

Arabic stress with no moras, no syllables, no feet and no extrametricality

Noam Faust
Université Paris 8, CNRS UMR 7023
noam.faust@univ-paris8.fr

Shanti Ulfsbjorninn
UCL - London
s.ulfsbjorninn@ucl.ac.uk

Abstract This paper continues the effort that began in Scheer & Szigetvari (2005) to present a compelling alternative to moraic accounts of stress systems, framed in the theory of Strict CV (Lowenstamm 1996). For this purpose, the empirical basis of the paper is a stronghold of moraic theory: stress in Palestinian Arabic, with its rich interplay of syllable structure and stress assignment, involving quantity sensitivity, a syllabically-determined stress shift and metrically-conditioned long vowel shortening. Showcasing the innovative grid-based notion of weight incorporation in Ulfsbjorninn (2014), the account provided recognizes only one unit relevant for meter: the nucleus. No appeal is made to moras, syllables, feet or extrametricality. Besides these principled advantages over the traditional moraic account, it is shown that metrical vowel shortening is much more simply explained in the present framework than in the moraic account, and can also explain final vowel shortening. The analysis is also brought to bear on Cairene Arabic, which in our analysis differs from Palestinian in a single parameter setting. Finally, the paper also improves on previous analyses of meter in Strict CV, as for the first time in Strict CV metrics, a computational component is explicitly formalized. Given all of the advantages of the Strict CV account here presented, we submit that this framework, rather than the moraic alternative, should be pursued.

1 Introduction

The stress systems of Arabic dialects have been a fertile bed for theoretical discussion of stress-assignment (see survey in Watson 2011). Moras feature prominently in most analyses. The present paper, in contrast, models stress assignment in Arabic (specifically Palestinian Arabic) without using moras at all. Instead, the only entity that is significant for stress assignment is the skeletal nucleus, which can be either filled or empty. Other features of the traditional account, such as foot and/or consonant extrametricality, syllabified vs. unsyllabified consonants, parsed syllables vs. unparsed syllables, weight hierarchies, feet and recursive/iterative foot construction are also dispensed with. Besides discarding all of these theoretical tools, the analysis is shown to be firstly, as effective as the moraic analysis in describing the difference between the Palestinian and Cairene dialects, and secondly, straightforwardly better than the moraic analysis at explaining Palestinian vowel shortening. The contrast between the ineffective moraic analysis and our own Strict CV approach is so marked that we believe it constitutes grounds for phonological theory to actively pursue the Strict CV approach, and discard the moraic approach along with many of the analytical tools it has developed.

Replacing moras with a nucleus-only framework is a worthy goal for the following reasons. Although moras may be used to formalize syllabification in general, their existence is motivated primarily on the basis of phonological quantity and stress assignment. In contrast, in Government approaches to Phonology, such as Strict CV, nuclei (filled or empty) are an independently-motivated representational device that is required for the syllabification of any language (Kaye et al. 1985, 1990; Charette 1991; Harris 1994; Lowenstamm 1996; Scheer 2004).¹ They are just an ‘ordinary’ part of the phonological skeleton, which may or may not be considered by stress.

It follows that an account based solely on the independently-necessary notion of full and empty nuclei is more economic than one based on moras. Moreover, in moraic accounts, moras

¹ See section 3 for more on the independent motivation of empty nuclei.

are contained under a syllable layer which in turn is dominated by a layer of constituents known as feet; the account in this paper manages to do away with moras, syllables and feet as layers of independent constituents in one fell swoop, thereby making the representation considerably simpler.

The idea that meter is universally projected only from nuclei was first put forth by Scheer & Szigetvari (henceforth S&S) in a paper from 2005. In that paper, the authors demonstrate that a number of systems that have traditionally been regarded as quantity-sensitive can be reanalyzed as fixed-stress systems. In these systems, *Quantity* and *extrametricality* are in fact epiphenomenal and can be interpreted as edge effects. As we will see in the present paper, this point can also be made with respect to some patterns in Arabic dialects. However, a full account of these systems cannot rely solely on reference to edges; the theory in S&S needs to be adapted to include the concept of quantity.

The necessary plug-in was provided in Ulfsbjorninn (2014) in the form of a process of *Incorporation*, whereby the projection from an empty nucleus is incorporated into that of an adjacent contentful one. This proposal effectively derives “true” quantity directly from the skeleton, again with no appeal to moras. As will become clear, Incorporation also manages to express the weight hierarchy in a representational way, rather than by assumption, since Incorporation leads to different weights depending on the skeletal shape of the underlying forms. Because the Arabic stress system discussed here is one with “true” quantity, Incorporation will play a central role throughout the paper.

Before we turn to an exposition of data and theoretical tools, let us survey the structure of the paper, highlighting its main argument once again. In section 2 we introduce the stress facts of Palestinian Arabic. We review the standard moraic analysis and its machinery, and explain why we find this machinery burdensome. In section 3 we introduce and motivate in further detail the framework and theoretical tools mentioned above: the Strict CV model of stress and the notion of Incorporation. Section 4 then provides an analysis of the facts from Palestinian. The analysis is then extended to both Cairene and the phenomenon of vowel shortening in Palestinian, showing that the present proposal fares better than the classic account not only in elegance and in economy of theoretical tools, but also in its predictions: the additional facts fall out of the account, rather than requiring additional complications. Finally, this section also provides the *computational* process that drives projection and stress assignment in our framework. In the conclusion, we assess our proposal. For the first time in this framework, both quantity and computation have been integrated into an analysis of stress assignment in Strict CV. But more importantly for the general public, we have devised an account of quantity-sensitive stress systems that - as we hope will have been clear at this point - is superior to moraic analyses because it does not require reference to moras, syllables, feet or extrametricality, and straightforwardly resolves questions that were thorny for the moraic account. To the extent that our view can be applied to other phenomena that have hitherto been understood in terms of moras, we thus call for a reevaluation of the mora and moraic syllabification as a theoretical tool.

2. Stress in Palestinian Arabic

2.1 The data

This paper will be concerned principally with the stress facts of one Arabic dialect, namely Palestinian Arabic (PA).² The basic facts are summarized in (2). The first of two or three light syllables is stressed (2a). But if the final syllable is a “superheavy” CV:C or CVCC (2b), or the penultimate syllable is heavy CVC or CV: (2c), then that syllable will be stressed. Note that final CVC syllables do not behave like medial CVC syllables, in that they do not attract stress. In HLL (Heavy-Light-Light) words, the antepenultimate syllable is stressed (2d). The dialect also exhibits stress shift, or a “three-syllable window” effect: when another syllable is added to an HLL word and it becomes HLLL, stress is shifted to the antepenultimate L (2e).

(2) Basic stress facts of Palestinian Arabic

a. antepenultimate in LL(L)	nísi	‘he forgot’
	kátabu	‘they wrote’
b. stress to weight I	biḥíbb	‘he loves’
	bis’í:r	‘he becomes’
	tarzám-t	‘I translated’
c. stress to weight II	tarzám-ti	‘You (fm) translated’
	sá:far	‘he travelled’
	tárzam	‘he translated’
d. different patterns in HLL	mádrase	‘school’
	sákkatat	‘she silenced’
e. Stress shift in HLLL	sakkátato	‘she silenced him’

It is impossible to do justice to all the literature that has been written on the topic of stress in Arabic dialects: the reader is referred to the survey in Watson (2011). In that article, one also finds the standard moraic analysis of the facts above, to which we now turn.

2.2 The moraic account and its problems

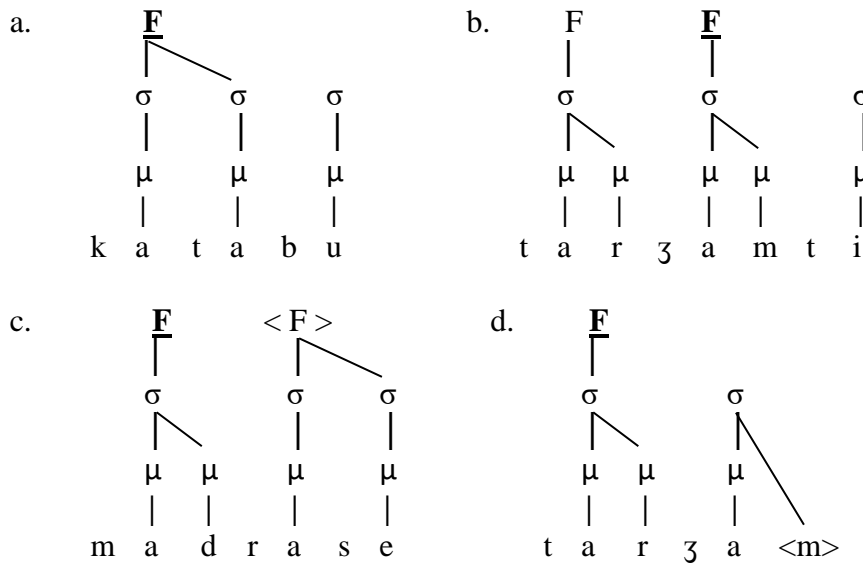
Hayes’s (1995) moraic account of PA remains the classic reference and the most influential account to date. We will now show that this account involves a considerable amount of analytically-problematic machinery. It is important to clarify here that this machinery was not proposed by Hayes ad-hoc for the Palestinian case, but rather argued for at length in the original book on the basis of data from many languages. It is nevertheless impossible, in the present context, to counter all of the arguments in its favor. Instead, we aim here simply to illustrate, through the case of Palestinian, what we regard as problematic in the adoption of these tools, in view of proposing what we consider to be a simpler approach.

To explain antepenultimate stress in [kátabu] ‘they wrote’, Hayes assumes that trochaic moraic feet are built from left-to-right in Palestinian. The final syllable is left unparsed due to an assumed ban on degenerate feet (3a). To capture stress-to-weight, Hayes designates codas as

² By “Palestinian” we refer to the group of dialects spoken in Israel, the Gaza strip and the West Bank by traditionally sedentary populations, to the exclusion of the Bedouin dialects of the same regions.

moraic (and long vowels as bi-moraic). A word like [tarzám-ti] ‘you (fm) translated it’ is parsed with two moraic feet, as in (3b). Stress, according to Hayes, falls on the rightmost foot (this is represented in (3) by a bold underlined **F**). However, this generalization bears a wrong prediction for /madrás/ ‘school’, since this word is predicted to have two feet, and if the rightmost were stressed, one would derive *[madrás]. To explain this fact, Hayes submits that at the right edge of the word feet are extrametrical (<F> in (3c)), so even though stress is supposed to fall on such a foot, that foot is ignored by the computation. Note that in (3b), the final foot is not at the right edge of the word - it is separated from it by the unparsed syllable. Now, if one counts final consonants as codas, one expects a word like /tarzam/ ‘he translated’ to be parsed as [{ta_μr_μ}{za_μm_μ}. Given that the rightmost foot has to be stressed, one wrongly predicts *[tarzám]. To express the fact that the final consonant is ignored in the calculation of stress, Hayes designates final consonants as non-moraic ((3d); the link between the final consonant and the syllable node will be explained presently).³

(3) Moraic analysis of Palestinian Stress (Hayes 1995) I



The tools of final foot and consonant extrametricality generate some serious problems.

