THE /áa/ MOMENT IN MODERN HEBREW

NOAM FAUST[1]
Université Paris 8, CNRS SFL

1 Problem

Modern Hebrew exhibits reduction of stem-final /áa/ sequences into one stressed [á]. This paper aims to provide an explanation for this fact. I begin by illustrating the phenomenon.

Verbs in Modern Hebrew (MH) canonically involve a set of three consonants (henceforth the variables <Q,T,L>), interdigited with a vocalic pattern, e.g. PASS.PRTC <a,u>. Thus, the "template" of the passive participle is QaTuL. The items in (1.i) illustrate the different roles of the two sets: the specific consonantal set <k,r,χ> provides lexical information, while the vowels (and affixes) correspond to morphological specification. Some consonantal sets display non-canonical behavior, in that one of the items in the set is not stably realized throughout in one or more word-forms. Consider for instance the set 'tear'in (1.ii). In (1.ii.a-d), this verb exhibits an unstressed vowel [a] where 'bind' positions the third consonant. This points to the third element being /a/, as suggested in Faust (2005); however, when the preceding stem vowel is [á] (1e,f), instead of the expected [áa], 'tear' simply lacks a third element.

(1)   Canonical vs. /a/-final items in MH

	i.'bind'	ii. 'tear'	Template
a. PASS.PRTC	kaʁúχ	kaʁúa	QaTúL
b. "ABLE" ADJ	kaʁíχ	kaʁía	QaTíL
c. ACT.PRTC.MSG	koʁéχ	koʁéa	QoTéL
d. INF	likʁóχ	likʁóa	liQTóL
e. PST.3MSG	kaʁáχ	kaʁá, *kaʁáa	QaTáL
f. PST.1SG	kaʁáχ-ti	kaʁá-ti, *kaʁáa-ti	QaTáL-t

[1] noam.faust@univ-paris8.fr

One may generalize as in (2):

(2)   Generalization
       After a stem vowel /á/, an /a/ in the stem-final position is unrealized.

The question is then raised as to *why* [áa] poses a problem. One answer was provided by Pariente (2012). Adopting Faust's proposal of an underlying consonantally-mapped /a/, he assumed that **i.** Final [V́a] sequences are trochees, and **ii.** There is a constraint against trochees with identical vowels. The present paper explores an alternative explanation based on the phonetics of stressed vowels, which are pronounced long. I submit that this special /a/ *is* in fact realized in (1e,f), as part of the length of the preceding stressed vowel.

    The paper is structured in the following manner. In section 2, I provide more details about /a/ as a member of the otherwise consonantal set, as well as previous analyses. Section 3 includes the novel parts of the paper. It begins with findings on the phonetic realization of the vowel [a] in stressed and unstressed position, and proceeds with the analysis itself. I claim that stressed vowels, because they are long, can be taken to realize an identical following vowel, but not a distinct following vowel. Section 4 concludes.

2 Background

2.1 Guttural Reflexes in Modern Hebrew

This subsection provides the full picture of the type of non-canonicity illustrated in (1).

    All of the items which behave like 'tear' in (1) above involve in their orthography one of the symbols <ה,א,ח,ע> as the third consonantal letter. These symbols corresponded, in Biblical Hebrew (BH) (as well as in the reading traditions of Jews whose vernaculars allowed it) to the guttural sounds [ʕ,ħ,ʔ,h]. These sounds are by and large absent from the phonemic inventory of general MH.[2] The symbols for <ʕ,h,ʔ> usually do not correspond to any clear and consistent consonantal pronunciation, whereas the consonantal pronunciation of <ħ> is [χ]. In this paper, I will concentrate on items with orthographic <ʕ>, such as 'tear' in (1.ii). I will return to other sounds in section 3.4.

    In (1), it was shown that this <ʕ> corresponds to [a] at the right edge of the stem after a vowel other than stressed [á]. In the latter context, it seems to remain unrealized. Another context where this seems to be the case is *before* a lexical vowel (3b). For instance, when the plural suffix /-im/ is added, <ʕ> goes unpronounced. Note, however, that the stem and the suffix vowels remain in separate syllables.

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[2] Some speakers of the "Mizrahi" variety do consistently pronounce pharyngeals [ʕ,ħ] (see e.g. Gafter 2014). It is my impression that [h,ʔ] are nevertheless equally absent from their speech.

(3)   <ʕ> before a lexical vowel realized as syllable boundary

	i. 'bind'	ii. 'tear'	Template
a. PASS.PRTC.MSG	kaʁúχ	kaʁúa	QaTúL
b. PASS.PRTC-MPL	kʁuχ-ím	kʁu.-ím	QTuL-ím

Like all other potential members of consonantal sets, the entity represented by the letter <ʕ> is not limited to the third position of the set. Rather, it is freely distributed in all three positions. Of special interest to the present purpose is its behavior in the second position, illustrated by the verb 'estimate' in (4.ii). As can be seen in (4.i), a second stem vowel [e] is syncopated before a V-initial suffix (4.i.b,d). In the <ʕ>-medial verb 'estimate', this syncope places <ʕ> in an internal coda position. As in the final position, it is then realized [a] (in bold in 4.ii.b). Crucially, in such a scenario it is realized as [a] even if the preceding vowel is [a] (4.ii.d).

