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| RESEARCH ARTICLE

Syllable Lightening in the Perfective of Moroccan Arabic Hollow Verbs

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| ABSTRACT

The paper provides a prosodic analysis of syllable lightening in the perfective of Moroccan Arabic (MA) hollow verbs. Previous works on MA verb inflectional morphology are limited in the sense that they failed to integrate the issue of syllable lightening in the perfective aspect. Drawing on secondary data from MA grammar works, we demonstrate that heavy syllables are lightened due to the prosodic constraints RHYTHMIC CONTOUR (RH-CONT) and *ΣH which militate against Heavy Light (HL) and Heavy (H) feet. This finding lends support to the role of foot patterns in the analysis of syllable de-weighting and enhances our understanding of the phonology of MA hollow verbs.

| KEYWORDS

Perfective, Lightening, Hollow Verbs, OT, Moroccan Arabic

| ARTICLE INFORMATION

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1. Introduction

The issue of full vowel/schwa (V/ə) alternations in the perfective of Moroccan Arabic (MA) hollow verbs has received little attention in the literature on MA phonology. As far as our knowledge goes, the only studies include the groundbreaking study of Benhallam (1980) which was subsequently followed by other works such as Heath (1987) and El Himer (1991). In contrast, the perfective of strong verbs has received ample attention in MA phonological research (see Bernous, 1994; Boudlal, 2001; Lowenstamm, (2011); among others).

Benhallam (1980) and Heath (1987) argue that schwa is derived from full vowels by a special reduction rule applying before /CC/ cluster within the core stem. Working within the model of Prosodic

Morphology (PM), El Himer (1991) holds that the underlying forms must be able to relate not only the perfective and imperfective, but also such derived forms as the causative. We believe that these treatments of V/ə alternations suffer from two weaknesses. First, they merely cite the perfective alternations instead of accounting for them. Second, they don't consider the phonological phenomenon of syllable lightening in the perfective of MA hollow verbs. This issue of syllable lightening has never been subject to a systematic investigation using any theoretical framework.

Syllable lightening (or de-weighting) is a process through which heavy syllables (H) become light (L). In the perfective of MA concave verbs, closed syllables with full vowels lose one mora (i.e. they become light) by reducing the full vowel to schwa. Reasons behind this de-weighting process can be found in the prosodic constraints on foot structure. In particular, research within metrical phonology has pointed out that the sequence of a heavy and a light syllable (HL) is inharmonious and languages generally do not parse such a sequence as a metrical foot (see Hayes 1985, 1995; Prince, 1990; Kager, 1999; Prince and Smolensky, 1993; and others). Within Optimality Theory (OT), Prince and Smolensky (1993, p.59) postulate the constraint Rhythmic Harmony (RH-HRM) which militates against HL feet. Kager (1999, pp. 173-4) derives the markedness of HL from foot structure at the micro-rhythmic level. He argues that moras receive micro-beats, and since nuclei are more prominent than codas, they receive strong micro-beats while codas receive weak ones. On this basis, Kager suggests that feet abide by the prosodic constraint RHYTHMIC CONTOUR (RH-CONT) banning HL feet. Prince (1990) claims that some foot types are more preferred than others, as in the following scale: LH> {H, LL} > HL> L, where the foot on the left is more optimal than the others. Based on this, the present paper attempts to provide an OT analysis of MA hollow verbs, claiming that their underlying full vowel (a, i or u) is reduced to schwa specifically within closed syllables in satisfaction of a prosodic requirement banning HL and H feet.

This paper is divided into four sections and is mapped out as follows. Section two provides a short review of the literature on V/ə alternations in the perfective aspect. Section three presents the data. Sections four and five propose a prosodic analysis of syllable de-weighting exhibited in the perfective of MA weak verbs.

2. Literature Review

2.1. Previous Accounts of V/ə Alternations in the Perfective Aspect

Earlier analyses of V/ə alternations in the perfective of MA hollow verbs suffer from a number of weaknesses. Generally, they are either preoccupied merely by classification, as is the case with traditional studies, or else have recourse to abstract derivations with some ad hoc steps. Benhallam (1980) and Heath

(1987) argue that V/ə alternation is an instance of vowel reduction as in the hollow verb form /gəl-t/ 'I said' (stem /gul/). For them, the underlying vowels (i, o or u) shorten to schwa by a special reduction rule applying before /CC/ cluster within the core stem. This treatment is limited since it does not consider the factors that force the reduction of full vowels. In fact, the scholars do not explain why full vowels are reduced when they occur before /CC/ cluster.

Youssi (1986, p. 201-2) claims that the imperfective should be used as a citation form given that the quality of the medial vowel cannot be predicted from the corresponding perfective form. However, instead of accounting for the perfective alternations, he (p. 211) merely cites them. By contrast, El-Himer (1991, p.171) postulates abstract segments in underlying representation, namely the archisegments U and I, but when these segments turn out to be undesirable in a derivation, he simply uses ad hoc diacritics in order to prevent them from occurring on the surface. Such abstract analyses cannot account for V/ə alternations without having recourse to unmotivated rules.