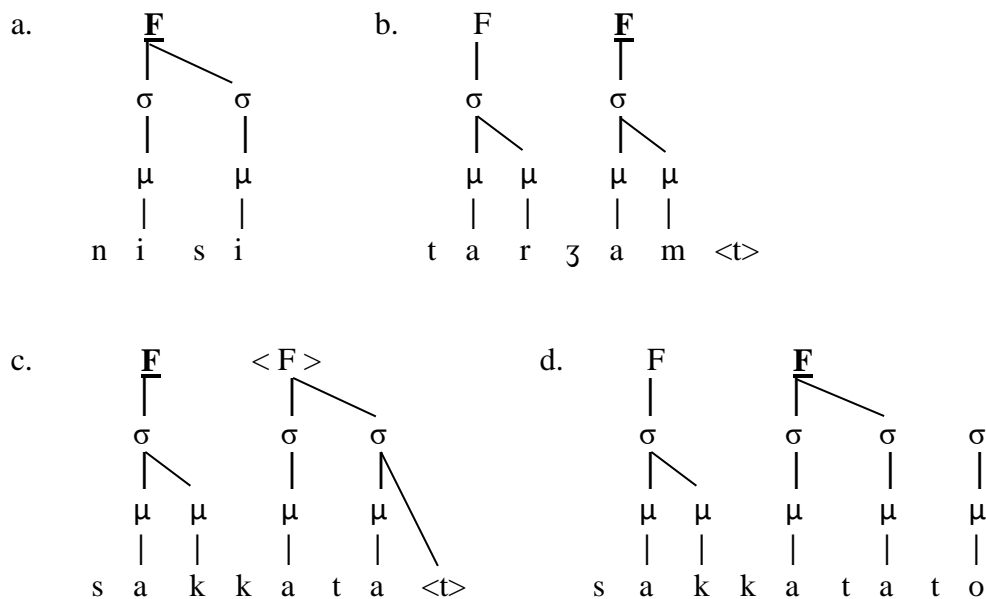
First, words like [nísi] ‘he forgot’ have only one foot, and it is final (4a). It must be assumed that final foot extrametricality is suspended in cases where there is only one foot. This is conceptually problematic as the only reason for suspending foot extrametricality in these cases is that it mispredicts a two-foot minimal word-size. Moreover, there is no independent evidence for a difference between metrical and extrametrical final feet.

Second, words with two moraic feet like [{ta_μr_μ}{za_μm_μ}t] ‘I translated’ (4b) are wrongly predicted to be stressed on the left foot *[tárzam], since the final foot is supposed to be extrametrical. Again we see that many stipulations and a great deal of theoretical machinery must be introduced because the hypothesis would otherwise make a (second) misprediction. The account must stipulate that the final foot of forms like [tarzám] is not extrametrical because it is separated from the right edge by the extrametrical consonant, and therefore isn’t really final:

³ It must also be assumed that moraic codas are obligatorily parsed with their nucleus. A blind left-to-right algorithm would give [{bi_μhi_μ}b_μ], leaving the moraic coda unparsed and wrongly predicting *[bíhibb].

$[[\{ta_\mu r_\mu\}\{ʒa_\mu m_\mu\}\langle t \rangle]$. However, as shown in (4c), words like [sákkatat] ‘she silenced’ also have an extrametrical C at the right edge, and their rightmost foot *is* extrametrical. To account for this, Hayes introduces another stipulation: after CVC syllables, the final consonant is extrametrical and unsyllabified, whereas after CV syllables, a final consonant is extrametrical but syllabified. This notion of varying syllabification is expressed by the link between the final consonant and the syllable node in (4c) and (3d) above, and the absence of such a link in (4b). An advantage of this account is that stress shift falls out of it, as shown in (4d): once a vowel is added to (4c), the rightmost, syllabic foot can no longer be extrametrical; nevertheless, this advantage comes at a great cost in terms of assumptions and machinery.

(4) Moraic analysis of Palestinian Stress (Hayes 1995) II



In (5) we summarize the generalizations of the analysis.

(5) Moraic analysis of Palestinian (Hayes 1995)

- All Codas are moraic.
- The final coda is not moraic.
- Moras and syllables are exhaustively and blindly parsed into moraic feet from left to right.
- A left-over CV syllable at the right edge is unparsed.
- Final moras are ignored if the foot would be degenerate.
- The moras of a single syllable cannot be parsed into different feet (see ft. 3).
- Final consonants are extrametrical but syllabified.
- Final consonants are extrametrical but **unsyllabified** after CVC or CVV.
- The rightmost foot is extrametrical at the right edge.
- The rightmost foot is extrametrical before an extrametrical but **syllabified** final consonant.

- k. The rightmost foot is **not extrametrical** before an unparsed but syllabified CV sequence.
- l. The rightmost foot is **not extrametrical** before an extrametrical **unsyllabified** final consonant.
- m. The rightmost foot is **not extrametrical** if it is the only foot.
- n. Stress rightmost foot.

There are several problems with the analysis described above. First and foremost, there are no less than four separate types of metrical invisibility: i. unparsed final light syllable (CV) ii. foot extrametricality, iii. unsyllabified consonant extrametricality, iv. syllabified consonant extrametricality. Each type is different either because it concerns different constituent, or because it has a different effect. Thus extrametrical consonants and feet both express entities that are ignored by the computation, but concern different constituents. Unparsed syllables and unsyllabified extrametrical consonants are doing the same thing - preventing preceding feet from being extrametrical - but they designate different constituents in different fashions. Unparsed, syllabified final CV sequences are unlike extrametrical, unparsed syllabified consonants in that only the latter allow the final foot to be extrametrical. Unsyllabified extrametrical consonants and syllabified extrametrical consonants have the same object - the final consonant - but a different effect on the preceding foot. Surely, a better analysis, both in terms of parsimony and perspicaciousness, would be one which reduces these different ways of being excluded for stress purposes.

Relatedly, for each of the generalizations in (5), there is at least one exception. Thus, all codas are moraic except the final one (5a,b); moras and syllables are exhaustively and blindly parsed into moraic feet from left to right, unless that would result in a degenerate foot, in which case the mora and the syllable are ignored, or in parsing only one of two tautosyllabic moras (5c-f); final consonants are unparsed but syllabified, except if they follow a heavy syllable (5g,h); and final feet are extrametrical unless they precede an unsyllabified consonant or an unparsed CV sequence, or if they are the only foot (5i-m). The principles are themselves motivated idiosyncratically from the data and most of the assumptions and machinery are introduced due to the mispredictions of other parts of the analysis.

An analysis with less exceptionality would be more compelling.

On another front, while we cannot consider here all of the languages and arguments from Hayes (1995) and subsequent moraic accounts, we *would* like to claim that there is a principled problem with several of the tools that such analyses employ. We will target three of these tools, namely i) moras, ii) extrametricality and iii) unparsedness. Unless these can be shown to be absolutely unavoidable for facts other than stress assignment, all three notions are ad-hoc tools of the formalization of stress facts. Thus, their use in motivating the facts involves the type of an informal logical fallacy known as “begging the question” (a type of *petitio principii*): when an arguer includes all or a part of what has to be proven in the premise of the argument under another guise. For instance, to claim that a coda attracts or does not attract stress because it is or is not moraic begs the question of what proves that it is moraic, and of course the answer to that cannot be whether it attracts stress or not. Similarly, and even more acutely, saying that some constituent is not taken into consideration *because* it is extrametrical begs the question of what, besides not being counted for stress, points to its extrametricality. If no such independent evidence is provided, then the account is merely a restatement of the facts in more technical terms, leaving the issues at hand to be explained. Equally fallacious is the treatment of

“unparsed” stretches such as the final CV in [kátabu]. While there are several ways of deriving this metrical invisibility, such as Hayes’s assumption that degenerate feet are not allowed, this seems to be as insightful as the term “extrametrical”: there is no independent proof that the final CV sequence of such words is unparsed, besides the fact that if it were, the analysis would not work.

Finally, and equally importantly, a general point against moraic accounts is the equal treatment of CVV and CVC as bimoraic. That long vowels are more stressable than short ones is intuitively straightforward - they contain more of the stressable material, namely vowels. But it is much less clear why a coda (and only an internal one) should add to the stressability of a preceding vowel. Moraic codas are a way to encode this, but they do little more than formalize the facts, as opposed to explaining them. An answer to this objection based on Gordon’s (2006:155) calculation of total energy of the rime also begs the question because it *a-priori* assumes that onsets should not be part of the calculation and it has no chance of *a-priori* separating extrametrical from non-extrametrical final consonants.

The asymmetry between long vowels and coda consonants with respect to stress is especially apparent in that while there are many languages (though not Arabic) that systematically lengthen stressed vowels, no language systematically expresses stress by coda-insertion.

We conclude from this section that the classic account of Palestinian stress can be improved. Indeed, most of the tools and notions employed in this account do not seem to have motivation outside that which they are invented to explain. While we cannot claim here to have proven this point convincingly for each and every human language – we’ve only done so for Palestinian – we do assert that the use of these problematic tools in Palestinian is representative of the general practice in linguistic analyses. In section 4 we will see that not one of these analytic tools is a necessary evil. But first we have to present the framework in which they become superfluous.

3 Theoretical framing

3.1 Strict CV and stress

Strict CV (Lowenstamm 1996, Scheer 2004) is a representational framework principally concerned with syllabification. Along with autosegmental theory, Strict CV assumes that phonological representations involve multiple tiers. Of these, relevant for our discussion are the ‘segmental’ or melodic tier, which houses the features, and the skeletal tier, to which these features are associated in various ways (one-to-one, many-to-one, one-to-many). Much like Clements and Keyser (1983)’s CV phonology, the entities found on the skeletal tier are two: C and V. But in Strict CV, as its name suggests, the only skeletal *constituent* is the minimal “syllable”, i.e. the CV unit. This derives a skeleton which is made up of strictly alternating Cs and Vs.⁴

Assuming such a skeleton, all words end in a V-slot which is either filled or empty. The two words in (6) thus have skeletons with the same number of CV units. If the final V-slot is

⁴ The system can be described in terms of precedence: # precedes C, C precedes V, V precedes %.

empty as in (6a), the word will phonetically end in a consonant; and if the final V-slot is filled with features as in (6b), the word will phonetically end in a vowel.⁵

(6) C and V final words end in nuclei (cf. Spanish (Harris and Gussmann 2002))

a. x	a	m	o	n		consonant-final word: [xamon] ‘ham’
b. p	a	l	o	m	a	vowel-final word: [paloma] ‘dove’
C	V ₁	C	V ₂	C	V ₃	

The phonetic interpretation of empty V-slots (such as V₃ in (6a)) must be inhibited. In GP, the force that manages inhibition is called “p-licensing”. For final empty nuclei (henceforth FENs), p-licensing is dictated by the parameter setting in (7a): in some languages (such as Yoruba), FENs are not p-licensed, and therefore must be filled, while in other languages FENs are p-licensed. As can be seen in the Arabic word in (7c), FENs are p-licensed in Arabic: the parameter in Arabic is set to <yes>.