(4)   Coda <ʕ> after unstressed lexical vowel *including* [a] realized as [a]

	i. 'launch'	ii. 'estimate'	Template
a. PST.1SG	ʃigéʁ	ʃi.éʁ	QiTéL
b. PST-3MPL	ʃigʁ-ú	ʃi.**a**ʁ-ú	QiTLú
c. PRTC-ACT.MSG	me-ʃagéʁ	me-ʃa.éʁ	me-QaTéL
d. PRTC-ACT-MPL	me-ʃagʁ-ím	me-ʃa.**a**ʁ-ím	me-QaTL-ím

Thus, as already noted, the /a/ that one finds in the position of the orthographic guttural only disappears after a *stressed* [á].

Let us now return to such cases of expected *[áa] realized as [á]. Importantly, it is possible to reveal the underlying presence of two /a/s in this case. In a literary register, verbs take object suffixes. As shown in (5.i.b), when the 3MSG.OBJ suffix [-v] is added to the 1PST.SG, stress is shifted to the vowel of the person suffix. Consider now the <ʕ>-final [kaʁá-ti] 'I tore' (presumably /kaʁáa-ti/) in (5.ii.a). When stress is attracted to the vowel of the last suffix in (5.ii.b), the second /a/ of the stem is no longer stressed, and the underlying sequence /aa/ resurfaces faithfully.[3]

(5)   Alternation [á] - [aa]

	i. 'bind'	ii. 'tear'	Template
a. PST-1SG	kaʁáχ-ti	kaʁá-ti	QaTáL-ti
b. PST-1SG-3MSG.OBJ	kʁaχ-tí-v	kʁa.a-tí-v	QTaL-tí-v

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[3] Interestingly, the pronunciation of the form after stress shift seems to be a property of the literary register of *Modern* Hebrew, rather than a reproduction of the facts of BH (insofar as these are ascertainable). In the Massoretic transcription of the bible (the only one used today), the stem-final orthographic <ʕ> appears with a schwa symbol below it regardless of whether the form is followed by an object suffix or not : <קְרַעְתִּי> and <קְרַעְתִּיו> for (4.ii.a and b) repsectively.

Since the alternations hitherto discussed are widespread and systematic in MH, the orthographic <ʕ> must correspond to some phoneme in the language. When this phoneme is realized, it is realized as [a]. It remains unrealized in two configurations: before a lexical vowel and after a stressed [á]. For these reasons, as already mentioned, it was supposed in Faust (2005) that the phoneme under examination is /a/.

Before examining how this idea is formalized, a final data point must be added to the puzzle. The ban on *[áa] sequences finds a well-delimited, systematic counter-example among penultimately stressed nouns and participles. These items usually exhibit the vocalization <é,e> at the right edge: as a lexical fact in the case of nouns (6a), and as a result of the attachment of the lexically-unstressed feminine suffix /-et/ in participles (6c). However, if the consonant between the two vowels is the orthographic <ʕ>, both are realized as [a], and the counter-example emerges (6b,d). I know of no in-depth account of the facts in (6).

(6)   Counter-examples to *[áa]: penultimately stressed nouns and participles

a.	téfeʁ	'stich'	c.	me-ʃagéʁ	'PRTC-launch.ACT-.MSG.'
	kéʁes	'belly'		me-ʃagéʁ-et	'PRTC-launch.ACT-FSG.'
b.	tá.aʁ	'blade'	d.	me-ʃagé.a	'PRTC-madden.ACT.MSG.'
	ká.as	'anger'		me-ʃagá-at	'PRTC-madden.ACT-FSG.'

I will return to the data in (6) in the ensuing analysis. The next subsection of this introduction discusses the formalization of consonantally-mapped /a/.

2.2 Formalization

All three previous studies of the consonantally-mapped /a/ (Faust 2005, Pariente 2012, Enguehard & Faust 2018) derive its non-realization before lexical vowels from its initial mapping to an onset position. Here, I will present Enguehard & Faust's (Henceforth E&F) approach, which will be further developed in the analysis.
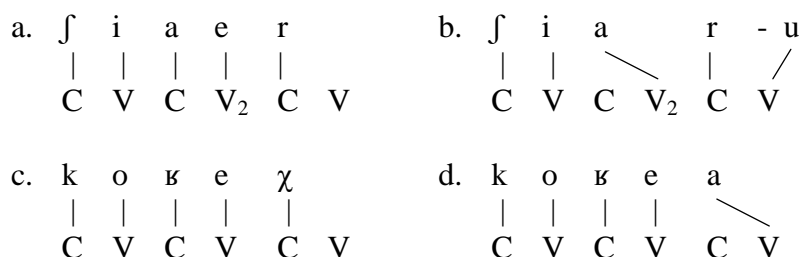
E&F's account is conducted within Strict CV (Lowenstamm 1996, Scheer 2004), an offshoot of Government Phonology (Kaye et al. 1990). This framework concentrates on autosegmental representations, assuming segmental and skeletal tiers. By axiom, the skeletal tier is composed of a sequence of CV units. As a result, at the skeletal level i. there are never adjacent C or V units; ii. every representation begins with a C slot; and iii. every representation ends in a V slot. To illustrate with data already introduced, consider (7). In (7a), the regular C-final form ends in an empty V at the skeletal level; and in (7b), the phonetically-adjacent consonants [g,ʁ] are separated by an empty nucleus at the skeletal level. The principles managing empty nuclei are discussed in the cited literature and needn't concern us here.

