Prosodic Repulsion in English and Cairene Arabic*

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Hart, William. 2015. Prosodic repulsion in English and Cairene Arabic. *Studies in Phonetics, Phonology and Morphology* 21.1. 143-168. This paper provides an introduction to the concept of prosodic repulsion, a force of resistance between phonological entities that is proposed to account for several seemingly disparate and heretofore unconnected phonological phenomena across human languages. Three basic aspects of phonological structure (i.e. nonfinality in metrical structure, onsets in syllable structure and binarity in foot structure) are reconsidered through the lens of prosodic repulsion as an introduction, and it is demonstrated that each of these aspects of phonological structure can be understood as the result of resistance between an element of a prosodic constituent and an edge of that constituent. Two case studies are then presented in order to demonstrate some of the ways in which the concept of prosodic repulsion can be applied to the re-analysis of old problems. In the first of these, a constraint banning word-final strong morae is proposed to account for the disparity in English between words with final stressed bimoraic syllables such as *kangaróo* and words with final unstressed bimoraic syllables such as *búffalo.* In the second case study, a constraint banning word-final morae from being parsed into feet is proposed to account for the notoriously complex pattern of stress in Cairene Arabic. Both of the proposed constraints crucially involve the resistance of moraic elements to the edge of the prosodic word, representing a specific subtype of prosodic repulsion constraints that are referred to above as *moraic resistance* constraints. **(Hankuk University of Foreign Studies)**

Key words: Prosody, metrical structure, nonfinality, foot binarity, English final tensing, Cairene Arabic stress, superheavy syllables, trimoraicity

1. Introduction

The concept of prosodic repulsion involves the resistance of phonological elements and structures to each other, with the word *elements* here referring to basic building blocks such as segments, morae and tones, and *structures* to larger constituents such as syllables, feet and prosodic words. While much work has been done in the past on the alignment of phonological constituents (e.g. Selkirk 1984, McCarthy and Prince 1993), prosodic repulsion covers the other side of the coin – disalignment. If alignment is construed as a kind of attraction between the edges of two entities, then disalignment can be understood as a kind of resistance or repulsion between them. Due to these two opposing forces, phonological elements and structures are attracted to each other, yet resist each other at the same time. Thus, in a manner

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somewhat akin to planetary systems or atoms, phonological constituents are held together and structurally defined by a balance of opposing forces working in concert.

One of the advantages of looking at phonological phenomena through the lens of prosodic repulsion is that it provides a conceptual framework that can be used to elucidate and unify a vast range of long established phonological observations. These include, but are not limited to, nonfinality (and noninitiality) phenomena in metrical, tonal, accentual and intonational systems, phonotactic patterns revealed in distributional regularities, and universal structural patterns of basic phonological entities. As an introductory illustration of the theoretical lens availed by the concept of prosodic repulsion, let us consider three basic aspects of phonological structure: nonfinality in metrical structure, onsets in syllable structure and binarity in foot structure.

Nonfinality is a defining feature of the English stress system. Putting aside complexities such as variation and lexical exceptions, the very basic pattern of English stress is that the head of a prosodic word is a right-aligned moraic trochee. Yet in nouns and unsuffixed adjectives this alignment is not perfect, since a single "extrametrical" syllable stands between the right-aligned head foot and the edge of the prosodic word. While this pattern has been accounted for in different ways with different terminology in each wave of theoretical developments that has rolled forward since the origins of generative phonology (cf. Chomsky and Halle 1968, Liberman and Prince 1977, Hayes 1980, 1995, McCarthy and Prince 1986/1996, 1993, Halle and Vergnaud 1987, Burzio 1994, among others), it is captured in classic Optimality Theory by the constraint **NONFIN**, which is presented by Prince and Smolensky (1993/2004) as the negatively stated structural requirement that "the head foot of the PrWd must not be final." From the perspective of prosodic repulsion, this type of nonfinality can instead be seen as the resistance to each other of two structures: the head of a constituent, and the constituent itself. While the head foot is attracted to the right edge of the prosodic word, it is simultaneously repelled by it, with a single syllable serving as a kind of buffer between them to maintain their disalignment and hold them apart.