Another aspect of Strict CV that is apparent in (7c) concerns non-final codas. Because the only skeletal unit is CV, phonetically adjacent consonants like [tb] in (7c) are separated at the skeletal level by an empty V-slot. Such nuclei also need to be p-licensed, or else they will be realized. As these are not at the end of the word, the FEN parameter is irrelevant to their silencing. Following Kaye (1990) and Charette (1991), such empty V-slots are permitted only when they precede a filled nucleus. This lateral relation between the two nuclei is called “Government” (Govt); it is defined in (7b). Government is indicated in (7c) by an arrow from the contentful V₃ to the lexically empty V₂.

(7) Empty Nuclei in Arabic⁶

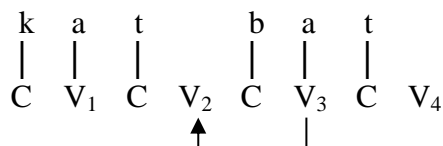
a. FEN parameter

P-Licensed FEN	<no>	Yoruba (no consonant final words)
	<yes>	Arabic (consonant final words)

b. Government

An empty nucleus is governed if it precedes a non-p-licensed nucleus.

c. Arabic example



⁵ Final empty nuclei (abbreviated as FEN) such as in (6a) were inherited into Strict CV from GP. For the empirical arguments see Kaye (1990), which discusses Moroccan Arabic, Kaye et al. (1990), Harris and Gussmann (2002).

⁶ The definitions in (7) describe the conditions accurately, though they are not the original definitions, which are long, baroque and framework-internal. For the original definitions see (Kaye et al. 1990, Charette 1991).

As a consequence of the two environments that empty nuclei inhabit, there are two distinct ways that empty nuclei may become p-licensed: (i) the FEN parameter that applies word-finally (V_4), and (ii) Government that applies word-medially (V_2).

Since Lowenstamm's initial proposal, Strict CV has been used primarily for phenomena having to do with syllabification, such as templaticity and vowel-zero alternations. The notions of medial and final empty nuclei have received ample motivation in the Strict CV literature on syllabification. Scheer and Szigetvari (2005), henceforth S&S, were the first to propose that Strict CV could insightfully model word-stress. In a framework not unlike Idsardi's (1992, 2009) Simplified Bracketed Grid Theory, S&S's model has metrical structure projecting directly from the nuclei or V-slots of the skeletal tier, thereby unifying the metric, syllabic and skeletal levels. In their analysis, while filled nuclei automatically project, empty nuclei do not necessarily do so; their projection is parametrized. Surface-level descriptive statements such as 'a language considers all 'codas' to be metrically significant', or 'all codas are moraic' belong to languages where all nuclei are projected, both filled and empty.

This model of Strict CV stress has one considerable formal advantage over previous models, namely that *the only object of metrical significance is the nucleus*. Moras are out of work in a metric world defined this way; and since this is the only world in which they were claimed to be necessary (rather than convenient), they can be dispensed with.

S&S's proposal also has a typological advantage. In languages such as Spanish, vowel-final words regularly receive penultimate stress [palóma] 'dove' and consonant-final words receive final stress [xamón] 'ham'. Such systems were standardly analyzed as quantity-sensitive with default stress on the penultimate syllable [(pa_μ)_{σ1}(ló_μ)_{σ2}(ma_μ)_{σ3}]. This default stress assignment could be bled by right-aligned heavy syllables where these attracted stress due to their moraicity: [(xa_μ)_{σ1}(mó_μn_μ)_{σ2}].⁷ In contrast, S&S's account reveals that such systems are not quantity-sensitive at all, but rather they have regular fixed stress. Because both words end in a V-slot, all that the algorithm has to do is identify the penultimate nucleus (V_2 in (8)) and designate it as the position of stressed vowel.⁸

(8) Quantity sensitivity reassessed as fixed stress

x	a	m	o	n		C final word: [xamón] 'ham'
p	a	l	o	m	a	V final word: [palóma] 'dove'
C	V_1	C	V_2	C	V_3	

Thus, quantity is reanalyzed as an edge effect. Accordingly, and because it does not appeal to the additional layers of syllable or mora, the analysis is simpler and formally more elegant. S&S go on to discuss stress assignment in Latin. They reanalyze this famous case of quantity sensitivity as yet another (more complex) fixed stress edge effect.

⁷ Another way is to derive such systems within moraic theory is by building a right-aligned trochaic foot on moras. However, because in the standard moraic theory of syllabification there is also a syllable layer, feet cannot be built directly on moras without violating the Strict Layering Hypothesis where each tier/domain/level is properly contained in the next (Nespor and Vogel 1986; Inkelas 1999).

⁸ Governed empty nuclei must be ignored to account for words like [áto] 'tall'. See a very similar discussion for word-final nuclei foot dependents in Harris and Gussmann (2002), Charette (2008).

However, Ulfsgjorninn (2014) shows that not all ‘quantity’ stress systems can be reanalyzed in this fashion. In addition to the pseudo-quantity systems described by S&S, there are also cases of “true quantity”. In Pulaar, for example, syllables of the form CVVC, CVV, CVC and CV can all occur word-medially. Stress in Pulaar is quantity-determined and can be shown to fall on the “heaviest” syllable in the word, wherever it appears in the word.⁹ The heaviest syllable of the word is determined in accordance with the weight hierarchy in (9) (Wiltshire 2006).

(9) Weight hierarchy for Pulaar

$$CVVC > CVV > CVC > CV$$

Because stress is quantity-determined and falls on any syllable in the word, a system such as Pulaar cannot be derived solely by reference to edges.

To account for true quantity systems, Ulfsgjorninn (2014) introduces two main components to the framework initiated in S&S: 1) a grid-based theory of projections and 2) Incorporation. In this metrical framework, nuclei are classified according to their projection potential. Universally, filled nuclei are stronger than empty nuclei, the latter are empty and can never *host* stress. Lexically-filled nuclei project to Line 2, while empty nuclei only project to Line 1. Long vowels are a consequence of vocalic melody spreading to a dependent V position, which also only projects to Line 1. To illustrate this, consider CVV and CVC sequences such as [ba:l] and [bal] in (10a).¹⁰ Their skeletons consist of three CV units for [ba:l] and two for [bal]. In both cases, it is the first nucleus (V₁) that is the filled head and both structures also contain an empty or dependent nucleus (V₂). In accordance with the universal projection conditions alluded to above, V₁ projects to Line 2, while the empty nucleus (V₂) only projects to Line 1.

(10) Projection in systems with “true” quantity

a. Underlying CVV vs. CVC

C	V ₁	C	V ₂	C	V ₁	C	V ₂
b	a			b	a	l	

b. Projection, filled to Line 2, empty to Line 1

L2		*				*			
L1		*		*		*		*	
0	C	V ₁	C	V ₂		C	V ₁	C	V ₂
	b	a				b	a	l	

⁹ In cases of a tie, the leftmost syllable is stressed.

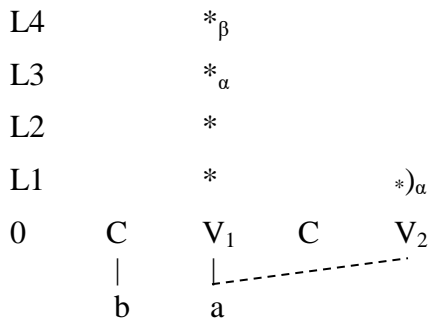
¹⁰ The rest of the word does not concern us here.

The key mechanism in Ulfsgjorninn (2014) is Incorporation, which handles the metrically projected word-medial empty nuclei (V-slots that project to Line 1). Incorporation consists of labeling these empty V-slots as dependents of filled nuclei; then reassigning their projective power into the projection of the head. As a result, the incorporating head gains one level of projection (promotion to Line 3).

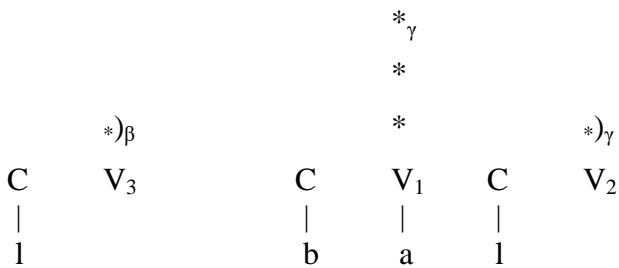
In Pulaar, Incorporation runs from left to right, and filled nuclei incorporate any empty nuclei to their right. Therefore, in the structure in (11a) that models a CVVC ‘syllable’ ([ba:l]), the two empty nuclei of [ba:l] are incorporated into the projection of the filled nucleus to their right. Therefore, the incorporating head (V1) gains two degrees of projection and ends up on Line 4. Meanwhile, in the structure that models a CVC [bal] (11b), there is only one empty nucleus to incorporate and so the incorporating head can only project to Line 3.

(11) Incorporation of “true” quantity

a. CVVC [ba:l]



b. CVC [bal]



Pulaar stresses the leftmost heaviest syllable (cf. (9)). If the structures [bal], [ba:l], and [ba] were to form a single word [balba:lba] (CVC.CVVC.CV), then it would be the CVVC that gets main stress, despite CVC being a heavy syllable at the left-edge of the word. This is because the incorporating head of [ba:l] projects higher than the incorporating head of [bal].

Incorporation within Strict CV can be regarded metaphorically in the following two ways. Unlike contentful nuclei, ENs have no way of exhibiting their metrically-projected status on their own; this results in their incorporation into the head of their preceding contentful nucleus, thereby signaling their presence. Alternatively, one may say that while such ENs do have weight (since they will be realized unless they are governed), this weight must be “identified” (Faust and Torres-Tamarit 2017), and identification is achieved by the mechanism of Incorporation. Therefore, the motivation for incorporation appears to be the identification of empty but metrically-significant positions and the consequence is a gain in projection for the incorporating head.