(7)   Basic representations in Strict CV

a. ʃ   i   g   e   ʁ   b. ʃ   i   g   ʁ - u
   | | | | | | | | | ╱
   C   V   C   V₂ C   V   C   V   C   V₂ C   V

Consider now the /a/-medial set in (8a). E&F argue that since /a/ is not allowed in a C-slot, it seeks to be realized on the following V-slot, here V₂. However, if that V-slot is occupied, /a/ simply cannot be realized as such. It remains in this position and is optionally realized as [ʔ].[4] If that V-slot *is* empty, as in (8b), then /a/ will associate to it. The same is true for /a/ in the stem-final position (8d), cf. (8c).

(8)   Realizations of consonantally-mapped /a/

<div style="margin-left:2em;">

a. ʃ   i   a   e   r   b. ʃ   i   a   r - u
    | | | | | | | ╲ | ╱
    C   V   C   V₂ C   V   C   V   C   V₂ C   V

c. k   o   ʁ   e   χ   d. k   o   ʁ   e   a
    | | | | | | | | | ╲
    C   V   C   V   C   V   C   V   C   V   C   V

</div>

E&F's Strict CV account thus rather effortlessly explains the two major realizations of consonantally-mapped /a/. However, they do not explain the non-realization of /a/ after stressed [á]. As we will see below, this shortcoming may have stemmed from lack of attention to phonetic detail.

E&F's account is purely phonological, in that it does not appeal to morphological factors in the determination of the different realizations of /a/. In contrast, Pariente (2012), following Faust (2005), accounts for the patterns above by appealing to inter- and intra-paradigmatic effects. In addition, Pariente evokes the concept of moras: /a/ is realized if it can be assigned a mora. I consider the use of moras (otherwise unmotivated language-internally) and the appeal to paradigmatic relations to be a weaknesses of these accounts. Still, as already mentioned, Pariente's is the only account to propose a logic for the non-realization of /a/ after a stressed [á]. The resulting [áa] sequence would, according to this author, create an impermissible type of foot: a trochee with identical vowels. Yet this is only a formalization: one then asks *why* such a trochee is not permitted, whereas other sequences of two [a]s are perfectly permissible. Moreover, the systematic exceptions in (6) above do not add to the elegance of this trochaic account.

In the ensuing analysis, I will show that the strict CV approach can lead to what is in my opinion a better understanding of this question. But first it must be rectified by integrating the facts from the phonetics of MH /a/.

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[4] E&F in fact adopt another option, according to which the C-slot remains unassociated and, like all empty C-slots in the language, is optionally realized as [ʔ] (e.g. [koʁeáni]~[koreʔáni] 'Korean', a word which of course has no historical guttural). However, as they make clear, an alternative account would have [ʔ] realizing a consonantally mapped /a/. Importantly, words like 'Korean' are written with the letter corresponding to BH [ʔ]. As will become clear, the version in the body of the paper is more compatible with the present analysis.

3 Analysis

This analytic chapter is arranged in the following manner. First, I report shortly on the main phonetic difference between stressed and unstressed /a/, namely duration. I then show how this cross-linguistically common correlate of stress has been analyzed in Strict CV. Applying that analysis to the MH facts leads to the conclusion already foreshadowed in the introduction: /a/ *is* in fact realized where it seems not to be realized. I conclude the section by providing a sketch of how the analysis might be extended to historical gutturals other than <ʕ>.

3.1 Phonetic Detail

It has repeatedly been reported that stressed vowels in MH are longer than their unstressed counterparts (Cohen et al. 2018 and references therein). No study, to the best of my knowledge, has checked the intuition of speakers that the consonantally-mapped /a/ completely disappears after [á].

   In order to do just that, I asked 16 speakers (8 women, 8 men, average age 40) to record themselves pronouncing written sentences with the words [katát] (</katáa-t/ 'cut.PST-2FSG') and [ʁatát] (</ʁatat/ 'vibrate.PST.3MSG') in context (i.e., not sentence-final). I found that indeed, there was no difference. In addition, I examined the unstressed vowel of [katát]. I found that **i.** it was, on average, *less than half as long* as the stressed vowel (0.43ms vs. 0.96ms), and **ii.** It was much more often than not pronounced as [ə].[5]

   Extrapolating from stressed [áː] to all stressed vowels, (9) provides a more phonetically-accurate rendition of the data in (1):

(9)   Canonical vs. /a/-final items in MH

	i.'bind'	ii. 'tear'	Template
a. PASS.PRTC	kəʁúːχ	kəʁúː.a	QaTúL
b. "ABLE" ADJ	kəʁíːχ	kəʁíː.a	QaTíL
c. ACT.PRTC.MSG	koʁéːχ	koʁéː.a	QoTéL
d. INF	likʁóːχ	likʁóː.a	liQTóL
e. PST.3MSG	kəʁáːχ	kəʁáː, *kəʁáː.a	QaTáL
f. PST.1SG	kəʁáːχ-ti	kəʁáː-ti, *kəʁáː.a-ti	QaTáL-t

Even though unstressed /a/ is reduced to [ə], I will retain its transcription as [a] in what follows, since this reduction is tangential to the analysis.

