSET independently of directionality of moraification for example:

(12)

Consequently, I will not consider cases of multiple epenthesis any longer except where it is crucial to the analysis. As shown in Tableau 4, we are left, however, with three candidates [CəCC], [C.CəC], and [CəC.C] all of which tie on *FILL. As our rankings stand now, the winner would be candidate b because candidates c and d both violate H-NUC. However, this is undesirable since the H-NUC violations are different: in d it occurs where a coda is expected; in c to avoid a violation of *COMPLEX-ONSET. As it will become clear in the next section, there is a way to avoid this tie, and as a way of anticipation, there is a way to make sure candidate c does not violate H-NUC.

Now, for exhaustiveness, let’s examine three more patterns, CVCV and CCəCC and CəCCəC. All three patterns involve quadriliteral roots. CVCV is the least problematic of all since it involves no constraint violation at all, including Ft-Bin. CCəCC and CəCCəC are reminiscent of the CəCC vs. CCəC of the triliteral roots. Given the tools at our disposal thus far, and as shown in Tableau 5 below, CəCCəC is unquestionably, the optimal candidate. This obtains because *FILL is ranked lower than both H-NUC and NO-CODA.

C.CaCC (Candidate c) loses exactly because it violates these two constraints. Since both patterns are attested in the language, however, we must find a way of allowing CCəCC to surface as output, namely
by ranking *FILL above the other two constraints as shown in Tableau 6 below. Again this problem will be addressed in the next section.

4.2 Role of morphology

Before we proceed further, examination of the distribution of the patterns among the major class categories is in order. The following table shows this distribution in terms of the type of roots involved:

<table>
<thead>
<tr>
<th>Trilateral roots</th>
<th>Quadrilateral roots</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbs</td>
<td>Adjectives</td>
</tr>
<tr>
<td>a. sound roots</td>
<td>CCAcC</td>
</tr>
<tr>
<td>b. hollow roots</td>
<td>CVC</td>
</tr>
<tr>
<td>c. weak roots</td>
<td>CCAc</td>
</tr>
<tr>
<td>d. double roots</td>
<td>CCAcCc</td>
</tr>
</tbody>
</table>

Tableau 5: Ft-Bin >> H-NUC >> NO-CODA >> *FILL

Tableau 6: Ft-Bin >> *FILL >> H-NUC >> NO-CODA
4.2.1 Hollow and weak roots

With hollow and weak roots (b and c), the root vowels determine the syllabic structure and consequently, the higher prosodic categories. We have seen in the previous section that this type of roots, CVC and CCV, satisfy the Ft-Bin constraint in terms of bimoracity differently: through the weight attributed to the coda in the former, and through the assumption that the initial consonant forms a kind of degenerate syllable in the latter. But this holds only of triliteral roots. Now consider the non-sound quadriliteral roots, in particular CCVC. Can we consider the initial consonant as moraic as we did for the triliteral roots? For reasons of consistency we should. But then the constraint at work is not Ft-Bin in this case, because this constraint is readily satisfied by the coda weight. Rather, it is the constraint banning complex onsets: *COMPLEX-ONSET.

4.2.2 Double roots: Gemination

Double or geminated roots observe a single pattern throughout all the triliteral roots: they are never broken by an epenthetic schwa. These roots have been assumed in the literature to be biliteral, gemination being the result of spreading. The reason why such a spreading takes place may simply be to satisfy Ft-Bin through the coda weight. In other words, geminate roots contain two epenthetic segments: a schwa to satisfy syllable structure and a coda to satisfy foot structure: CəCə. The reason that the coda is resorted to to augment weight rather than a vowel is that there are no epenthetic vowels in MA except the schwa, but as we have seen in the previous section the schwa by itself does not qualify for a mora. Furthermore, the initial syllable contains a mora dominating both a schwa and the second consonant, which is thus made unavailable as an onset for a presumably epenthetic vowel.

A word such as serr “secret” would be obtained as shown in Tableau 8 overleaf:

Candidate b, sərr, candidate c, srər, and candidate d, ssər, all tie on *FILL, but candidate b is the winner because both candidates c and d violate H-NUC, providing further support for crucially ranking H-NUC over NO-CODA (see previous section). Obviously, a reverse ranking would have favored candidates c and d.