There are several formal advantages to Ulfsgjorninn’s proposal. First, in moraic theory, weight could be contributed by either long vowels or codas. In this proposal, phonological quantity comes about only through the incorporation of empty nuclei: as in S&S, *the only object of metrical significance is the nucleus*. Second, and as a result, the weight hierarchy of any language does not need to be separately listed in the grammar, for instance, Pulaar’s weight hierarchy (cf. 9) is fully derived by Incorporation. Satisfyingly, incorporation will lead to different projection outcomes depending on the shape of the input; from this, stress can be mapped directly: the highest projecting head maps to primary stress. This way, true quantity is

ultimately just another consequence of what stress always is: projection. Third, the proposal shows squarely that moras are unnecessary even for those systems that were left out by S&S, namely the clearly quantity-sensitive systems. Such systems can no longer constitute a valid objection to the abolition of moras in S&S.

The final advantage of this marriage between a grid theory of projections and Strict CV concerns the difference between FENs and ENs, which as we saw was independently-motivated in Strict CV. If this difference can be identified as a representational one regarding nuclei, it can also be parametrized for the purposes of stress-assignment. This is the starting point of the next section, where Incorporation, projection and empty nuclei feature in a non-moraic analysis of that stronghold of moraic theory that is Arabic stress.

3.2 Projection, Incorporation and empty nuclei in Palestinian Arabic

As we discussed in the previous section, once moras are traded for empty nuclei, *consonants never count for stress purposes*. Only nuclei do. There are three types of nuclei: (i) contentful nuclei; (ii) empty nuclei, i.e. nuclei that would be realized if not for government; and (iii) FENs, i.e. nuclei that are allowed to remain unassociated even though they are not governed. Therefore, crucially, the status of final consonants and internal codas is different. Final consonants are C-slots preceding a parametrically p-licensed empty nucleus, while internal coda consonants precede a governed nucleus.

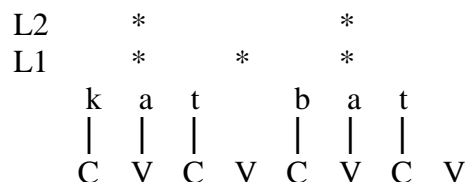
Projection parameters can exploit this distinction and refer to FENs independently from medial empty nuclei – enforcing different conditions on the projection of FENs and ENs. For the calculation of stress, a language may count FENs or it may not, and it may count ENs or it may not. We propose to formalize these choices with the two parameters in (12). The setting of the parameters for Palestinian Arabic is underlined:

- (12) Proposed parameter of metrical projection and their settings for Palestinian Arabic
- a. Governed EN are metrically-significant: <yes, no>
 - b. FENs are metrically-significant: <yes, no>

We further assume that all metrically-significant nuclei project to Line 1. Accordingly, as originally proposed by Charette (1984), when the parameter in (12b) is set to <no>, this effectively produces extrametricality: if the FEN is not metrically significant, the final consonant would *seem* to be extrametrical, whereas medial coda consonants will not be affected. When this parameter is set to <yes>, one derives the cross-linguistically recurrent pattern of final stress in consonant-final words and penultimate stress in vowel-final words (e.g. regular stress in Spanish as shown in (8)).

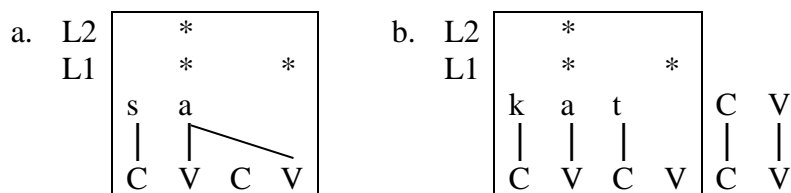
Now consider the representation of the Palestinian [katbat] ‘she wrote’ in (13). Because the parameter in (12a) is set to <yes>, the governed empty nucleus projects once (to Line 1), while contentful nuclei project twice (to Line 2). As can further be seen in (13), the FEN does not project at all, because the parameter in (12b) is set to <no> in Arabic. Again, the final consonant *seems* extrametrical, where in fact it is irrelevant for stress purposes.

(13) The projections of ENs, FENs and contentful nuclei in a grid-based approach



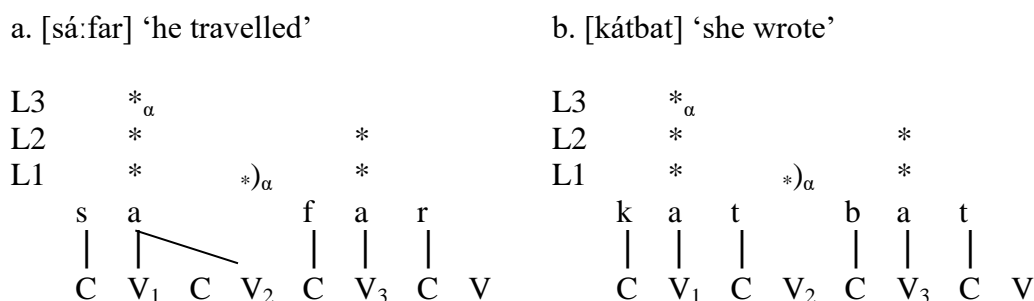
Palestinian, like Pulaar, treats CVC and CVV syllables on a par (as contributing weight). As already discussed, this was a problem of the traditional view, because there was no reason to equate codas and long vowels, besides the empirical support. But just like in Pulaar, given the parameter setting of Arabic, the Strict CV view described here does not face that problem: in both long vowels and closed syllables there are two consecutive metrically-significant nuclei, as shown in (14).

(14) Long vowels and closed syllables are metrically equivalent



As described in the previous section, in quantity-sensitive systems, representation such as (14a,b) trigger a process of Incorporation. This is the case in most Arabic dialects. Thus, the projective power of the governed EN is incorporated into the projection of the preceding V-slot, as shown in (15). As a result, the incorporating nucleus projects again, thrice into Line 3. Note that unlike in Pulaar, FENs do not project at all (cf. parameter setting in 12b), and therefore V_1 projects higher than V_3 and attracts stress.

(15) Incorporation in Arabic



At this point we can already point out several merits that our approach to Arabic stress shares with previous metrical accounts in Strict CV, but that are not shared by moraic approaches. First, our approach does not require the logically fallacious moras (cf. section 2.2.). Second, no syllables or feet are necessary, and consequently no different treatments of monosyllabic and bisyllabic feet. Third, our approach obtains extrametricality from an independently necessary

distinction of the theory, namely ENs vs. FENs. Fourth, it has only one type of phonological entity that is relevant for stress assignment, namely the nucleus (vs. both vowels and moraic consonants or syllables in the traditional analysis). And most importantly, this last advantage provides motivation for the parallel between long vowels and non-final closed syllables, and may even be explanatory with respect to why such (phonetically-different) syllabic configurations (CVV, CVC) and not others (CV) are those that attract stress.

Having said that, these are just the basic facts of Arabic stress. In the next section, a fuller analysis of the Palestinian data is provided, as well as extensions to Cairene and the phenomenon of metrical vowel shortening.

4 A Strict CV Metrical account of Palestinian and Cairene

4.1 The basic pattern

In the previous subsection, we saw that FENs in Arabic do not project at all, whereas ENs project to Line 1 and contentful nuclei project into Line 2. We will now use these facts in order to account for the entire data set of Palestinian Arabic.

In the data section, we saw that Palestinian exhibited stress shift, reflecting the cross-linguistically recurrent observation of a “three-syllable window” restriction. We propose to build this requirement into the algorithm as in (16a) on the basis of Line 1 projection, effectively establishing a domain of stressability. Note that our “window” is not based on vowels, but on metrically-significant nuclei (henceforth MSN), i.e. in PA both contentful nuclei and ENs, to the exclusion of FENs. We saw further that heaviness is a result of a V slot projecting to Line 3 as a result of Incorporation. Incorporating V slots are thus inherently stronger than simple contentful ones, which have no independent reason to project to Line 3. We assume that Line 3 is the (minimal) locus of main stress (16b).¹¹ As a consequence, incorporating vowels within the window will immediately be assigned stress. In the absence of incorporating vowels, no vowel fulfills the requirement of projecting to Line 3. We propose that in this case, (16c) holds. Our algorithm therefore singles out as problematic cases like /mak_tabā/, where the EN is the leftmost MSN. ENs cannot be stressed. In Palestinian, this is resolved as in (16d), by retracting the stress one syllable to the left, outside of the stress window.

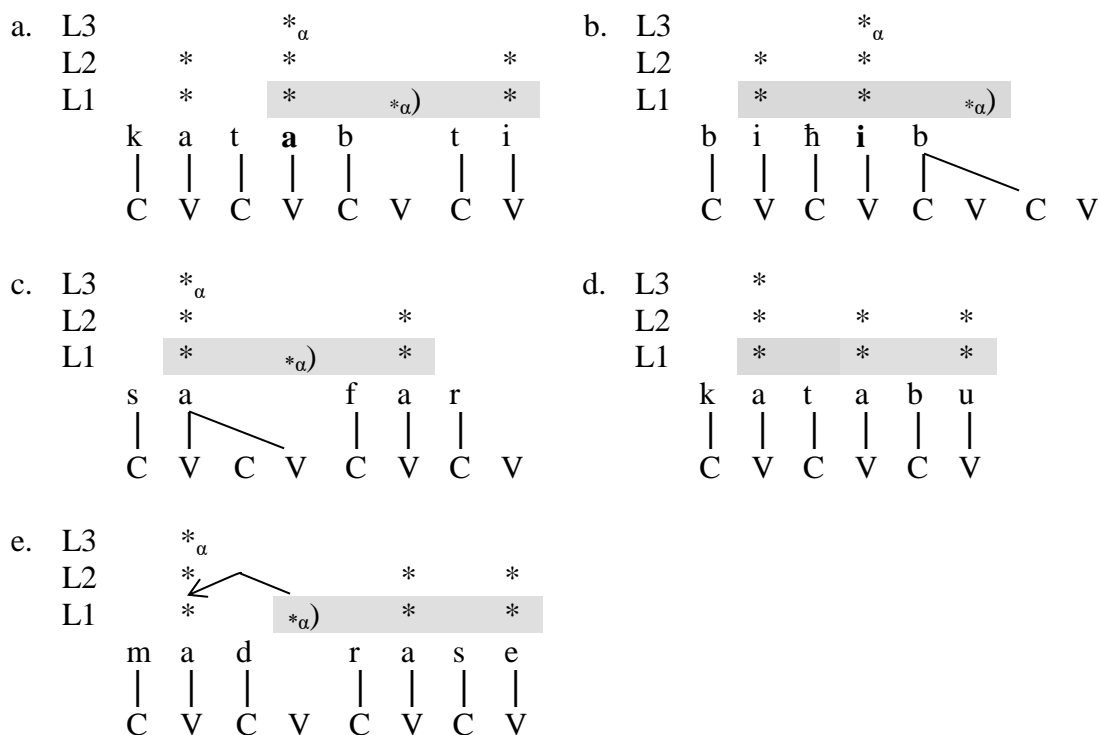
- (16) Algorithm for Palestinian Arabic
- a. Define window among last three Line 1 projections.
 - b. Establish head on a Line 3 projection
 - c. In the absence of a Line 3 projection, projects onto Line 3 the leftmost MSN and make it head (kátabu).
 - d. If that is an empty nucleus, stress the preceding MSN (preantepenultimate: mádrase)

Let us now illustrate this algorithm with real examples. The three-MSN window on Line 1 is shaded in all the examples below. In (17a-c), the incorporating vowels (in bold) within the window are stressed, because they fulfill the requirement of having a Line 3 projection. In a form

¹¹ This is a principled assumption because all filled V-slots universally project to Line 2, therefore to achieve prominence over equally projected V-slots, a V-slot must minimally project to Line 3. Line 2 is then left for secondary stress. Note that Line 1 could not play that role, because even ENs project onto Line 1.

with no incorporating vowel, such as (17d), a projection is added to the first MSN in the window. As a result, this vowel is stressed. However, if that first MSN does not have content, as in (17e), it cannot serve as a bearer of main stress. The solution proposed for Palestinian is to attribute the additional projection to the preceding, preantepenultimate MSN, as depicted by the arrow. Of course, this is not the only solution to the problem - we will see below that the Cairene dialect has another solution.