   The requirement for stressed vowels to be long is common cross-linguistically. In the next subsection, I show how it has been analyzed in Strict CV analyses of languages other than MH.

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[5] In addition, I found that on average, the vowel was more centralized among women than among men: F2 was much lower in the pronunciation of men (1598Hz) than in the pronunciation of women (1824Hz), while much less difference was found in F1 (525Hz vs. 567Hz resp.). I emphasize that these results are preliminary and await statistical analysis. All of the recordings were made on Smartphones and analyzed by myself. For a more general study see Silber-Varod et al. (2019).

3.2 Stress-to-Length in Strict CV

MH is definitely not the only language to express stress through length. Consider, for instance, the pattern illustrated in (10) with data from another Semitic language, Qaraqosh Neo-Aramaic (Khan 2002). In this language, stress is by and large penultimate. A stressed vowel is pronounced long in an open syllable (10a), but short in a closed syllable (10b). Unstressed vowels are short in natural speech, even in open syllables (10c).

(10)   Qaraqosh Neo-Aramaic non-past 'open'

a. 3MSG	pá:θəχ
b. 3FSG	páθx-a
c. 1PL	paθə́x-na

Larsen (1998) analyzes an identical pattern in Standard Italian by assuming that stress is realized as an additional CV unit, in grey in (11). Whether this "stress CV" is associated to segmental material or not depends on the status of the following nucleus V_2. If V_2 is contentful, as in (11a), then the stress CV can be engaged, resulting in a long vowel; if V_2 is empty (11b), the stress CV remains unengaged.[6]

(11)   Strict CV analysis: Stress is expressed as an inserted CV

Note that length in Qaraqosh, like in MH, is not contrastive; yet it is treated in phonological terms, rather than as the outcome of phonetic interpretation.

The cross-linguistic analysis of stress as an additional skelettal unit has been further refined in Ulfsbjorninn (2014) and Enguehard (2016). Importantly for the present purpose, Ulfsbjorninn has proposed that in cases like (11b), it is possible that no CV is inserted. According to his analysis of similar cases, a stressed vowel must head an incorporation domain (ID), i.e. a domain with a head ($_h$) and a dependent ($_d$) to its right. Assuming that empty nuclei, and only empty nuclei, can be dependents, an additional CV is required only in open syllables (12a). In closed syllables, the following empty nucleus serves as a dependent (12b). IDs are framed in the representations that follow.

(12)   Ulfsbjorninn (2014): insert CV only when it is necessary in order to create an ID.

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[6] See Faust & Lampitelli (2020) for the full analysis of the effects of the stress CV in Qaraqosh.

Ulfsbjorninn's IDs echo, from within Strict CV, the more mainstream idea that stressed syllables must be "heavy", i.e. bi-moraic (e.g. Hyman 1985, Hayes 1995). For a comparison of the two approaches to stress-weight relations, see Scheer & Szígetvari (2005), Faust & Ulfsbjorninn (2018). For the present purpose, Ulfsbjorninn's account is important because it suggests that the skeleton is augmented only when necessary.

MH, to summarize, resembles languages like Italian and Qaraqosh in lengthening stressed vowels in open syllables. Careful phonetic studies are necessary in order to see whether this effect is also true in closed syllables. Since nothing in the present analysis hinges on this fact, I propose to adopt Ulfsbjorninn's proposal and generalize as follows:

(13)   Hebrew Stress
        a. Hebrew stressed vowels must head an incorporation domain.
        b. Incorporation domains cannot be established across occupied C.[7]

Consider now a word like [kaʁáːχ] 'bind.PST.3MSG'. The underlying representation /kaʁaχ/ is given in (14a). Because of (14b), the stressed vowel may not head an ID. As a result, an additional CV unit is inserted to that end (14b).

(14)   The stress CV in MH: additional CV inserted in order to establish ID

a. * k   a   ʁ   á   χ   b. k   a   ʁ   á   χ
      | | | | | | | | ⟍ | ⎤
      C   V   C   Vₕ C   V   C   V   C | Vₕ   C   V_d | C   V   ⎬ [kaʁáːχ]
                                                                             ⎦

The next subsection returns to consonantally-mapped /a/s and their realizations.
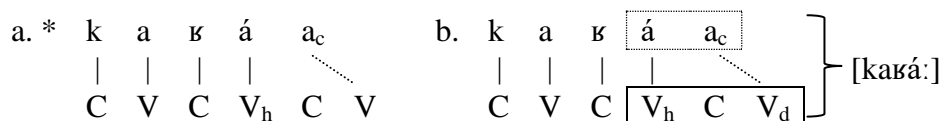

3.3 The [áa] Moment in Modern Hebrew

The interpretation of phonetic length in the previous subsection sheds new light on the ban on [áa] sequences. Consider the initial representation of /kaʁáa/ 'tear.PST.3MSG' in (15a), with the consonantally-mapped /a/ represented henceforth as /a_c/ for convenience. Following E&F's account, /a_c/ is expected to map to the V-slot to its right. As a result, unlike in the case of /kaʁáχ/ in (14), the C-slot following the stressed vowel is *not* occupied. Moreover, the following vowel is identical to the vowel that must head the domain.