2.2. Earlier Treatments of the Alternating Forms for the Pronoun 'she' (at ~ ət)

In their studies of the alternate forms for the pronoun 'she', Benhallam (1980, p.23) and Keegan (1986, p.91) argue that /-at/ is the underlying suffix for the third person singular feminine. The low vowel [a] is reduced to schwa via a vowel reduction rule. In contrast, Heath (1987, p. 233) and Dell and Elmedlaoui (2002, p. 23) assume that the schwa in the suffix /-ət/ is underlying. For Heath, it is retained when the stem-final C is from the set /t d T D/, e.g., /mat-ət/ 'she died', /naD-ət/ 'she got up', etc. On the contrary, the schwa is deleted when the stem-final C is from the set /s S l r R n/, as in /bas-t/ 'she kissed', /kan-t/ 'she was', /gal-t/ 'she said', /dar-t/ 'she did', etc. In El Himer (1991), the alternants [at] and [ət] can be used interchangeably across the board since the change is governed by two rules, the first of which is assumed to be optional. The other one is claimed to be obligatory, however. These rules definitely ensure that the alternant [-at] becomes [-ət] either optionally in the context CC___C # as in kətbat/ət 'she wrote' or obligatorily in the context VC ___ C # as in xafət 'she got afraid'.

Among recent studies, Lowenstamm (2011) claims that the [at] ~ [ət] alternation can be seen as a matter of stress assignment. For him, assigning stress to the first syllable requires the appearance of the segment [ə] and to the second syllable requires the realization of the segment [a], (i.e. kətba´t and kə´tbət 'she wrote'). This claim is supported by the fact that the initial stress of kə′tbət 'she wrote' can be forced to move to the second syllable in the context of the 2nd sing. masc. accusative, expressed by the exponent {-u} 'him, it', while the stress of the form kətbát 'she wrote' remains in situ. Thus, the segment [a] is licensed to replace the segment [ə], e.g. kətbátu 'she wrote it', form the input /kə′tbət-u/ or /kətbát-u/.

Adopting OT, Hachoumi (2023) assumes that the epenthetic segments [a] and [ə] are used interchangeably and appear when the 3rd person feminine singular suffix is attached to the consonant-final verbs (e.g. /ktb-t/: kətbat/kətbət 'she wrote', /ʃmm-t/: ʃəmmat/ ʃəmmət 'she smelt', etc.). However, these two epenthetic segments fail to be used interchangeably in other contexts, especially when the target person affix is attached to the concave simple verbs (e.g. /xaf-t/: *xafat / xafət 'she got afraid, /biʕ-t/: *baʕat/ baʕət 'she sold', etc.). To rule out these kinds of candidates, Hachoumi calls for the markedness constraint *a$^{3.SG.\ F.\ PFV/\ ConcaveSimpleVerbs}$ which interacts with other constraints (e.g. *i/u$^{3.\ SG.\ F.\ PFV}$, DEP_{IO}, NO-CODA and DEP_{oo}) as the following tableau illustrates: (Hachoumi, 2023, p. 283)

(1)

/xaf {-t}/ Base: [xaf]	a$^{3.SG.\ F.\ PFV/\ ConcaveSimpleVerbs}$	*i/u$^{3.\ SG.\ F.\ PFV}$	DEP_{IO}	NO-CODA	DEP_{oo}
a. xa.fat	*!		*	**	**
☛b. xa.fət			*	**	**
c. xa.fit		*!	*	**	**
d. xa.fut		*!	*	**	**

The only criticism that could be leveled at Benhallam (1980) and Keegan (1986) is that they do not consider the reasons behind the reduction of the low vowel [a]. As far as Heath (1987)'s account is concerned, the most serious limitation is that of deletion. In fact, he does not explain why the schwa is deleted from the actual output as in galt 'she said' of /gal-ət/. In this case, there is no trigger for deleting the schwa. In El Himer (1991), the optional change of the segment [a] in the context CC ____C# can be considered as a pitfall since the weak final verbs appear with the segment [a] even if it appears in the proposed context as in klat 'she ate', not *klət. Finally, the epenthesis analysis (Hachoumi, 2023) suffers from two main limitations. First, it is empirically inadequate since *a$^{3.SG.\ F.\ PFV/\ ConcaveSimpleVerbs}$ is not a constraint; rather it is a generalization. In the absence of a rigorous theoretical justification, this remains a sweeping generalization. Second, it fails to account for ə-epenthesis in the context of the vowel-final verbs like kla 'to eat', which may undergo ə-deletion as hiatus resolution (*klaət). In this situation, the epenthesis analysis is against the principle of economy because it is illogical to epenthesize schwa and delete it in the same position.

In our discussion of syllable lightening in the perfective of MA hollow verbs, we assume, along the lines of Benhallam (1980), that the underlying feminine suffix /at/ is realized as [ət] through vowel reduction.

This full-vowel-to-schwa reduction occurs specifically within closed syllables in satisfaction of a prosodic requirement banning HL and H feet. Before we go to the specifics, a look at the data is necessary.