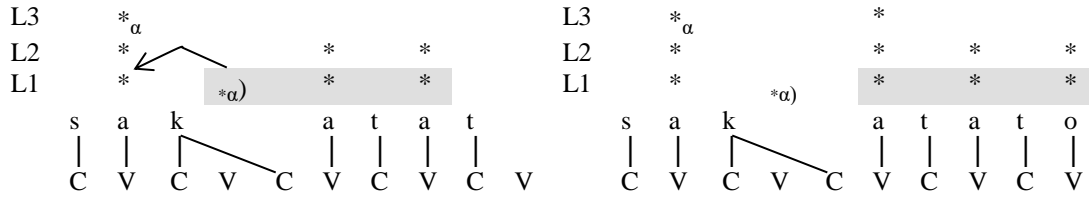
(17) Examples from Palestinian



The phenomenon of stress shift in Palestinian follows directly from our window-based analysis. As (18a) shows, the base /sakkatat/ ‘she silenced’ is analogous to /madrase/ ‘school’ in (1e): the first MSN in the window may not be stressed and so stress is retracted. But once the object marker is added, the first MSN in the window becomes eligible for stress-bearing. Stress appears to have shifted rightwards.¹²

¹² Stress shift may also be described as the result of a pressure not to leave a long unstressed stretch at the right edge of the word. In this case, the present account would quantify “long” as three MSNs on L1. Still, note that such a view only defines the problem, not the solution. The present account derives both the problem and the solution: in both the original and the shifted cases, stress is on the leftmost MSN of the window.

(18) Stress “shift” in Palestinian: [sákkatat] ‘she silenced’ vs. [sakkátato] ‘she silenced it’



In section 2.2, we examined the classic account of these facts and saw how it required no less than four types of extrametricality and the introduction of several notions that were not independently motivated. In our analysis, stress in Palestinian - not just the basic parameters - can be explained without moras, without unparsed constituents and without unmotivated extrametricalities of feet, consonants and syllables, using only nuclei as MSNs.^{13,14} Insofar as these tools and distinctions are problematic, we contend that our account is preferable to the traditional view. We note further that our account entirely dispenses with both syllables and feet, thus rendering it even more economical. In the next two sections we discuss other aspects of the comparison between the two accounts.

4.2 A note on Cairene and on windows

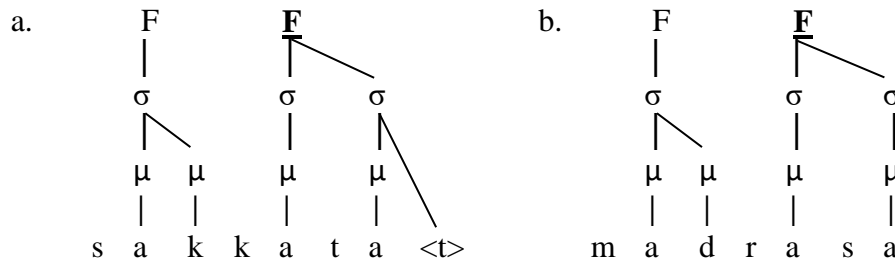
One merit of Hayes’s account, on which he capitalizes, concerns the Cairene dialect. This dialect, studied in depth in Watson (2002), is minimally different from Palestinian in the following way. While LLL words are stressed antepenultimately as in PA [kátabu], HLL words are stressed on the penult in Cairene [sakkátat], [madrása], unlike the PA [sákkatat], [mádrase]. Under Hayes’s analysis, this can be reduced to a parameter setting: all one needs to say is that unlike in Palestinian, the rightmost foot is never extrametrical in Cairene. The representations of these words in Cairene are therefore as in (19): the LL foot, being rightmost and not extrametrical, is stressed:¹⁵

¹³ Enough of our account is laid out now to mention a predecessor. Yoshida (1993) includes an appendix with a preliminary account of Palestinian stress in CVCV. His algorithm is simply “stress the antepenultimate nucleus”, counting the FEN. But this makes the wrong prediction for /sakkatat/ => *[sakkátat]. In Cairene, where as we will see [sakkátat] is the correct form, the account would fail in explaining [kátabet].

¹⁴ This is of course not a complete account. At least since Kenstowicz & Kisseberth (1979), Palestinian has been famous for issues relating stress and epenthesis. Epenthetic vowels are ignored by stress even when they create a closed syllable. For instance, the [e] of certain verbal forms like [yí-ktēb] ‘that he write’ gets syncopated before vowel-initial suffixes, leaving behind a triconsonantal cluster *[yí-ktb-u]. This is repaired by epenthesis between the first two stem consonants [yí-ktbu]. In our framework, such facts can be covered by having the stress algorithm not apply to empty nuclei that come to be non-p-licensed ENs (and *phonetically* interpreted). We do not develop the account here because in our opinion this analysis is neither an advantage nor a disadvantage of our framework as compared to competing accounts (rule ordering etc...).

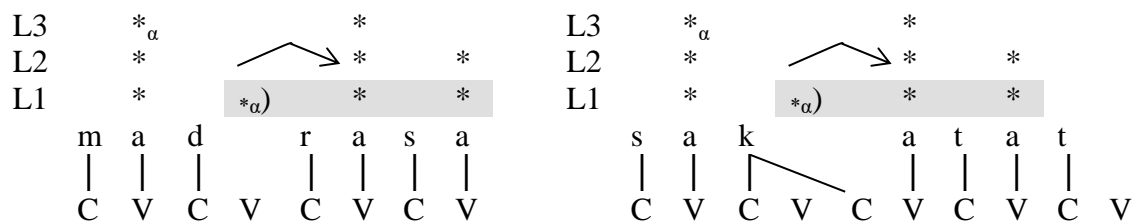
¹⁵ Fathi (2013) develops an account of Cairene stress in which it is claimed that stress is simply penultimate. Forms like [kátabu] are represented as having only one underlying /a/ that branches onto the two stem positions. Thus, this form is in fact stressed on the first copy of the penultimate vowel. In order to falsify this analysis, one would have to find examples of CVCVCV words with antepenultimate stress and different first and second vowels. The verbal system does not present such cases, but this is probably due to independent factors.

(20) Cairene penultimate stress in HLL in a moraic account



This is indeed an elegant aspect of the moraic, extrametrical account. However, it hardly constitutes an advantage over our own account. As we saw in the previous subsection, precisely words like [mádrase] and [sákkatat] called for a specific repair in Palestinian, because the algorithm placed stress on an EN. In Palestinian, the repair was to retract the stress one MSN to the left. In order to account for the Cairene facts, all one needs to do is parametrize this choice: in Cairene, the same problem is resolved by advancing the stress one MSN to the *right*.

(21) Stress protraction in Cairene (cf. Palestinian retraction in 14e)



The algorithm for stress assignment in Cairene is given in (22). It is minimally different along a single parameter in our account too, and so this cannot be regarded as an advantage of Hayes' analysis over the one presented here.

(22) Algorithm for ~~Palestinian~~ **Cairene**:

- Define window among last three Line 1 projections.
- Establish head on a Line 3 projection
- In the absence of a Line 3 projection, projects onto Line 3 the leftmost MSN and make it head (kátabu).
- If that is an empty nucleus, stress the **preceding** **following** MSN (preante**penultimate**: madrása)

If so, Palestinian moves the stress to the vowel that incorporates the projection of the unstressable MSN, at the cost of exiting the window; Cairene prefers to remain within the three MSN window, at the cost of stressing an MSN which is not related to the first MSN of the window in any way.¹⁶

¹⁶ Watson (2011) mentions several facts about Cairene that are exceptional. For instance, some LLL nominal plurals are stressed on the penult, e.g. [wazɪra] ‘ministers’; and some LLL sequences are stressed on the penultimate vowel [katab-ét-ak] ‘she wrote you’ (example from Fathi (2013)). These can be accounted for equally well in both competing accounts and for this reason will not be discussed here.

Another element that moraic accounts such as Hayes's may boast is their treatment of windows and stress shift. Indeed, once all of the parameters of the analysis are set, no reference to counting is necessary, and stress shift does not require a window to be defined. Our account, in turn, appears to be stipulative, as it does not derive the window from anything. However, we submit that this is an illusion: important aspects of the moraic account are just as stipulative as our proposal on this issue. The element doing the work of the window alignment in Hayes's account is "stress rightmost" (5n above). It expresses the generalization that once all of the potential stress peaks have been established, the algorithm seeks the one that is closest to one edge rather than the other. But of course the choice of the edge does not follow from anything: it is equivalent to stating that a certain edge matters, while the other doesn't. This is exactly what the window alignment does in our analysis. If so, in both systems, an edge is arbitrarily assumed. Now, in Hayes's system, the placement of stress at a certain distance from this arbitrarily-designated edge follows from the interaction of several other stipulations, called "parameters", such as the direction of feet-building, the possibility to leave feet unparsed and the claim that feet are trochaic. But it is very unclear to us whether this is any less stipulative than simply saying "leftmost within the window of 3 MSNs". For a discussion of a way to derive the three syllable window without feet, see Kager (2012).¹⁷

If so, the moraic account does not fare better than the one proposed here in terms of inter-dialectal comparison. It is furthermore debatable that the way that the moraic account derives the window is less costly than simply stipulating that window, as we do in our account. In the next subsection we will see a case from Palestinian in which an Incorporation-based account has a clear advantage over the moraic view.