4 Even if these speculations do not hold given that the geminate integrity is observable even in dialects where the epenthetic vowels may be full vowels such as i for example in Egyptian Arabic, we may still obtain the same effects if we assume the existence of a simple version of geminate integrity, namely that they are not broken by an epenthetic segment: *C Δ C
4.2.3 Sound roots: templates vs. sonority

Among sound triliteral roots, verbs and adjectives show the same pattern throughout (CCaC) as opposed to nouns which show a variation between CCaC and CaCC. The question to be asked is whether this distinction has any significance in the grammar of the language or not. In my view it does. For whatever reason, CCaC seems to be a kind of template that verbs and adjectives – but not nouns – have to conform to. We have first to find out what distinguishes, prosodically, CCaC from CaCC. We have assumed so far that both are bi-moraic and while the former is also disyllabic (13a), our constraints do not allow us to choose which structure to assign to the latter (13b or 13c):

\[(13)\]

Now suppose that the prosodic structure of CCaC is (13d) instead of (13a). That is with the leftmost mora directly adjoined to the foot node instead of projecting its own syllable. Under some *STRUC evaluation metric, this structure would be less costly than either (13a) or (13c), because it has one node (□) and one association line fewer than the others: 4 n(odes), 7 l(ines) vs. 5 n(odes), 8 l(ines). It thus ties up with (13b) in terms of *STRUC violation, but it is also more harmonic since the latter violates also No-Coda. Tableau 9 below shows how these four output structures are evaluated by the two crucial constraints *STRUC and NO-CODA.

However, if H-NUC is included in the constraints, it will rule out candidate d in favor of b, since, as we have seen above, H-NUC is ranked over NO-CODA. This may seem to be a not completely undesirable result, since we need a way to obtain the b-candidate (CaCC) in some cases (nouns), and ranking H-NUC over No-Coda would just do that. Recall that H-NUC was introduced to capture the
idea that a syllable whose mora dominates a consonant is less favored than one whose mora dominates a vowel, and that we ran into a paradox illustrated in Tableau 4 where \( \text{C.C}_\text{aC} \) and \( \text{C}_\text{aC}.\text{C} \) incurs each an H-NUC violation. What we actually want is to force a C which is dominated by a mora into a coda position if it is preceded by a V; otherwise, as in the case where it is word initial, there is no syllable it can adjoin to, and cannot therefore surface as a coda. The solution we have adopted is to assume that this consonant cannot by itself project its own syllable, and so it is directly adjoined to the foot; we now assume accordingly that if a mora is adjoined directly to the foot (though it violates the Strict Layer Hypothesis), it does not violate H-NUC, since there is no syllable and hence no nucleus. For the same reasons, neither does it violate Onset.

Now the verbs and adjectives can all be obtained through the simple ranking: Ft-Bin, *Complex-Onset » H-NUC » No-Coda » *Fill. Nouns, however, require more discussion. Indeed, the majority of the nouns that can surface either as \( \text{C}_\text{aCC} \) or \( \text{CC}_\text{aC} \) abide by the sonority hierarchy, whereby the schwa is inserted to the left of the most sonorous consonant as exemplified by (14).

\[
\begin{array}{llll}
(14) & \text{a. } \text{kəlb} & "\text{dog}" & \text{b. } \text{bɤəl} & "\text{mule}" & \text{c. } \text{ʕnəb} & "\text{grapes}" \\
& \text{səlk} & "\text{wire}" & \text{sɬəl} & "\text{bucket}" & \text{hqəf} & "\text{snake}" \\
& \text{ʁɜm} & "\text{lapidation}" & \text{ʒməl} & "\text{camel}" & \text{hmad} & "\text{personal name}"
\end{array}
\]

No matter what mechanism we adopt to derive this sonority effect, it is clear that nouns on the one hand, and verbs and adjectives, on the other, require different syllabifications. Benhallam’s algorithm, for example, captures what seems to be the more general case through (Right-to-Left) directionality of syllabification, favoring thus the \( \text{CC}_\text{aC} \) pattern. For us, in spite of its preponderance in the language, the \( \text{CC}_\text{aC} \) is not an unmarked pattern. Rather it is a morphological template associated somehow with the syntactic feature \([+V]\), that is verbs and adjectives. In more general terms, as we will shortly see, it is such a foot as in (13d) which constitutes a kind of morphological template, including also the surface pattern CCV which has a similar prosodic structure as \( \text{CC}_\text{aC} \). But templates are useful only so far as Prosodic Circumscription operates in the language, and given that OT rejects PC in favor
of more local Alignment constraints (McCarthy and Prince, 1994), we will try to see how the MA data bear on this issue. First, however, let’s see how the Nouns CCaC and CəCC patterns could be obtained, that is how sonority can be encoded in the form of constraints.