I assume that these last two conditions allow for an ID to be established, possibly through the merger of the two /a/s, represented by the dotted frame in (15b). Similar to the case of (12b) above, since no additional CV is required, none is inserted. In other words, as foreshadowed, /a_c/ is not unrealized in this configuration – it is realized as part of the stressed vowel. Importantly, the fact that the two vowels form one domain correlates with the intuition of speakers that they are realized as a single syllable.
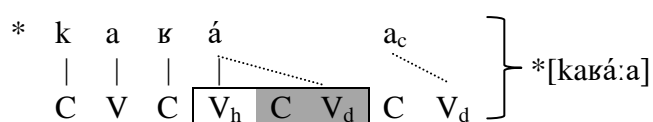
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[7] This assumption derives both the weightlessness of closed syllables in MH and the cross-linguistically common final consonant extrametricality, familiar from moraic analyses (e.g. Hyman 1985, Hayes 1995).

(15)   /áa/ to [á]: no stress CV required, none inserted

a. * k   a   ʁ   á   a_c   b. k   a   ʁ   á   a_c
       | | | | ⋱ | | | |
       C   V   C   V_h   C   V   C   V   C [V_h   C   V_d] — [kaʁáː]
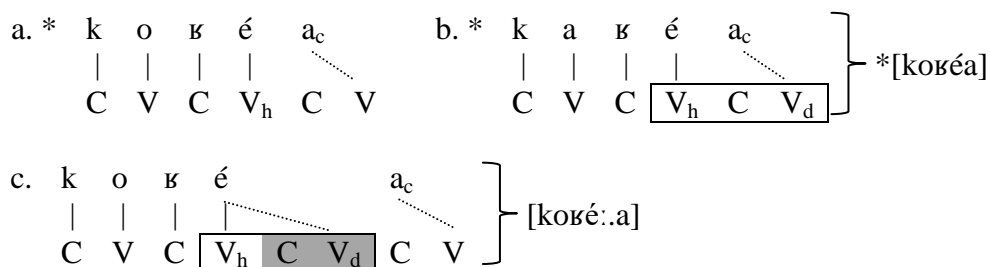
Consider now the representation of the unattested sequence [áa] in (16). There is, in principle, nothing wrong with this representation, except for the fact that it involves an inserted CV where one is not called for. In other words, a sequence [áa] will not be formed because it can be avoided through coalescence, and not because of a ban on trochees with identical vowels.

(16)   Unattested [áa]

* k   a   ʁ   á   a_c
   | | | ⋱   ⋱
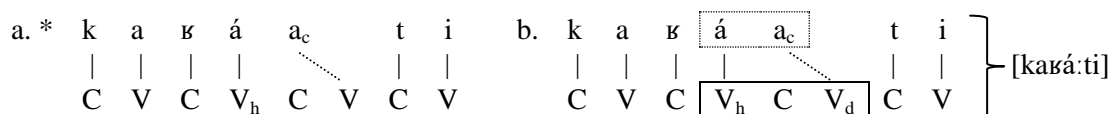   C   V   C [V_h   C   V_d] C   V_d   — *[kaʁáːa]

I will now show that all of the other configurations encountered in the data section conform to the proposal. First, let us examine /a_c/ after a stressed vowel other than /á/, as in [koʁéː.a] 'tear. ACT.PRTC.MSG'. The two vowels at the right edge of (17a) are not identical. Thus, even though the intervening C-slot is empty, they cannot be merged without features being lost. Since they cannot be merged, an ID cannot be formed (17b).[8] As a result, as shown in (17c), **i.** a stress CV must be inserted for the /é/ to head an ID, and **ii.** the resulting sequence is perceived as disyllabic.

(17)   /éa/ to [é:.a]: no merger possible, Stress CV inserted.

a. * k   o   ʁ   é   a_c   b. * k   a   ʁ   é   a_c
       | | | | ⋱ | | | |
       C   V   C   V_h   C   V   C   V   C [V_h   C   V_d] — *[koʁéa]

c. k   o   ʁ   é   a_c
    | | | ⋱   ⋱
    C   V   C [V_h   C   V_d] C   V   — [koʁéː.a]