4.3 Vowel shortening in Palestinian

4.3.1 Metrical vowel shortening

Abu-Salim (1986) provides an interesting set of facts from PA which we claim are much more neatly accounted for in our approach than in the moraic approach he endorses. The issue is therefore important in the context of this paper. In this subsection we compare the two approaches.

The data are presented in (23). They present the following generalizations. Long vowels in open syllables shorten before stressed vowels in heavy syllables (23a.iii., 23b.iii). But long vowel do *not* shorten if they are in closed syllables (23b.ii), or when they are separated from the stressed vowels by a short vowel in an open syllable, whether unstressed (23c.ii) or stressed (23d.ii).

¹⁷ Interestingly, for reasons that are internal to Optimality Theory, Kager ends up rejecting the grid-based window and adopting weakly layered feet. Needless to say, we cannot share that conclusion; it is also far from consensual among linguists that do employ feet and moras in their analyses. Moreover, Kager replaces the concept of windows with ternary feet. But ternary feet are as controversial as windows, and therefore no better than windows as a primitive of the analysis.

(23) Vowel shortening in Palestinian

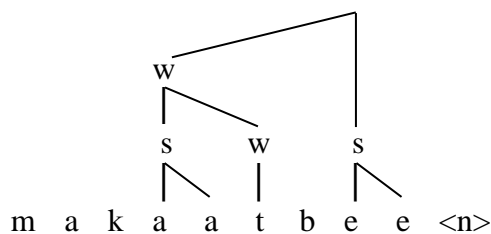
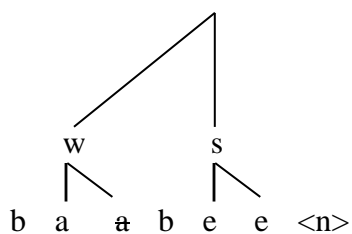
- | | | | | | |
|-------|---------------------------|---------------|-------|------------|-----------------------------|
| a. i. | bá:b | ‘door’ | c. i. | mó:lad | ‘birthday’ |
| ii. | bá:b-o | ‘his door’ | ii. | mo:lad-é:n | ‘two birthdays’ |
| iii. | bab-é:n | ‘two doors’ | d. i. | ká:tabat | ‘she corresponded’ |
| b. i. | maká:tib | ‘offices’ | ii. | ka:tábat-o | ‘she corresponded with him’ |
| ii. | maka:tb-é:n ¹⁸ | ‘his offices’ | | | |
| iii. | makatíb-na | ‘our offices’ | | | |

Abu-Salim’s analysis is presented in (24), abstracting away in the representation from moras and syllables (as Abu-Salim does, while openly assuming them). The main claim is that a long vowel cannot survive under a weak branch (labeled “w”). In (24a), stressing the rightmost foot places the long vowel in such a position, and so the vowel reduces (as represented by the barred *a*). In (24b), in contrast, since the internal coda is syllabified with the preceding long vowel, that vowel has its own label “s”. It is not in a directly weak position and thus does not shorten.¹⁹ The same rationale protects the long vowel in (24c), although as we will see this representation is more problematic. A bigger problem is (24d), where the algorithm wrongly predicts shortening (23d.ii above).

(24) Vowel shortening in a moraic account (Abu-Salim 1986)

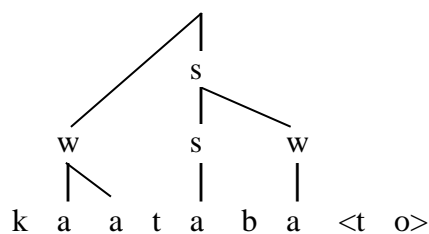
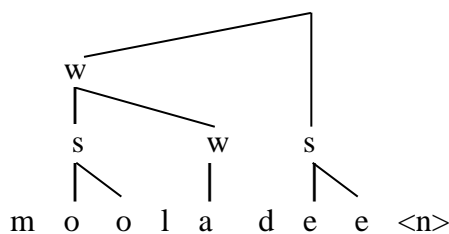
a. /bá:b-e:n/ => [babé:n]

b. /maká:tib-e:n/ => [maka:tbé:n]



c. /mó:lad-e:n/ => [mo:ladé:n]

d. /ká:tab-at-o/ => *[kátabato]



Before we address (24d), one might already point out that (24c) is inconsistent with Hayes’s account: it foots HL in one constituent, creating an uneven trochee, a configuration which Hayes

¹⁸ This form, like all cases of long vowels in non-final closed syllables, involves syncope of the base’s short /i/.

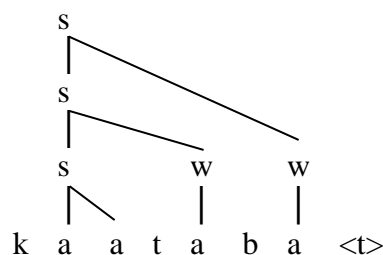
¹⁹ We’ve not yet seen the syllabification of long vowels in closed syllables under a moraic account. The representations in (24b) involves an uneven trochee, which Hayes would not accept. Yet he does not discuss such cases in Palestinian. On (24c) see main text.

explicitly avoids. Moreover, note that the account requires reference to labels on feet and recursive/iterative footing.

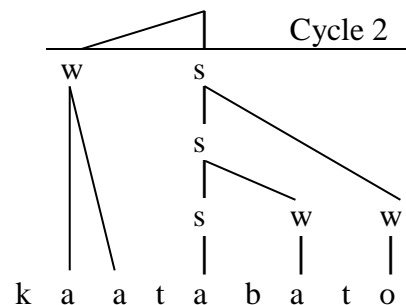
In order to explain the resistance to shortening in (24d), Abu-Salim proposes a cyclic derivation. The base [ká:tabat] ‘she corresponded’ is first computed, and [a:] is in a strong position (25a). Then, with the addition of the object suffix, a new cycle begins (25b). There is re-footing, during which [ka:] remains long. The shortening rule does not work on the 2nd cycle, so while [ka:] will indeed be under a weak label, it is not shortened.

(25) Resistance to shortening under a bicyclic approach (Abu-Salim 1986)

a. /ka:tabat/ => [ká:tabat]



b. [ka:tábat]/+o/ => [ka:tábato]



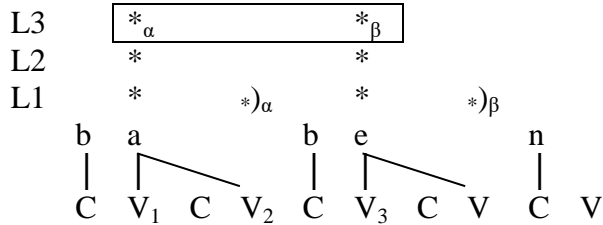
To the problematic aspects in (24) one may now add: (i) the essentially ternary (or nested) footing in (25), completely inconsistent with Hayes’s account, and (ii) the brute force tool of not applying a rule in a second cycle. In addition, the bicyclic effect in this account cannot be reduced to the inalterability of the structures of the first cycle - these crucially have to change for stress to shift in this account. Finally, while a bicyclic account seems to make sense for [ka:táb-at-o] ‘she corresponded with him’ because of the syntactic complexity involved, note that a very similar level of syntactic complexity is involved in the possessive construction, too, and we have seen in (23b.iii) above that this configuration does bring about shortening.

While it is true that Abu Salim’s account is not Hayes’s, and that perhaps Hayes’s account could cover the facts in a less ad-hoc manner, no such extension of Hayes’s account exists (to our knowledge), and it would be an empty exercise to construct one here. Nevertheless, one might assert that Hayes’ account would run into difficulties with the data above because it does not attribute different strengths to monosyllabic and bisyllabic moraic feet, and the phenomenon is clearly sensitive to that distinction: the vowel shortens before a stressed heavy syllable, but not before a stressed light one. We will now present an account of these data in our own framework.

The main insight of Abu-Salim’s account is that /ba:be:n/ ‘two doors’ is problematic because it involves equal prominence. Crucially - and this is ignored by Abu-Salim - the problem of equal prominence is determined without reference to main stress. Indeed, in the pronounced word, the final vowel would be more prominent by receiving main stress, and there would be no conflict. Consider now the representation of this word in our approach before main stress assignment (26). As can be seen by the frame, both vowels project to Line 3, creating a clash.

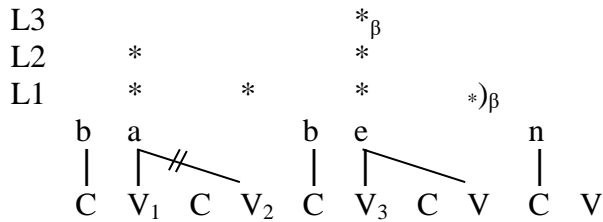
Note that the intervening MSN V_2 does not prevent the clash: its only projection is incorporated in the preceding MSN.²⁰

(26) Vowel shortening: the problematic form as clash



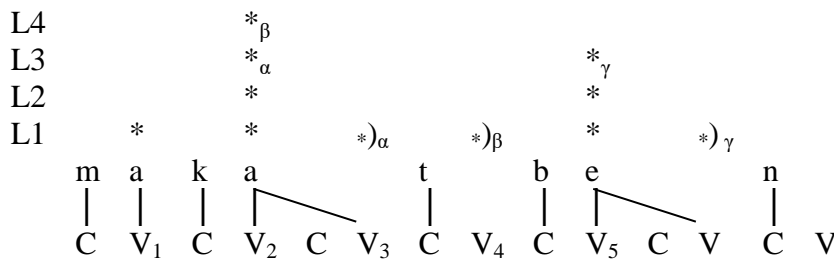
We claim that the clash in (26) is avoided by undoing the incorporation of V_2 . This undoing has a segmental effect. It appears that in Palestinian vowels can only become long by spreading into *an incorporated position*. Since the position is not incorporated metrically, it cannot be identified by segmental spreading. Because the vowel does not spread to V_2 , the result will be a short vowel associated only to V_1 .

(27) Vowel shortening: Clash, no incorporation, no spreading into unincorporated position



To support our proposal, we will now show that none of the other words considered by Abu-Salim raises the issue of clash as defined here. First, consider the way a long vowel in a closed syllable would be represented in our approach (28). According to the incorporation principle (which applies from left to right), and like in the Pulaar example in (11), both ENs V_3 and V_4 will be incorporated into V_2 . As a result, even though there is no separation between V_2 and V_5 - both ENs have been incorporated - there is no equal prominence: V_2 projects higher than V_5 .

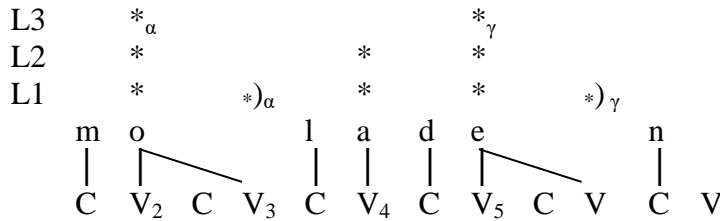
(28) No vowel shortening in closed syllables: double incorporation, no clash



²⁰ The same clash arises before non-final CVC under our view, as in /makɑ:tib-na/ => [makatibna] 'our offices'.