4.2.4 Sonority:

There are many ways in which this problem can be viewed, but these may divide into two types depending on whether the constraints affect the nucleus (H-NUC) or the onset (H-ONS), or probably both. In other words, in triliteral roots, we have three consonants which compete either for the nucleus position (H-NUC at work) or for the onset position (H-ONS). A violation of H-ONS results if a segment which wins through the pairwise comparison (it is less sonorous than its competitor) fails to be an onset. Similarly, a violation of H-NUC results if a segment which is more sonorous than its neighbor fails to be a nucleus. Let’s consider each in turn.

H-ONS and sonority

The less sonorous a segment, the more harmonic it is as an onset. Thus the least sonorant C occupies onset; by default, if a C is not an onset then it is moraic. Competition for Onset may be reduced to competition between C1 and C2 since C3 is automatically out of competition for independent reasons: since it is the last segment of the sequence it cannot be the onset of anything else. Thus we are left with the two possibilities: either of C1 or C2 is more sonorant than the other. Both possibilities are supported by the data, but they have also exceptions (> or < means more or less sonorous than): So

(15) a. C1>C2
    rʒəm, ʕɡəz, ʕnəb, ʕməʃ, ʔnəʃ, ʔsəl, ʔbaʃ, ʔsər
    Exceptions: ʕənq, rəzq - rəaq

b. C1<C2
    kəlb, səlk, bənt, qənt, ʃərʒ, ʔərt
    Exceptions: ʒməl, tən, ʔhər

H-ONS accounts only for part of the data. Tableau 10 shows the outputs of roots /klb/ (where k<l) and /ʒml/ (with ʒ<m). The right output is obtained for the former, but not for the latter.

<table>
<thead>
<tr>
<th>Tableau 10: H-ONS &gt;&gt; H-NUC</th>
</tr>
</thead>
<tbody>
<tr>
<td>/klb/</td>
</tr>
<tr>
<td>a. kəlb</td>
</tr>
<tr>
<td>b. kləb</td>
</tr>
<tr>
<td>c. kəλb</td>
</tr>
</tbody>
</table>

| /ʒml/                       |
| a. ʒməl                      | *  |
| b. ʒəml                      | *  | ʒ! |
| c. ʒəməl                     | **! |

H-NUC and sonority:

The more sonorous a segment, the more harmonic it is as a nucleus. As, with H-ONS, I will assume that competition is between pairs of contiguous segments. Thus given a C1C2C3 root, the two pairs C1/C2 and C2/C3 are compared simultaneously. Ignoring for the time being cases where the C’s have the same sonority, we would have four possibilities. These are listed in (16) below together with examples of each.

(16) a. * filler |
    ʔənq, rəzq - rəaq

b. * filler |
    ʒməl, tən, ʔhər

H-ONS accounts only for part of the data. Tableau 10 shows the outputs of roots /klb/ (where k<l) and /ʒml/ (with ʒ<m). The right output is obtained for the former, but not for the latter.
The way H-NUC is interpreted raises some problems at this stage: is violation considered to be failure of a potential consonant-candidate to be dominated by a mora? Or does the fact that a C which is not a potential candidate but which dominates a mora count as an H-NUC violation?

Suppose a consonant’s satisfaction of H-NUC is to be interpreted as its being dominated by a mora, then X in all the following three representations satisfies H-NUC:

(17)

Under this interpretation only (16b) and (16c) can be obtained. The pattern in (16b) is exemplified by Tableau 11. Given the pairwise comparison, both ʕ and z qualify as nuclei from (ʕ>g) and (z>g). Candidate a incurs one violation of H-NUC: ʕ fails to be nucleus, but candidate b wins because both potential nuclei are realized as such, resulting in observation of H-NUC.