3. Data Facts

The corpus of data pertaining to verbal morphology is taken from Hachoumi (2023). The variety of MA which the present paper focuses on is that of Average Moroccan Arabic (AMA), which is spoken in Rabat, Morocco. Consider the following paradigms:

(2) ʃuf 'see'

1st P.	ʃəf-t	ʃəf-na
2nd P. masc.	ʃəf-ti	ʃəf-tu
2nd P. fem.	ʃəf-ti	ʃəf-tu
3rd P. masc.	ʃaf	ʃaf-u
3rd P. fem.	ʃaf-ət	ʃaf-u

(3) xaf 'fear'

xəf-t	xəf-na
xəf-ti	xəf-tu
xəf-ti	xəf-tu
xaf	xaf-u
xaf-ət	xaf-u

(4) biʕ 'sell'

1st P.	bəʕ-t	bəʕ-na
2nd P. masc.	bəʕ-ti	bəʕ-tu
2nd P. fem.	bəʕ-ti	bəʕ-tu
3rd P. masc.	baʕ	baʕ-u
3rd P. fem.	baʕ-ət	baʕ-u

(5) ʒri 'run'

ʒri-t	ʒri-na
ʒri-ti	ʒri-tu
ʒri-ti	ʒri-tu
ʒra	ʒra-w
ʒra-t	ʒra-w

(6) ktəb 'write'

1st P.	ktəb-t	ktəb-na
2nd P. masc.	ktəb-ti	ktəb-u
2nd P. fem.	ktəb-ti	ktəb-u
3rd P. masc.	ktəb	kətb-u
3rd P. fem.	kətbat/ət	kətb-u

(7) kərkəb 'roll'

kərkəb-t	kərkəb-na
kərkəb-ti	kərkəb-tu
kərkəb-ti	kərkəb-tu
kərkəb	kərkb-u
kərkb-at/ət	kərkb-u

(8) ʃəmm 'smell'

1st P.	ʃəmmit	ʃəmmina
2nd P. masc.	ʃəmmiti	ʃəmmitu
2nd P. fem.	ʃəmmiti	ʃəmmitu
3rd P. masc.	ʃəmm	ʃəmmu
3rd P. fem.	ʃəmmat/ət	ʃəmmu

The paradigms in (2), (3), and (4) above show that the underlying full vowels (a, i or u) shorten to schwa in the first and second person of the perfective when they occur in initial closed syllables. Conversely, open syllables keep their vowels unreduced. These paradigms also display a further issue that needs to be considered and accounted for, namely, the schwa that shows up in the 3rd person feminine singular forms. It is derived from the reduction of the low vowel [a] in a closed syllable. The segment [a] reduces to

schwa either optionally as in ʃəmmat/ət 'she smelt' or obligatorily in baʕət 'she sold'. In contrast, the 3rd person feminine singular forms of final-weak verbs as in (5) do not constitute any counterexamples to vowel reduction in the perfective. In the case of the verb form ʒrat 'she ran', we end up with the ill-formed form * ʒrət if we reduce the segment [a], which appears only in the third person singular and plural of the perfective forms of both hollow and final-weak verbs (e.g. baʕət 'she sold', baʕu 'they sold'/ ʒrat 'she ran', ʒraw 'they ran', etc.). In the 3rd person plural form ʒraw 'they ran', the suffix [u] becomes the glide [w] since it is attached to the verb stem that ends in a vowel. By contrast, the suffix [u] does not change when it occurs after stems ending in consonants as in baʕu 'they sold'.[1]

If we delete the segment [a] from the 3rd person feminine singular forms like kətbat 'she wrote', we end up with the 1st person singular perfective form or 2nd person singular perfective form ktəbt 'I/you (sing.) wrote'. In the case of the verb form ʃəmmat 'she smelt', we end up with ill-formed words (e.g. *ʃəmmt) if we delete the segment [a], and with the 1st singular perfective or 2nd singular perfective ʃəmmit 'I/you (sing.) smelt' if we replace it by the segment [i], which is used in the other cases. Therefore, the only solution to distinguish and avoid the ill-formedness of these related morphological categories is to reduce the segment [a], whether there is a consonantal cluster as in ʃəmmat/ət 'she smelt' or not as in kətbat/ət 'she wrote'.

Now let us compare the 1st singular perfective forms ktəbt 'I wrote' and ʃəmmit 'I smelt' with the 3rd feminine perfective forms kətbat 'she wrote' and ʃəmmat 'she smelt'. The affixation of the 1st singular affix to the sound verb requires no epenthetic segment, while it does when it is affixed to the final double verbs. It requires the epenthetic segment [i]. By contrast, the affixation of the 3rd singular feminine affix requires the segment [a] in both cases. The segment [a] emerges to differentiate the 3rd singular feminine from the 1st singular in the case of the sound verbs and to distinguish the 3rd singular feminine from 1st singular and to split a consonantal cluster in the case of the final double verbs.

In El Himer (1991)'s analysis, the presence of the segments [i] in certain forms of simple verbs such as ʃəmmit 'I smelt' is explained via a generated syllable. Accordingly, all the perfective personal pronoun affixes are presented as extrasyllabic segments in the first stage of their derivation, whether they are vowels or consonants. On the whole, this analysis highlights that the generated syllables, filled by the segment [i], are meant to generate full syllables. In Bernous (1994)'s account, the absence of the segment [i] in certain forms of complex verbs such as ʕəlləmt 'I taught' is explained as a deletion of the segment [i] when it is preceded by a full syllable. These two treatments suffer from two main weaknesses. In El

[1] Only future research can enlighten us about the issue of u/w alternation.

Himer (1991), for instance, the generated syllable violates the principle of economy in terms of generating and deleting in almost all the cases as *ktəbit. As far as Bernous (1994)'s account is concerned, the most serious limitation is that of deletion. Bernous does not explain why the segment [i] is deleted from the actual output as in ʕəlləmt 'I taught' of /ʕəlləm-it/. In this case, there is no good reason motivating the deletion of the segment [i].