Forms like [kaʁáː-ti] 'tear.PST-1SG' IN (18) are analyzed just like [kaʁáː]. Two identical vowels merge and allow for the creation of an ID without the need for the insertion of an additional CV.
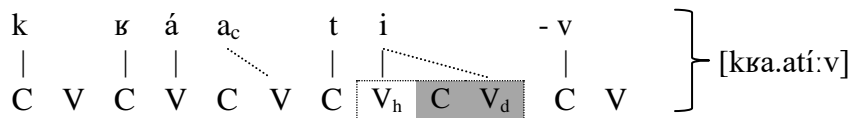
(18)   /áa/ to [á]: no stress CV required, none inserted

a. * k   a   ʁ   á   a_c   t   i   b. k   a   ʁ   á   a_c   t   i
       | | | | ⋱ | | | | | | | |
       C   V   C   V_h   C   V   C   V   C   V   C [V_h   C   V_d] C   V   — [kaʁáːti]

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[8] The ill-formedness of (16b) can be further attributed the lack of real diphthongs in MH: all surface diphthongs are VC sequences.
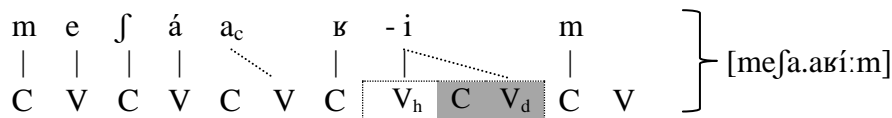
As the reader will recall, it is possible, in a high register, to add object suffixes to verbal stems. Often such suffixation attracts the stress away from the base, leaving behind, in lieu of a single stressed [á], two unstressed ones: [kʁaa-tí:-v] 'tear.PST-1SG-3MSG.OBJ'. This "unpacking" effect is predicted by the present account. Since no domain is created, no merger is expected; the two /a/s in (19) will be perceived as two distinct syllables.[9]

(19)   [á] from /áa$_c$/ alternates with [a.a] due to stress shift

$$
\begin{array}{ccccccccccc}
k & \text{\textbf{ʁ}} & \text{á} & a_c & & t & i & & \text{- v} & & \\
| & | & | & \diagdown & & | & \diagup & & | & & \\
C & V & C & V & C & V & C & \boxed{V_h \;\; C \;\; V_d} & C & V &
\end{array}
$$

$$\Big\rbrace \!\!\!- \;[kʁa.atí:v]$$

This configuration is in fact identical to that of any other unstressed /aa$_c$/ sequence with /a$_c$/ standing in a medial coda position. This is illustrated in (20) for the example [me-ʃa.**a**ʁ-ím] 'PRTC-estimate.ACT-MPL' (cf. /me-ʃagʁ-ím/ 'PRTC-launch.ACT-MPL'). Again, no domain is created, no merger occurs, and the two /a/s are perceived as heterosyllabic.

(20)   /aa$_c$/ to [a.a] due to medial coda /a/

$$
\begin{array}{ccccccccccc}
m & e & \text{ʃ} & \text{á} & a_c & & \text{ʁ} & \text{- i} & & m & \\
| & | & | & | & \diagdown & & | & \diagup & & | & \\
C & V & C & V & C & V & C & \boxed{V_h \;\; C \;\; V_d} & C & V &
\end{array}
$$

$$\Big\rbrace \!\!\!- \;[meʃa.aʁí:m]$$

To summarize, because MH requires stressed vowels to head an ID, a sequence /áa/ will be realized as [á:]; and since no such requirement holds for unstressed /a/, an unstressed sequence /aa/ will remain disyllabic.

A similar case in the evolution of European Portuguese (EP) has been brought to my attention, which is worth mentioning here. Brandão de Carvalho (2011) shows that in the Gallo-Portuguese stressed /áa/ has merged into /á/ in EP (/ma.a/ => /ma/ 'bad.FSG'), whereas unstressed /aa/ has not merged (/kaavejrə/ => /kaavejrə/ 'skull').[10] As in MH, all stressed syllables in EP are heavy (Pimenta 2019), so a similar analysis can be proposed: a stress syllable [á:] can stand for two underlying /a/s, but an unstressed syllable cannot do so. The parallel between the two cases is relevant when considering the alternative analysis in Pariente (2012), namely the principled exclusion of trochees with identical vowels. In EP, penultimate stress is the default case, and trochees with identical vowels have always been ubiquitous in the language, e.g. [kázə] 'house'. As a result, the merger of /maa/ into [má:] cannot be attributed to this rule.

The main challenge to analyses of the ban on *[áa] comes, as already shown in (6) above, from penultimately stressed nouns and participles. Forms like [tá.ar] 'blade' and [meʃagá-at]

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[9] In my preliminary phonetic investigation, I found that unstressed /aa/ sequences are pronounced only slightly longer than a single stressed [á] (120ms vs. 110ms among the 14 speakers who performed both). While some performances of such /aa/ sequences showed a phonetic correlate of disyllabicity (mostly two intensity peaks), others did not. Nevertheless, both quality and length clearly distinguish the unstressed /aa/ sequence from a *single* unstressed /a/, which as discussed is pronounced at around 40ms and as [ə]. It seems that length and [a] quality in unstressed positions are necessarily perceived by speakers as two hetero-syllabic /a/s.

[10] The retention of the underlying hiatus can be seen in that this word is realized [kavéjrə], whereas single unstressed /a/s are regulary reduced: /kaza/ => [kázə]. The realization of two unstressed /a/s as one [a] is general in the language, applying across morpheme boundaries: [kázə] 'house' + [əzul] 'blue'=> [kàza**z**azúl] 'blue house'.