Tableau 11: C>C<C: H-NUC decisive

<table>
<thead>
<tr>
<th>/C&gt;C&lt;C/</th>
<th>Candidates</th>
<th>*FILL</th>
<th>H-NUC</th>
</tr>
</thead>
<tbody>
<tr>
<td>ʕgaz</td>
<td>a. ʕgaz</td>
<td>*</td>
<td>ʕ!</td>
</tr>
<tr>
<td>ʔz</td>
<td>b. ʔgaz</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>ʕz</td>
<td>c. ʕgaz</td>
<td>**!</td>
<td></td>
</tr>
</tbody>
</table>

The pattern in (16c) is exemplified by Tableau 12, taking as an example the nominal root /drb/. In this case there is only one candidate r from (r>d and r>b). Again the candidate in which H-NUC is violated (b) loses for the one in which it is not (a). (16a) and (16d) cannot be accounted for, however,

Tableau 12: C>C>C: H-NUC decisive

<table>
<thead>
<tr>
<th>/C&lt;C&gt;C/</th>
<th>Candidates</th>
<th>*FILL</th>
<th>H-NUC</th>
</tr>
</thead>
<tbody>
<tr>
<td>ʔdrb</td>
<td>a. dərb</td>
<td>*</td>
<td>r!</td>
</tr>
<tr>
<td>ʔdrb</td>
<td>b. dərb</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>ʔdrb</td>
<td>c. dərb</td>
<td>**!</td>
<td></td>
</tr>
</tbody>
</table>

in the same way. Tableaux 13 shows the pattern in (16a) with the nominal root /rzq/ as example. Here both r and z qualify as nuclei from (r>z) and (z>q). In both candidates a and b, either r or z fails to be dominated by a mora, and so the two candidates tie up on H-NUC. The actual form is rzəq, meaning that candidate b should be the winner.
H-NUC also fails to correctly assign the correct syllabification to the pattern in (16d), but this time by favoring the wrong candidate. Here both m and l qualify as good nuclei from (m>j) and (l>m). m fails to be within a nucleus in candidate b, but both m and l are dominated by a mora each in candidate a; hence the winner is candidate a. But the actual form is candidate b.

Notice that although H-ONS can decide the issue for the tie in Tableau 13, it cannot for Tableau 14 since such nouns as the ones there exemplified present similar problems for H-ONS (cf. Tableau 10). It seems that H-NUC can still be maintained as the decisive constraint, but under an interpretation where all the candidates for nucleus are evaluated at the same time, rather than pairwise. This indeed would yield the right result for all problematic cases, besides accounting for the ones accounted for by the pairwise comparison.

To conclude this section on the role of sonority in the prosodic structure of non-derived nouns in Moroccan Arabic, it is important to note that no matter what technical mechanisms are used to prosodify these nouns, the role of sonority cannot be denied. What is important for our purposes is, on the one hand, the observation of the bimoracity constraint (formalized as Ft-Bin) and the variation observed in the outputs. Contrasted with the verbs and adjectives behavior, this is quite revealing. As already demonstrated, the verbs and adjectives do not abide by the sonority hierarchy, but they rather all conform to a kind of prosodic template. Except for cases where the prosodic structure is decided by the full vowels (CVC) or gemination (CəCiCi), all verbs and adjectives have the prosodic structure repeated in (18) for convenience.

(18)

That this structure is active in the morphology of MA is evidenced by such morphological processes as the broken plural and the diminutive formation (see examples in the next section). What role this structure plays and how is an open question: is it a “primitive” template or does it derive from constraints interaction?
4.2.5 Prosody and Morphology

In this section a few representative examples that illustrate the role prosodic structure plays in some morphological processes is presented.