Finally, the schwa in the paradigms in (6), (7) and (8) is not part of the base; it is epenthesized for syllabic purposes in accordance with Benhallam's (1990) Syllable Structure Assignment Algorithm (SSAA). According to SSAA, schwa epenthesis in items like the ones in (6) and (7) operates from right to left. It occurs between the second and third consonants in trisegmental roots as in the stem [ktəb] and between each cluster of two consonants in quadrisegmental roots as in the stem [kərkəb]. Benhallam (1990)'s SSAA cannot yield the desired results in a number of cases, especially when the personal pronoun affixes are attached to certain morphological categories such as ktəbt 'I wrote'. Its application yields the wrong output *kətbət 'I wrote'. One way of solving the problem is proposed by Boudlal (2001), who assumes cyclic application of schwa epenthesis. The SSAA fails to account for geminated verbs on the pattern CəCC (Al Ghadi, 1994). The items in (8) above show that schwa epenthesis does not conform to the rules of SSAA since schwa is inserted between the first and second consonants. It is inserted in that position to avoid the splitting up of geminates. (See Boudlal, 2001; Noamane, 2018).

4. The Proposed Analysis of Syllable Lightening in the Perfective of MA Hollow verbs

For most works on MA, the schwa is assumed to be epenthetic (Benhallam, 1980, 1988, 1990a; Al Ghadi, 1990; El Himer, 1991; Boudlal, 2001; Bensoukas & Boudlal, 2012 and others). It is epenthesized to break up impermissible sequences of consonant clusters (Benhallam, 1980; Al Ghadi, 1990).Its insertion is motivated by syllable structure requirement. In Benhallam (1980), schwa has a specific directionality of application in that it applies from right to left to form a schwa syllable. In Benhallam (1990), it is syllabified as a nucleus, while in Bensoukas and Boudlal (2012) it is syllabified as a part of a single branching mora. Other Moroccan linguists, on the contrary, hold that schwa has a phonemic status (Benkirane, 1982; Benkaddour, 1982; Keegan, 1986 and others). Under this assumption, the schwa is a mora and, consequently, it is crucial to the syllable weight. Benkaddour (1982) distinguishes two schwas: the phonetic schwa and the phonemic schwa. For him, the phonemic schwa serves as a morphological contrast between verbs of the type /CCəC/ such as /DRəb/ "hit" and /lʕəb/ "play", and nouns of the type of /CəCC/ such /DəRb/ "hitting" and /ləʕb/ "play/ game". The phonetic schwa serves to break up a three-consonant cluster that the language does not allow (e.g. /l-bnat/ → [ləbnat] "the girls").

In his account for MA data, Gafos (2002) assumes that what is perceived as a schwa vowel is just an effect of temporal organization of gestures. He claims that in MA, "for example …. the active participle of the verb 'to write' is [katəb], with a schwa-like vocalic transition in the final cc cluster….. There is a period of no constriction in the transition between /t,b/ that is identified as a schwa-like vocalic element.". (pp. 271-2). In this connection, Hall (2006, p.391) draws an important distinction between intrusive vowels, or 'phonologically invisible inserted vowels', and epenthetic vowels. Intrusive vowels can have either the quality of schwa or that of a nearby vowel through copying. They are characterized by a highly variable duration, optionality and absence in fast speech. Hall (2006, p. 424) states that in vowel intrusion, the articulatory gestures associated with existing segments are phrased in a way that creates an acoustically vocalic period, but no phonological segment is inserted, and hence no new syllable is created.

In the light of the debate concerning the status of the schwa in MA, how can an analysis postulating vowel reduction be defended? If the schwas of the perfective in paradigms (2), (3) and (4) are reduced forms of the corresponding full vowels of the aorist, they must be moras since input vowels are specified as such in the lexicon. In addition, vowel reduction would imply that there are two types of schwas in MA: reduced vowels and epenthetic schwas. Both types of schwas are not underlying but only the result of phonological processes. More important is that the epenthesis analysis (Hachoumi, 2023) is against the principle of economy because schwa epenthesis in the perfective of hollow verbs must be preceded by full vowel deletion. It is costly and unnatural to make two phonological processes in the same position (e.g. Input: / ʃuft/ → vowel deletion: ʃft → schwa epenthesis: ʃəft → surface form: [ʃəft] 'I saw'). Vowel reduction may seem to be economical (e.g. Input: / ʃuft/ → vowel reduction: ʃəft → surface form: [ʃəft]). Furthermore, there is no good reason motivating the deletion of full vowels. In the present study, we assume that ~~V/ə~~ alternations in the perfective of MA hollow verbs is an instance of vowel reduction triggered by some prosodic constraints on foot structure, namely RH-CONT and *ΣH.

It should be pointed out that forms such as ʃəft 'I saw' can only satisfy Foot-Binarity (FT-BIN) (Prince and Smolensky, 1993) if the last consonant is considered as a separate unit from the preceding syllable, of course, on the assumption that the schwa does not correspond to a mora[2] (Al Ghadi, 1990, 1994/2022; Boudlal, 2001; and Bensoukas & Boudlal, 2012a-b). The same conclusion has been drawn by Al Ghadi

[2] In Shih (2018, p.19), schwa can be moraic in some languages (e.g. Piuma Paiwa, an Austronesian language spoken in Taiwan.). For him, moraic and non-moraic schwas have significantly distinct phonetic effects, particularly in duration and vowel quality variability.