'madden.ACT.PRTC-FSG' seem to be counter-examples. Pariente (2012) discusses such items briefly. Recall that according to Pariente, *[áa] is ruled out by a constraint against identical vowels in a trochee. Citing Bat-El (1989), he assumes that the post-tonic vowel in [tá.ar] and [meʃagá-at] is extrametrical. For this reason, it can*not* be footed in a trochee with the stressed vowel, and so does not violate the relevant constraint.

Consider now the plural forms of penultimately stressed nouns (21). In the position of the post-tonic [e] or [a] of the singular one consistently finds a pre-tonic vowel /a/ in the plural, (again, also realizable as [ə]). Falk (1996) develops an analysis in which this vowel is underlyingly /a/, and is reduced post-tonically to [e] in (21a) (Falk does not treat the data in 21b).

(21) Segholate plurals

		QéTeL					QáaL		
	SG	PL				SG	PL		
a.	téfeʁ	tefaʁ-ím	'stitch'		b.	táaʁ	teaʁ-ím	'blade'	
	kéʁes	kʁas-im	'belly'			káas	keas-ím	'anger'	

In my own work (Faust 2011, 2014), I extended Falk's proposal to the unstressed feminine suffix: it is in fact an underlying /a/. In other words, in both [táaʁ] and [meʃagá-at], the post-tonic [a] is not the realization of the consonantally-mapped $/a_c/$, but rather that of a lexical /a/.

Abstracting away from the specifics of the purported post-tonic reduction, consider now how a sequence like /táaʁ/ is to be represented in the present framework. The $/a_c/$ in such words is in an onset position (22a). Because the onset to its right is occupied, the stressed /á/ cannot form an ID with the following vowel, even though the two are identical. A stress CV has to be inserted as in (22b).[11] The non-reduction of post-tonic /a/ in this case follows from the adjacency of the other lexical /a/s.

(22) $/aa_c/$ to [a.a] due to medial coda /a/

Importantly for the present purpose, once the lexical nature of the second vowel is established, its post-tonic position is not a crucial ingredient of the analysis. The analysis is thus compatible with the desgination of this vowel as extrametrical; but does not require moras or different foot structures for [táːaʁ], [kaʁáː] and [koʁéːa].

3.4 Other Historical Gutturals

In this final subsection of the analysis I would like to mention paradigms with other historical gutturals and briefly comment about their possible analyses. The data in (23) are partly repeated

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[11] Accordingly, I found that sequences like the one in [táaʁ] are longer (144ms) than both unstressed [a.a] sequences and stressed [á] (again, 120 and 110 respectively). They also exhibit two intensity peaks much more consistently than unstressed /aa/ sequences.

from (1). Orthographically, the two new paradigms are also "guttural"-final: (23.iii) is <ħ>-final and (23.iv) is <ʔ>-final.

(23)   More historical gutturals

	i. 'bind'	ii. 'tear'	iii. 'smear'	iv. 'read'[12]	Template
a. PASS.PRTC	kaʁú:χ	kaʁú:a	maʁú:aχ	kaʁú:	QaTúL
b. "ABLE" ADJ	kaʁíχ	kaʁí:a	maʁí:aχ	kaʁí:	QaTíL
c. ACT.PRTC.MSG	koʁéχ	koʁé:a	moʁé:aχ	koʁé:	QoTéL
d. ACT.PRTC-PL	koʁχ-í:m	koʁ.-í:m	moʁχ-í:m	koʁ.-i:m	QoTL-im
e. INF	likʁóχ	likʁó:a	limʁó:aχ	likʁó:	liQTóL
f. PST.3MSG	kaʁá:χ	kaʁá:	maʁá:χ	kaʁá:	QaTáL
g. PST.1SG	kaʁá:χ-ti	kaʁá:-ti	maʁáχ-ti	kaʁá:-ti	QaTáL-t
h. PST.1SG-3MSG.OBJ	kʁaχ-ti:-v	kʁaa-tí:-v	mʁaχ-tí:-v[13]	kʁaa-tí:-v	QTaL-tí-v
i. ACT.PRTC-FSG	koré:χ-et	koʁá:-at	moʁá:χ-at	koʁé:-t	QoTéL-et

The <ħ>-final paradigm is characterized by the same realizations as in (22.ii), with the addition of [χ]. There is nevertheless an interesting difference in the form with the object suffix (23.iii.h): there is no "unpacking" effect once stress is attracted away from the stem [a]. Indeed, it is a general fact about the historical guttural <ħ> that in medial coda position, more often than not there is no additional /a/ vowel.[14]

The <ʔ>-final paradigm exhibits the same realizations as the regular verb in (22.i), except that it seems to lack a final consonant. It is noteworthy in two respects. First, the in medial coda position an additional [a] appears as in the /a/-final paradigm (22h);[15] and second, as shown in (23.iv.i), upon suffixation of the unstressed suffix /et/ to [koʁé:], there is a merger of the base and suffix vowels.

Because these facts are illustrations of much more wide-spread patterns with several other complications, this is not the place to provide a full analysis. However, I would like to suggest here that they might follow from considerations of faithfulness to underlying forms.