MA nominal broken plurals show a variety of patterns. The majority of these patterns have one thing in common: no matter what the structure of the input, the output always begins with the foot shown in (18) above. Similarly diminutives show the same behavior as far as the initial foot is concerned. Representative examples of both broken plurals and diminutives are shown below:

(19)

<table>
<thead>
<tr>
<th>Noun</th>
<th>Plural</th>
<th>Gloss</th>
<th>Diminutive</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. kəlb</td>
<td>klab</td>
<td>&quot;dog&quot;</td>
<td>klijjib</td>
</tr>
<tr>
<td>darb</td>
<td>druba</td>
<td>&quot;alley&quot;</td>
<td>drijjib</td>
</tr>
<tr>
<td>šəbd</td>
<td>šbid</td>
<td>&quot;slave&quot;</td>
<td>šbijjid</td>
</tr>
<tr>
<td>b. ʒmol</td>
<td>ʒmol</td>
<td>&quot;camel&quot;</td>
<td>ʒmiįjil</td>
</tr>
<tr>
<td>sTəl</td>
<td>sTula</td>
<td>&quot;bucket&quot;</td>
<td>sTįjil</td>
</tr>
<tr>
<td>bħar</td>
<td>bħura</td>
<td>&quot;sea&quot;</td>
<td>bįijir</td>
</tr>
<tr>
<td>c. nəӡm-a</td>
<td>nӡum</td>
<td>&quot;star&quot;</td>
<td>nӡim-a</td>
</tr>
<tr>
<td>ʃɜӡr-a</td>
<td>ʃӡar</td>
<td>&quot;tree&quot;</td>
<td>ʃӡir-a</td>
</tr>
<tr>
<td>ʒərd-a</td>
<td>ʒradi</td>
<td>&quot;garden&quot;</td>
<td>ʒrid-a</td>
</tr>
<tr>
<td>məحن-a</td>
<td>mħajn</td>
<td>&quot;ordeal&quot;</td>
<td>mħin-a</td>
</tr>
<tr>
<td>d. fil</td>
<td>fjal</td>
<td>&quot;elephant&quot;</td>
<td>fįjjil</td>
</tr>
<tr>
<td>muӡ-a</td>
<td>mmaӡ</td>
<td>&quot;wave&quot;</td>
<td>mmiӡ-a</td>
</tr>
<tr>
<td>e. tabSil</td>
<td>tbaSəl</td>
<td>&quot;plate&quot;</td>
<td>tbiSəl</td>
</tr>
<tr>
<td>səllum</td>
<td>slaləm</td>
<td>&quot;ladder&quot;</td>
<td>sliįlim</td>
</tr>
<tr>
<td>f. xərbij-a</td>
<td>xrabį-a</td>
<td>&quot;carpet&quot;</td>
<td>xribį-a</td>
</tr>
<tr>
<td>Tagįj-a</td>
<td>Twagi</td>
<td>&quot;hat&quot;</td>
<td>Twigįj-a</td>
</tr>
</tbody>
</table>

Both the plurals and diminutives begin with CCV, with V filled by a full vowel. It is surprising to notice the variation among the corresponding singualrs, and how they adapt to the target pattern. Whether this can be accounted for through Prosodic Circumscription (McCarthy and Prince, 1993) is highly doubtful since the variation within the input makes it hard to parse it into a unified prosodic category. It seems that Generalized Alignment (McCarthy and Prince, 1994), and the more recent version of the Correspondence constraint promises a better account of these morphological patterns. This, together with more non-concatenative morphological processes in MA, will be explored in future research.

5 Conclusion

This paper started with a review of prosodic structure in MA and proceeded to the examination of how it is structured and what distribution it shows. We have come to the conclusion that there are some regularities best expressed through the existence of constraints imposed on the category minimal prosodic word. The OT framework has allowed us to dispense with min[PrWrd] itself, since it is derivable from the interaction of universal prosodic constraints such as ONSET, NO-CODA and Ft-BIN. The main challenge that MA phonology and morphology presents for any theory is the general tendency for verbs and adjectives on the one hand, and non-derived nouns, on the other, to show different prosodic structure, the former abiding by a certain invariant shape, the latter abiding by the sonority hierarchy. We have not reached any definitive conclusion as to how best this distinction is to be captured within OT theory. It may be expressed through the presence vs. absence of a constraint within one part of the grammar but not in the other (verbs vs. nouns?), in the form of a template such
as the one in (18) for example. It is possible to derive the presence or absence of this template itself from a variation attributable to the behavior of a crucial constraint within a given component of the grammar. This stand has been implicitly adopted in this paper, where H-NUC was interpretable as categorical with verbs and gradient (subject to sonority) with nouns. A door which was left open for future research is the exploration of other families of constraints such as Generalized Alignment.

**References**