(1994) and Boudlal (2001), who argue that tri-consonantal verbs should have either one of the following structures, depending on whether the schwa occurs before the second or the third consonant:

(9) a. PrWd b. PrWd

(Al Ghadi, 1994, p.26; Boudlal, 2001, p.71)

The fact that 1st person perfective forms of hollow verbs have the surface structure in (9a) supports our argument that the input is parsed as a single foot comprising a heavy syllable and a mora and not as a foot followed by a mora (e.g. (ʃuf.t) vs. (ʃuf).t). If the weakly-layered mora is considered to be L, 1st person perfective will be parsed as (HL), which violates RH-CONT.

(10) RH-CONT (Kager, 1999, pp. 173-4)

A foot must end in a strong-weak contour at the moraic level.

The satisfaction of RH-CONT through the de-weighting of the heavy syllable brings this constraint into conflict with two constraints of the moraic faithfulness family, namely, MaxLink-Mora [SEG], which militates against the deletion of the segment-mora link existing in the input, and IdentLink-Mora [SEG] which is violated whenever an underlying association to a mora is altered, as is the case where one mora is doubly associated to two segments (Morén, 1999, 2003). A case in point is a segment associated underlyingly with a mora and sharing its mora with a following or a preceding segment. In the case under discussion, RH-CONT must dominate MaxLink-Mora [SEG] and IdentLink-Mora [SEG], which do not need to be ranked with respect to each other, since RH-CONT is satisfied at the expense of violating these two moraic faithfulness constraints. Thus, from this discussion emerges the hierarchy: RH-CONT>> MaxLink-Mora [SEG]; IdentLink-Mora [SEG], which is illustrated by the following tableau:

(11)

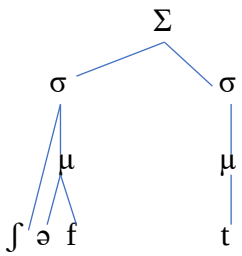
Input: /ʃuᵘfᵘ -tᵘ/	RH-CONT	MaxLink-Mora [SEG]	IdentLink-Mora [SEG]
μ μ μ a. ʃ u f . t	*!		
μ μ ☛b. ʃ ə f . t		*	*

In accordance with the principles of moraic theory (Hyman, 1985; Zec, 1988; Hayes, 1989; Gordon, 2004, 2005; Ryan, 2016, 2019), the full vowel [u] in [ʃuf.t] is underlyingly moraic (V=μ). The coda consonants [f] and [t] are moraic by virtue of Hayes (1989)'s Weight-By-Position (WBP). In [ʃuf.t], the first syllable [ʃuf] is heavy (H) and the second syllable [t] contains a consonant, making it a light minor syllable (L). The sequence forms an (H L) trochaic structure, which violates RH-CONT. Since schwa is non-moraic in MA (ə=0), it should be combined with a following coda consonant via WBP (əC= μ) (Bensoukas, 2006/7; Boudlal and Bensoukas, 2012b; Bensoukas, 2021). In [ʃəf.t], the schwa syllable [ʃəf], which is a major syllable, contains exactly one mora. This makes it a light closed syllable (L), of course, on the assumption that schwa syllables are light and full vowel syllables are heavy (Bensoukas, 2006/7; Boudlal and Bensoukas, 2012). The final trailing consonant [-t] is parsed as carrying its own extra-prosodic or degenerate mora (t =μ). Then, the combined output [ʃəf.t] is actually evaluated as a sequence of two moras (μμ), forming an LL foot.

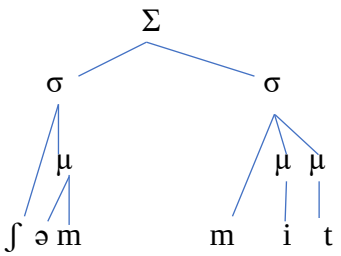
Now let us compare the first singular perfective form ʃəft 'I saw' with the 1st sing. perf. form ʃəmmit 'I smelt'. The affixation of the first person affix to the hollow verb requires no epenthetic segment, while it does when it is affixed to the double verbs. It requires the epenthetic segment [i], which emerges to distinguish the 3rd singular feminine (ʃəmmat/ət 'she smelt') from 1st singular and to split a consonantal cluster. The perfective output forms [ʃəfᵘ.tᵘ] and [ʃəmᵘ.miᵘ tᵘ] abide by RH-CONT banning HL feet. Consider the following exemplification for more clarity:

(12)

a. LL



b. LH



The structure in (12a) intentionally optimizes for an LL foot type, which runs counter to Prince (1990)'s scale: LH> {H, LL} > HL > L, where the foot on the left is more optimal than the others. The structure in (11b) optimizes for the absolute optimal iamb, LH. The structures above in (12) show that MA grammar splits into two completely different strategies. In the perfective of hollow verbs, closed syllables lose one mora (i.e. they become light) by reducing the full vowel to schwa in order prevent an illicit HL metrical parse. In contrast, the second syllable in the first singular perfective form ʃəmmit 'I smelt' becomes heavy by epenthesizing the segment [i], which emerges to form an LH structure. In the light of this analysis, the first singular perfective form ʃəmmit 'I smelt' cannot be included within a unified account of moraic loss as it behaves differently.