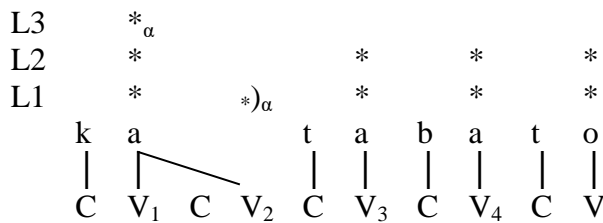
Incorporation thus straightforwardly excludes long vowel shortening in closed syllables as a result of clash. Our approach fares equally well with respect to the two other forms, [moːladéːn] ‘two birthdays’ and [kaːtábató] ‘she corresponded with him’. For [moːladéːn], no clash is expected because the two incorporating nuclei (V₂ and V₅) are separated, at the level of their heads (Line 2) by a filled and unincorporated nucleus (V₄):

(29) Vowel shortening in Palestinian: no clash in [moːladéːn]



Meanwhile, for [kaːtábató] in (30), no clash is expected between V₃, which will eventually bear stress, and V₁, since clash is defined at Line 3 before main stress assignment:

(30) Vowel shortening in Palestinian: no clash in [kaːtábató]

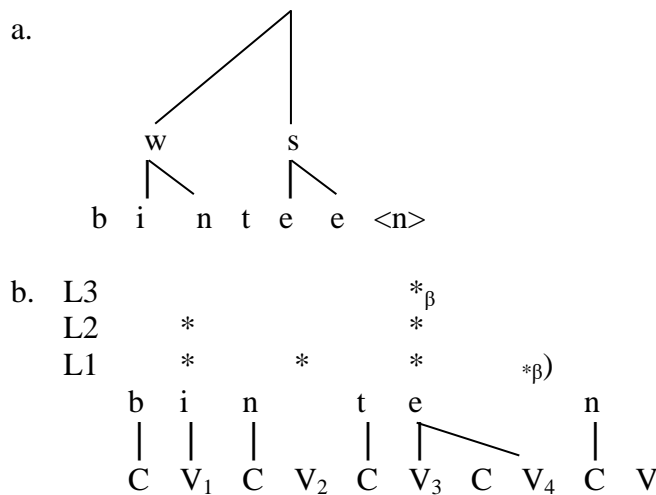


In Abu-Salim’s account, this form necessitated a special bicyclic account; in ours, it is not exceptional at all.

Finally, consider forms like /bint-eːn/ ‘two girls’, derived from /bint/ ‘girl’ and realized [bintéːn] (the unsuffixed base is sometimes realized with epenthesis [bínit]). Such forms are not discussed by Abu-Salim, but in fact they pose a problem for his account. The first syllable is bimoraic, just as in /baːb-eːn/. In /baːb-eːn/, Abu-Salim assumed that the first monosyllabic foot couldn’t stand under the weak branch of a higher foot. Yet as is shown for Abu-Salim’s account in (31a), this is exactly the case in [bintéːn], which the phonology does not alter at all. Abu-Salim is obliged to limit the effect to monosyllabic feet created by vowels, again by brute force.

Our account does not suffer from this drawback. As shown in (31b), we predict that the incorporation of V₂ will be undone in order to prevent clash. In the case of [babéːn], the lack of incorporation correlated with the unavailability of V₂ for spreading. In contrast, in the base /bint/, spreading is not an issue. No segmental effect is predicted, and indeed none is attested.

(31) Vowel shortening in a moraic account (Abu-Salim 1986)



4.3.2 Final vowel shortening

McCarthy (2005) discusses final vowels in Arabic dialects and their treatment in the literature. As shown in (32) with data from Palestinian, all such vowels are pronounced short, but lengthen and attract stress upon suffixation. There are no final phonetically-long vowels in these dialects.²¹

(32) Vowel shortening in Palestinian

a.	kátab-u	'they wrote'	c.	ʔírmí	'throw!'
	katab-ú:-li	'they wrote to me'		ʔírmí:-ha	'throw her!'
b.	nísi	'he forgot'	d.	hább-ha	'he loved her'
	nisi:-t	'I forgot'		hább-ha:-f	'he didn't love her'

McCarthy concludes that i) underlyingly, all final vowels are long; and ii) the phonological computation shortens them. We accept the first claim without discussion.²² The second claim,

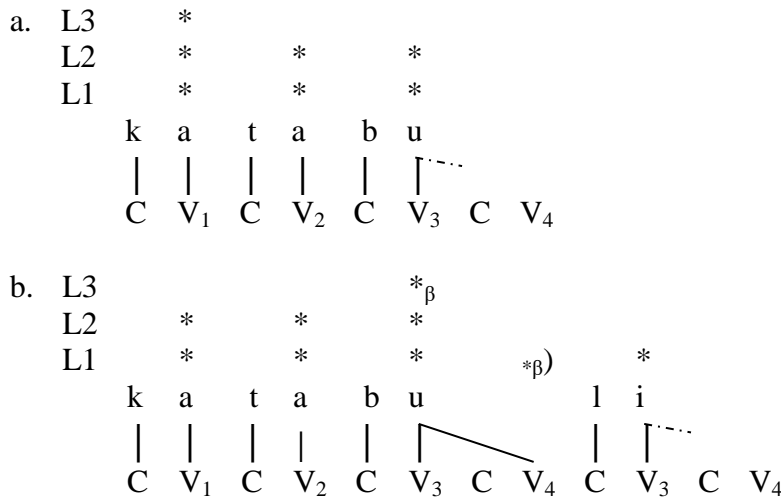
²¹ With the exception of loans such as Cairene [ɡató:] ‘cake’, and a more interesting case in the Palestinian native system involving a segmentally-null third person marker, [katabú:] ‘they wrote it’ (cf. (32a)). We assume that this marker is not skeletally empty, thereby rendering the phonetically-final vowel phonologically non-final.

²² For McCarthy, this generalization is expressed in the constraint hierarchy MaxV: >> FinalC >> MaxV. In prose, Arabic dialects like PA want words to end in a consonant, and will accept the total deletion of final short vowels in

which McCarthy derives from the interaction of several constraints that will not concern us here, is the topic of this short subsection.

Both our explanation for vowel shortening and our account of basic stress receive further support from the shortening of final vowels. A core component of our analysis of metrical vowel shortening was that long vowels could only spread into incorporated V-slots. It follows that in order for a final vowel to be long, it must spread into a word-final dependent (empty) V-slot, a FEN (a position that does not itself have independent lexical content). However, it was a central claim in our account that in Palestinian, FENs are not metrically-projected. Consequently, FENs cannot be identified by Incorporation and, just like in the demoted incorporation domains, the final vowel cannot be permitted to spread into these unincorporated V-slots. For this reason, no final long vowels will survive being computed by the phonology (33a). But when more material is added, as in (33b), the once FEN is now a regular EN and consequently a MSN. It is therefore incorporated, resulting both in length and in stress, exactly as predicted by our account (the long vowel is within the window).

(33) FEN (V₄) unprojected, unincorporated and unable to host spreading²³



The Incorporation and demotion account of clash-induced vowel shortening developed in the previous subsection easily extends to final vowel shortening, providing additional support for the proposal in this paper.

In the next section, we will collect and tie together our account of syllable structure and metrics in Palestinian. This will demonstrate how our

order to achieve that goal; but final long vowels will have to be represented by something on the surface, and so they shorten, but are not deleted. Besides the ad-hoc ordering of constraints, we find the use of FinalC problematic, since it predicts languages in which all words end in a consonant on the surface; no such language exists. In the main text we explain the shortening of final long vowels. As for final short vowels, Strict CV also has a way of ruling these out, while keeping final long ones: it can be claimed that all lexical representations in Arabic must end in an empty nucleus. C-final words comply with that condition, as do the words in (33), but words with final contentful V-slots do not.

²³ Note that these representations introduce a final CV for final vowels. This addition has no bearing on our metrical analysis, since the V-slot of that CV does not project and will be ignored by the window.

assumptions work together procedurally, as well as the parametric difference between Palestinian and Cairene.

4.4. Computational component of stress in Palestinian and Cairene

Like its predecessors in metrical Strict CV, the analysis in this paper treated mainly the final representations of the different forms. The computational component of the grammar has not been made explicit in either S&S or Ulfsbjorninn's work. In (34) below we specify, by way of summary, the ordered processes by which the underlying representation is assigned stress in the two Arabic dialects discussed. Although the examples come from these two dialects, the model has the potential for universal scope. For those who may wish to pursue and develop this new metrical framework, it will serve as a starting point from which testable hypotheses can be extracted.

As is shown in (34), the grammar first applies the projection parameters. Subsequently, a window of three MSNs is defined. Then follows the application of Incorporation of all the ENs in the representation. If following incorporation there is a nucleus inside the window that projects high enough (minimally to Line 3), the computation can stop and stress has been assigned: [biḥíbb], [bis^ʕí:r], [ka.tábt].