For <ħ>-final forms, Both Faust (2005) and Pariente (2012) assume that the third element in the consonantal set of (23.iii) is not only /χ/ but /aχ/. In this sense, unlike in the case of /aᶜ/, it would be "enough" to realize only one of the two segments in order to satisfy faithfulness, whence /mʁaaχtiv/ => [mʁaχ-tí:-v]. It then becomes interesting to ask why the sequence /aχ/ is

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[12] This verb also has several other uses, including 'dub, call, summon'. The passive participle is most common with the meaning 'dub', for which it exhibits the special form [kaʁú:j], rather than [kaʁú:] as in (21).

[13] An epenthetic vowel is realized in this form [meʁaχtí:v].

[14] Forms with an additional /a/ do exist. Still, within the verbal system, the additional /a/ is always optional, e.g. /tsaχku/ => [tsaχaku]~[tsaχku] 'laugh.PST-3PL'. Moreover, there are forms in the inflectional paradigm for which such an [a] seems downright ungrammatical, [t-aχʃev-u] '2-think.NONPST-MPL' but not *[taχaʃevu]; the inverse situation (in which a form *without* an additional [a] is ungrammatical) is unattested. See Faust (2019) for a fuller description.
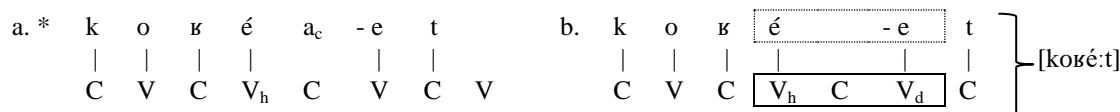
[15] Again (cf. ft. 3), this pronunciation seems to be a property of the high register of *Modern* Hebrew rather than a reproduction of the facts of BH. In the Massoretic transcription of the bible, a stem-final orthographic <ʔ> appears with no symbol below it whether it is followed by a object suffix or not : <קראתי> and <קראתיו> for (22.ii.g and h) respectively.

realized as such in forms like [moʁé:aχ]; answering this question is beyond the scope of this paper.

<ʔ>-final forms have not been addressed to the best of my knowledge by any previous study. The main question raised by these forms is the following. Given that <ʔ> *is* realized as [a] in medial coda position, why is it silent in the word-final position? To explain this, it can be useful to adopt an approach with varying underlying strengths, as in Gradient Harmonic Grammar (Smolensky & Goldrick 2016). Both <ʔ> and <ʕ>-final forms would be lexicalized with an /a_c/, except that in <ʔ>-final forms that /a_c/ would be "weaker". Like the stronger /a_c/, the presence of the weak /a_c/ would be completely lost before another consonant, and so it would have to be realized: /kʁaati/ => [kʁaativ] in (23.iv.g), *[kʁa-tí:-v]. Again like the stronger /a_c/, this weaker /a_c/ would remain unrealized before lexical vowels, e.g (23d), presumably because a syllable boundary still maintains faithfulness to its underlying presence. The difference between the two /a_c/s would emerge in the word-final position: while the stronger /a/ would resist deletion, the weaker one would be deleted.

Finally, forms like [koʁé:t] are especially interesting from the present perspective. The underlying representation would be /koʁéa$_c$-et/, with a weak /a_c/. In the case of [tá:aʁ] above, I assumed that the presence of /a_c/ in the C-slot between the two vowels did not allow them to coalesce into one domain. In contrast, if the /a_c/ in (23.iv) is weaker, it can be made to remain afloat in such cases; if this is true, then the analysis of the ban on *[áa] above in fact extends to /e/. Since the C-slot to the right of /é/ is not occupied in (24a), the two /e/s can merge into one domain in (24b), and are thus perceived as a single stressed vowel.

(24)   /ée/ to [é] through weak /a_c/: no stress CV required, none inserted

Thus, if indeed such an analysis of <ʔ> can be maintained, it would lend a relatively independent piece of support to the present account. Importantly, this confirmation (if it is indeed one) comes exactly from the domain of penultimately-stressed participles, which was claimed to be irrelevant in the competing account in Pariente (2012).

4 Conclusion

I have discussed in this paper the reason for the realization of a single long [á:] where one expects to find [á:a], i.e. a stressed /á/ followed by a consonantally-mapped /a_c/. I proposed that this seemingly fully coalesced realization is allowed by the identical quality of the two vowels, coupled with the need for stressed vowels to head a binary hierarchical domain in the sense of Ulfsbjorninn (2014). In fact, both vowels are realized in this single long [á:]. This pattern is preferable to the insertion of additional skelettal structure, a strategy that is adopted when the two vowels cannot be realized jointly.

I concluded the analytic section with a short discussion of the challenges posed by other historical gutturals. The historical <ħ> is nowadays realized /χ/ and is unremarkable in the internal coda position, yet it still rejects preceding non-low vowels at the stem edge; the

historical <ʔ>, in contrast, is deleted stem-finally, but is realized as [a] in internal coda position. How do speakers encode these regularities in their linguistic knowledge? I intend to pursue this question in future work.

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