The constraints considered so far in connection with 1st person perfective also account for the other first and second person forms in a straightforward way. By way of illustration, the derivation of [bəʕ.na] from the input /biʕ-na/ is given by the following tableau:

(13)

Input:/biᵘ ʕᵘ-naᵘ/	RH-CONT	MaxLink-Mora [SEG]	IdentLink-Mora [SEG]
μ μ μ a. b i ʕ. n a	*!		
μ μ ☛b. b ə ʕ .n a		*	*

In [biʕ.na], the first syllable [biʕ] is heavy (H) and the second syllable [na] contains a full vowel, making it light (L). The sequence forms an (H L) trochaic structure, which violates RH-CONT. In [bəʕ.na], both syllables [bəʕ] and [na] are light, forming a bimoraic iambic foot of the type LL.

The items that end up with a vowel such as [xəftu] ‘you were afraid’ present a special case that needs to be analyzed. For illustration, consider the following data set. For ease of demonstration, syllable boundary is indicated by a dot.

(14) The perfective form of xaf ‘be afraid’

1P.	____	xəf.na
2P.masc.	xəf.ti	xəf.tu
2P.fem.	xəf.ti	xəf.tu

The data in (14) shows that the low vowel -a- is reduced to schwa in closed syllables whereas the three vowels [a,i,u] remain unaffected in open syllables. The nonoccurrence of vowel reduction in open syllables is due to the fact schwa cannot occur in open syllables, unlike full vowels, which can freely occur in all positions. The constraint against the occurrence of schwa in open syllables is formulated as *ə]σ (Al Ghadi, 1994; Boudlal, 2001; Bensoukas and Boudlal, 2012a-b among others). Incorporating the constraint *ə]σ in the grammar of MA along with the other constraints can adequately predict which vowel should be the target of reduction in the perfective of MA hollow verbs. To see how forms such as [xəf.tu] ‘you were afraid’ are obtained, consider the constraint tableau below where the constraints RH-CONT and *ə]σ need not be ranked with respect to each other and both MaxLink-Mora [SEG] and IdentLink-Mora[SEG] are ranked low in the hierarchy.

(15)

Input: /xa$^{\mu}$f$^{\mu}$.tu$^{\mu}$/	RH-CONT	*ə]σ	MaxLink-Mora[SEG]	IdentLink-Mora[SEG]
μ μ μ a. x a f. t u	* !			
μ μ b. x ə f. t ə		* !	*	**
μ μ μ c. x a f . t ə	*(!)	*(!)		*
μ μ ☛d. x ə f. t u			*	*

Candidate (15a) is discarded for incurring a fatal violation of RH-CONT, which leads to its exclusion. Although candidate (15b) satisfies RH-CONT, it loses the competition because it falls short on *ə]σ as it allows schwa to appear in open syllables, something the language does not allow. Candidate (15c) is ruled

out since it incurs a violation of the undominated constraints RH-CONT and *ə]σ. As things stand, candidate (15d) ends up winning the competition by virtue of its satisfaction of the higher-ranked constraints despite its violation of MaxLink-Mora [SEG] and IdentLink-Mora [SEG]. The winning candidate also falls short on NOSHAREDMORA constraint, militating against branching moras (Morén, 1999).

To sum up so far, the above tableaux show that closed syllables with full vowels lose one mora (i.e. they become light) by reducing the full vowel to schwa in satisfaction of RH-CONT. Consider the following representative items:

(16) Lightening/De-weighting

HL	⟶	LL
a. *ʃuf.t		ʃəf.t
b. *ʃuf.tu		ʃəf.tu
c. *ʃuf.na		ʃəf.na
d. *ʃuf.ti		ʃəf.ti

The generalization that could be made about the items in (16) is that all the perfective forms abide by the prosodic constraint RH-CONT, banning HL feet. The same thing can be said about the perfective forms [ʃa.fu] 'they saw' and [ʃa.fət] 'she saw' which conform to a bimoraic iambic foot of the type LL.

5. Alternative OT Analysis of the Alternating Forms for the Pronoun 'she' (-at ~ -ət)

As already stated, the alternants [at] and [ət] are used interchangeably in the context of strong verbs (e. g. kətbat/ət 'she wrote'). In contrast, the vowel [a] obligatorily reduces to schwa in the context of hollow verbs.

(17) The 3rd singular feminine perfective

/xaf-t/	*xafat	xafət	'she got afraid'
/biʕ-t/	*baʕat	baʕət	'she sold'
/gul-t/	*galat	galət	'she said'

Let us now see if the constraints developed in the preceding section can account for syllable de-weighting manifested by the 3rd person feminine perfective forms of MA hollow verbs. To show how a form such as [baᵘ.ʕətᵘ] 'she sold' is obtained, consider the constraint tableau below where the constraint RH-CONT should be ranked higher in the hierarchy and MaxLink-Mora[SEG] and IdentLink- Mora[SEG] need not be ranked with respect to each other as the tableau below illustrates:[3]

[3] To simplify the constraint tableaux in this subsection, we have not included *ə]σ.