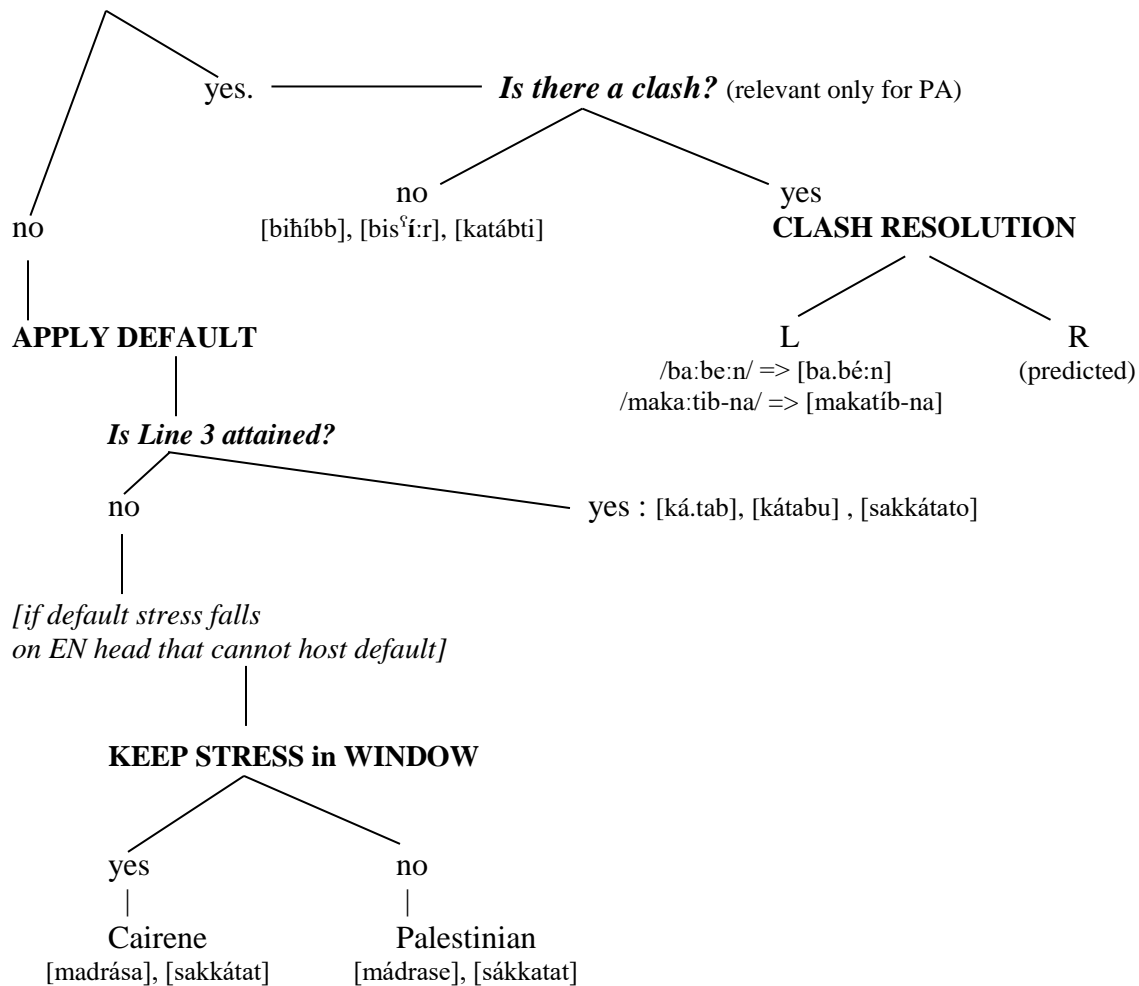
In PA, if after Incorporation there are *two* adjacent nuclei that both reach Line 3, this results in Clash and demotion of the left incorporation domain: /ba:be:n/ => [babé:n], /maka:tib-na/ => [makatib-na]. That the demoted domain is the left one in PA follows straightforwardly from the right-aligned window: clearly there is a preference to give more prominence to Line 3 projections within the window, and the head of the left incorporation domain is always outside that window. Our model does predicts that in a system with a left-aligned window and a parallel sensitivity to clash, the rightmost of two incorporation domains will be demoted. We include this prediction in (34), even though we do not know of such a system.

If, however, the word has no empty nuclei, then incorporation does not apply and no nucleus within the window reaches Line 3. In this case, default stress is assigned. In Palestinian and Cairene Arabic, the default stress projects the leftmost MSN in the window to Line 3: [ká.tab], [kátabu], [sakkátato].

Finally, if the leftmost MSN cannot be projected by the default rule because it is an empty nucleus and cannot bear stress, stress must be shifted. The direction of this stress shift is determined by the parameter at the bottom of the diagram: retraction in Cairene [sakkátat], [sa:fáru], protraction in Palestinian [sákkatat], [sá:fáru].

To summarize this analytic section, we claimed that our Incorporation-based, Strict CV metrical account is superior to the traditional moraic one in elegance, economy and coverage. It is more elegant because it manipulates independently-motivated distinctions, whereas the tools of the moraic account are not independently-motivated. It is superior in economy because it requires far less specific machinery: indeed, it does not even involve feet or syllables. As for coverage, we showed that our account matches the advantage of the moraic account, but extends much more smoothly into the matter of vowel shortening in Palestinian, whether induced by clash avoidance or by positional considerations. Finally, this subsection has made explicit what previous work in the framework has mostly tacitly assumed: a computational component that takes in a stressless underlying representation and produces a stressed representation built directly on the skeleton. We may now move to conclude the paper.

(34) Stress computation

PROJECT Vs [according to the projection parameters: FEN, EN]**BUILD WINDOW** [for Palestinian and Cairene: last 3 MSN]**INCORPORATE***Is Line 3 attained?*

5. Conclusion

This paper continued the effort in Scheer & Szigetvari (2005) and Ulfsbjorninn (2014b) to present a strong Strict CV alternative to moraic accounts of stress systems. It showcased the innovation of Ulfsbjorninn (2014), which in order to account for true quantity introduced a metrical grid and a principle of Incorporation into the theory. For the first time, this theory is applied to data that have been analyzed repeatedly using the competing moraic theory, namely the systems of Arabic dialects.

The Strict CV grid makes direct reference to the skeletal tier, independently-necessary in the representation of words, rather than to additional moraic and syllabic tiers. All metrical phenomena are parametric variations on the projection of a single phonological object: the V-slot, filled or empty. The quantity-sensitive grammars considered here do not require any idiosyncratic unit of quantity and no weight scales are needed. This is because the outputs of the computation vary only in accordance to the different shapes of the words that are fed to it: different URs give different projection outcomes. With this system in place, stress is simply mapped onto the highest projection.

The account presented here therefore does not require 1) moras, 2) extrametricality, 3) parsed vs. unparsed MSNs, 4) syllables, 5) feet, 6) recursivity. Doing away with these analytical tools also removes many of the complications and problems that we identified in the traditional account of stress assignment and syllable structure based on moraic theory, particularly that of Hayes (1995). As was shown, Hayes's account required no less than four types of extrametricality and much of its complexity came in the form of solutions to the mispredictions of other parts of the analysis. While our account matches the available moraic analysis in empirical coverage of the stress facts, it supersedes that analysis in terms of empirical coverage: it also handles Palestinian long vowel shortening. This metrically-conditioned vowel shortening received a highly complicated analysis in Abu-Salim (1986), but can be very simply handled in our framework, and moreover in a way which unifies metrically-conditioned vowel shortening with final vowel shortening. Encouragingly, this analysis is a straightforward extension of the account of the basic stress facts that we have developed (both are Incorporation-based analyses). Unlike our predecessors in Strict CV metrics, we also furnish an account that is equipped with an explicit computational component.

We submit that the contrast between our analysis and the ineffective moraic analysis is so marked that it constitutes grounds for phonological theory to actively pursue the Strict CV approach, and discard the moraic approach along with many of the analytical tools it has developed. At the very least, reconsideration of the grammatical necessity of moras is certainly opportune.²⁴

²⁴ To paraphrase on a catch sentence in the conclusion of Outi Bat El's famous (1994) paper against the Semitic root.

References

- Bat-El, O. 1994. Stem modification and cluster transfer in Modern Hebrew. *Natural Language and Linguistic Theory*, 12:571-593.
- Charette, M. 1984. The Appendix in Parametric Phonology. *Studies in African Linguistics*. Supplement, 9:49–53.
- Charette, M. 1991. *Conditions on Phonological Government*. Cambridge: CUP.
- Charette, M. 2008. The vital role of the trochaic foot in explaining Turkish word endings. *Lingua*, 118: 46-65.
- Clements, G. N. and S. J. Keyser. 1983. *CV Phonology: A generative theory of the syllable*. Cambridge MA: MIT Press.
- Fathi, R. 2013. *Vowel length in Egyptian Arabic: a different view*. PhD dissertation, Université Paris VII.
- Faust, N. & Torres-Tamarit. 2017. Stress and final /n/ deletion in Catalan: combining Strict CV and OT. *Glossa*. Available online.
- Gordon, M. 2006. *Syllable weight: phonetics, phonology, typology*. New York: Routledge.
- Harris, J. 1994. *English Sound Structure*. Oxford: Blackwell.
- Harris, J. and E. Gussmann. 2002. Word-Final Onsets. In: *UCL Working Papers in Linguistics*, 14:1-14.
- Hayes, B. 1995. *Metrical Stress Theory*. Chicago: University of Chicago Press.
- Hyman, L. 1985. *A Theory of Phonological Weight*. Dordrecht: Foris.
- Idsardi, W. J. 1992. *The Computation of Prosody*. Doctoral dissertation. MIT.
- Idsardi, William J. 2009. Calculating metrical structure. In: Cairns, C. and E. Raimy (Eds.) *Contemporary Views on Architecture and Representations in Phonological Theory*. Cambridge: MIT Press. 191 - 211.
- Inkelas, S. 1990. *Prosodic constituency in the lexicon*. New York: Garland.
- Kager, R. 2012. Stress in windows: language typology and factorial typology. *Lingua* 122: 1454–1493.
- Kaye, J. 1990. ‘Coda’-Licensing. *Phonology*, 7:301-330.

- Kaye, J., Lowenstamm, J. and J. R. Vergnaud. 1985. The internal structure of phonological representations. *Phonology Yearbook*, 2:305-328.
- Kaye, J., Lowenstamm, J. and J. R. Vergnaud. 1990. Constituent Structure and Government in Phonology. *Phonology*, 7:193-231.
- Kenstowicz, M., and C. Kisseberth. 1979. *Generative Phonology*. San Diego: Academic.
- Lowenstamm, J. 1996. CV as the Only Syllable Type. In: Durand, J. & B. Laks (eds.), *Current Trends in Phonology Models and Methods*. European Studies Research Institute, University of Salford. 419-442.
- McCarthy, J.J. 2005. The length of stem-final vowels in Colloquial Arabic. In Alhawary, Mohammad T. and Elabbas Benmamoun (eds.), *Perspectives on Arabic Linguistics XVII-XVIII*. Amsterdam: Benjamins. 1-26.
- Nespor, M. and I. Vogel. 1986. *Prosodic Phonology*. Dordrecht: Foris.
- Scheer, T. 2004. *A Lateral Theory of Phonology. Vol 1: What is CVCV, and why should it be?* Berlin: Mouton de Gruyter.
- Scheer, T. and P. Szigetvari. 2005. Unified representations for stress and the syllable. *Phonology*, 22(1):37-75.
- Ulfsgjorninn, S. 2014. *A Field Theory of Stress: the role of empty nuclei in stress systems*. Ph.D. Dissertation. SOAS – University of London.
- Yoshida, S. 1993. Licensing of empty Nuclei: the case of Palestinian vowel harmony. *The Linguistic Review*, 10:127-159.
- Watson, J. 2011. Word stress in Arabic. In: van Oostendorp, M., Ewen, M., Hume, E., and K. Rice (eds.), *The Blackwell companion to phonology*. Wiley-Blackwell, Oxford.
- Watson, J. 2002. *The Phonology and Morphology of Arabic*. Oxford: Oxford University Press.
- Wiltshire, C. R. 2006. Pulaar's Stress System: A Challenge for Theories of Weight Typology. In Mugane et al. (Eds.), *Selected Proceedings of the 35th Annual Conference on African Linguistics*. 181-192. Somerville, MA: Cascadia Proceedings Project.