(18)

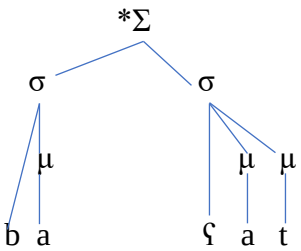
Input: /baᵘ.ʕaᵘ tᵘ/	RH-CONT	MaxLink-Mora[SEG]	IdentLink- Mora[SEG]
μ μ ☛a. b a. ʕə t		*	*
μ μ μ b. b a ʕ . t	*!		*

Here, candidate (18a) wins the competition by virtue of it satisfying the higher constraint RH-CONT. Candidate (18b) fatally breaches the undominated RH-CONT, leading to its dismissal.

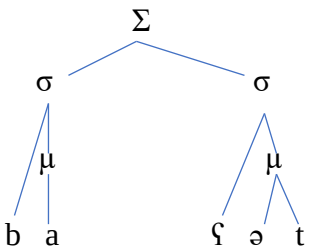
Upon closer inspection, tableau (17) above does not include the candidate [baᵘ.ʕaᵘ tᵘ] which satisfies all the constraints developed so far. Note that both candidates [baᵘ.ʕaᵘ tᵘ] and [baᵘ. ʕətᵘ] abide by RH-CONT banning HL feet. For more clarity, we provide the following exemplification:

(19)

a. LH



b. LL



The structure in (19a) fails another constraint on foot structure that bans feet constituted of a heavy syllable. In Bensoukas (1994), Prince (1990)'s scale (LH> {H, LL} > HL > L) can be turned into a constraint hierarchy, as in (19) below:

(20) *ΣL >> *ΣHL >> {*ΣH, *ΣLL}>> *ΣLH (Bensoukas, 1994, p.219)

According to this hierarchy, then, *ΣH is dominated by RH-CONT, which is similar to *ΣHL. The constraints needed to account for the [at] ~ [ət] alternation are summed up in the following hierarchy: RH-CONT >> *ΣH>> MaxLink-Mora [SEG]; IdentLink- Mora [SEG]. This is demonstrated in the following tableau (Feet are enclosed between parentheses):

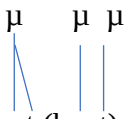
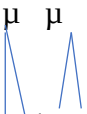
(21)

Input: /baᵘ.ʕaᵘ tᵘ/	RH-CONT	*ΣH	MaxLink-Mora [SEG]	IdentLink- Mora [SEG]
μ μ μ a. ba.(ʕ a t)		*!		
μ μ μ b. (b a ʕ. t)	*!			*
μ μ ☛c. (b a.ʕ ə t)			*	*

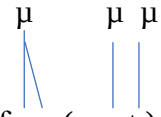
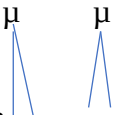
In [ba.ʕat], the first syllable [ba] is light and the second syllable [ʕat] contains a full vowel followed by a coda consonant, making it heavy. The heavy syllable [ʕat] violates *ΣH. In [baʕ.t], the first syllable [baʕ] is heavy and the second syllable [t] contains a consonant, making it a light minor syllable. The sequence forms an HL trochaic structure, which violates RH-CONT. In [ba.ʕət], both syllables [ba] and [ʕət] are light, forming a bimoraic iambic foot of the type LL.

The above analysis can be extended to other 3rd person feminine perfective forms, namely kətbat ‘she wrote’ and ʃəmmat ‘she smelt’. The constraints given in (21) can predict the optimal candidates containing the segment [ə] rather than the segment [a] as in [kət.bət] ‘she wrote’ and [ʃəm.mət] ‘she smelt’. Consider the tableaux below. To avoid repetition, we will provide one inclusive comment on both tableaux.

(22)

Input: /kətᵘ.baᵘ tᵘ/	RH-CONT	*ΣH	MaxLink-Mora [SEG]	IdentLink- Mora [SEG]
 a. kə t.(b a t)		*!		
 ☛b. (kə t.b ə t)			*	*

(23)

Input:/ʃəmᵘ.maᵘ tᵘ/	RH-CONT	*ΣH	MaxLink-Mora [SEG]	IdentLink- Mora [SEG]
 a. ʃə m.(m a t)		*!		
 ☛b. (ʃə m.m ə t)			*	*

The two tableaux in (22) and (23) show that the optimal candidates employ the segment [ə] instead of the segment [a] to form a bimoraic iambic foot of the type LL.

Framing LL as an optimal iambic parsing mechanism in (21), (22) and (23) runs counter to Prince (1990)'s scale, which identifies LH as the optimal harmonic iamb. It seems that the choice of LL instead of LH forms in MA is a result of the interaction of stress and weight. In MA, closed schwa syllables, which are light, never attract stress when co-occurring with closed syllables with full vowels, which are heavy (Bensoukas and Boudlal, 2012). In disyllabic words, heavy syllables are generally stressed whether it is in penultimate or ultimate position. Words with two light syllables always stress the penultimate syllable (Benhallam, 1990, p.101; El Hadri, 1993, p.248; Bensoukas and Boudlal, 2012b, p.20). Consider the following exemplification:

(24)

a. L´L		b. LH´
ʃa´.fət	'she saw'	*ʃa. fa´t
kə´t.bət	'she wrote'	kət.ba´t
ʃə´m.mət	'she smelt'	ʃəm.ma´t

The data in (24a) shows that the first syllables attract stress because the words are made up of two light syllables. In (24b), the final syllables, which are heavy, attract stress in the presence of light syllables. Assigning stress to the first syllable requires the appearance of the segment [ə] (e.g. ʃa´fət 'she saw') and to the second syllable requires the realization of the segment [a], (e.g. kətba´t 'she wrote'). Note that assigning stress to the second syllable of the 3rd person feminine perfective forms of MA hollow verbs yields ill-formed words (e.g. *ʃafa´t). To rule out forms such as *ʃafa´t, we need to call for the universal constraint Non-Finality which prohibits stress from falling on the final syllable.

(25)Non-Finality (Prince and Smolensky, 1993, p. 30)

The prosodic head of the word does not fall on the word-final syllable.

This constraint interacts to a large extent with the following principle :

(26)Weight-to-Stress Principle (WSP) (Prince and Smolensky, 1993; Kager, 1999, p.155) :

A heavy syllable is stressed in foot structure.

WSP requires that, when there is a string of a light and a heavy syllable, stress falls on the heavy syllable. Non-Finality must dominate WSP to force stress to move to the penultimate syllable. On its part, WSP must dominate MaxLink-Mora [SEG] and IdentLink- Mora [SEG]. The derivation of [ʃa´fət] from the input /ʃafa´t/ is given by the following tableau:

(27)

Input:/ʃaᵘ.faᵘ tᵘ/	RH-CONT	*ΣH	NONFINALITY	WSP	MaxLink-Mora [SEG]	IdentLink-Mora [SEG]
μ μ μ a. (ʃ a. f a´ t)			*!			
μ μ ☛b. (ʃ á. f ə t)				*	*	*

The (LH) candidate in (27a) fails because stress falls on the final syllable. By contrast, the (LL) candidate in (27b) wins since stress falls on the penultimate syllable. Note that the constraints given in (27) can predict the optimal candidates containing the segment [ə] rather than the segment [a] as in [kə´t.bət] 'she wrote' and [ʃə´m.mət] 'she smelt'.

Unlike hollow verbs, final-weak verbs do not constitute any counterexamples to vowel reduction in the perfective. Consider the data in (28) below.

(28)

ʒat	'she came'	mʃat	'she went'
klat	'she ate'	ʃrat	'she bought'

We assume, following Keegan (1986), that the suffix vowel /a/ is deleted because sequences of vowels are banned in MA.[4] If the items above retain the suffix vowel /a/, we end up with the following ill-formed forms:

(29) * ʒaat *mʃaat *klaat *ʃraat

In OT, the constraint ruling out sequences of vowels is dubbed as NoHiatus.

(30) NoHiatus: sequences of vowels are prohibited (Orie and Polleyblank, 2002, p.110).

This constraint is posited because a hiatus structure is formed when the vowel of the root and that of the affix are juxtaposed. Hiatus structures are cross-linguistically marked (Casali, 1997). Different languages employ different strategies to resolve hiatus structures. According to our data, the one strategy employed by the grammar of MA is vowel deletion. In particular, the low vowel of the affix is deleted to avoid a hiatus structure. To account for this issue, we assume that RH-CONT and the markedness constraint NoHiatus must outrank *ΣH, MaxLink-Mora [SEG] and IdentLink- Mora [SEG].

[4] MA does not have long vowels (Heath, 1997; Benkirane, 1982; Lowenstamm, 1991; Mustafawi, 2018 among others)

(31)

Input: /mᵘ.ʃaᵘ aᵘ.tᵘ/	RH-CONT	NoHiatus	*ΣH	MaxLink-Mora [SEG]	IdentLink-Mora [SEG]
μ μ μ μ a. m.(ʃ a a) . t		*!	*		
μ μ μ μ b. (m.ʃ a a) . t		*!			
μ μ μ μ c. m.(ʃ a a . t)	*(!)	*(!)			
μ μ μ ☛d. m.(ʃ a . t)				*	*

Candidates (31a) and (31b) are discarded for fatally breaching NoHiatus, banning sequences of vowels. Candidate (31c) is ruled out as it falls short on the higher-ranked constraints RH-CONT and NoHiatus. As things stand, candidate (30d) wins the competition.

Conclusion

In this paper, we have presented a prosodic treatment of vowel alternation and syllable lightening in MA hollow verbs. Specifically, we have empirically shown that heavy syllables are lightened (or de-weighted) to satisfy the prosodic constraints RH-CONT and *ΣH which militate against HL and H feet. These constraints enter into a relation of dominance with two moraic faithfulness constraints (i.e. MaxLink-Mora [SEG] and IdentLink- Mora [SEG]). We have also argued that the only location for vowel reduction is in closed syllables since schwas can't occur in open syllables in MA. Additionally, we have claimed that final-weak verbs, unlike hollow verbs, do not resort to vowel reduction to achieve syllable lightening. The suffix vowel /a/ is deleted because sequences of vowels are banned in MA by virtue of the constraint NoHiatus. Finally, we have shown that the choice of LL instead of LH structures in the 3rd person feminine perfective forms of MA hollow verbs is dedicated by the constraint Non-Finality.

This study has lent support to the role of foot patterns in the analysis of syllable lightening. Earlier treatments on V/ə alternation in the perfective fail to give convincing analyses since they do not have recourse to foot patterns in their studies. In this paper, we have attempted to overcome this handicap and consider V/ə alternation as a result of syllable lightening. Future research on the bimoraicity prosodic requirement (i.e. to avoid trimoraicity *μμμ) will certainly contribute to a deeper understanding V/ ə alternations in the perfective of MA hollow verbs.

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