The concept of prosodic repulsion can also be used to provide a motivated understanding of the universal tendency for syllables to prefer onsets. Though this structural tendency has been formalized and accounted for in different ways over the years, in OT it is most often handled by the constraint **ONSET**, which states simply that "syllables must have onsets" (Prince and Smolensky 1993/2004). However, alternatives to this positively stated constraint include Kager's (1999) **$*[_{\sigma}V$** and Downing's (1998) **$*$ALIGNL (σ, μ_S)**. Both of these formalizations of the onset constraint have the advantage of fulfilling the theoretical desideratum for markedness constraints to be stated negatively as bans on particular types of marked structures, rather than as positively stated structural requirements. This is important because the dispreferred structures targeted by markedness constraints are often avoided in various ways both across and within languages, as demonstrated by Pater (1999) for the constraint targeting sequences of nasals followed by voiceless consonants, for example. Significantly to the current proposal, the two negatively framed representations of the **Onset** constraint mentioned above also embody the concept of prosodic repulsion, since each of them formalizes the resistance of an element to the edge of a constituent. In ***[$_\sigma$V** it is a vocalic element that is repelled from the edge of a syllable, while in ***AlignL (σ, μ_S)** it is a moraic one. Yet the crucial observation to be made is that in both of these formalizations of **Onset**, a strong element is attracted to the left edge of the syllable while simultaneously being repelled by it, in most cases requiring a minimal consonantal buffer to keep them apart.

As a final illustrative example of the ways in which prosodic repulsion can illuminate well-established generalizations about phonological structure, let us consider foot binarity, one of the most basic aspects of metrical structure across human languages. In OT, the tendency for feet to consist of two elements is captured in the constraint **FtBin**, which states positively that "feet are binary under moraic or syllabic analysis" (McCarthy and Prince 1993), accounting for both monosyllabic and disyllabic feet, respectively. From the perspective of prosodic repulsion, however, foot binarity can be seen instead as the resistance of an element within a foot to the edge of the foot itself. In monosyllabic feet it is the head mora that resists the edge of the foot, while in disyllabic feet it is the head syllable. Yet in both we find the same essential balance of forces, with the head element being attracted toward one edge of the constituent while repelling the other, and a weak element (a syllable or mora) serving as a buffer between them to hold them apart and maintain their disalignment.

This final example of foot binarity provides a glimpse as to how the concept of prosodic repulsion can be applied to shed light on even some of the most basic assumptions of phonological theory. Like the two reconceptions of the **Onset** constraint discussed previously, this new view also allows us to posit a major aspect of phonological structure as being regulated not by a positive structural requirement but rather by a negatively stated markedness constraint militating against ill-formed structure, satisfying one of the key desiderata of phonological theory.

In addition to providing a motivated foundation for understanding basic phonological observations such as the three cases discussed above, another benefit of the concept of prosodic repulsion is that it can serve as a fresh perspective for the re-analysis of thorny problems that have served as proving grounds for various theories over the years. The current investigation consists of a re-examination of two such problems by focusing in on one particular type of prosodic repulsion which will be referred to as *moraic resistance,* suggesting new solutions to these old problems in order to reveal some of the benefits of prosodic repulsion for active researchers. Specifically, moraic resistance constraints will be proposed to account for the markedness of particular structures that result in the observed distinction in English between words with stressed and unstressed final bimoraic syllables (e.g. 'kangaroo' [ˌkæŋgəˈɹu:] vs. 'buffalo' [ˈbʌfəloʊ]) as well as the apparent exception of so-called superheavy syllables to the otherwise regular pattern of metrical nonfinality in the Cairene Arabic stress system. It will be demonstrated that both cases hinge crucially upon markedness constraints that militate against the alignment of morae with the edges of prosodic constituents. The English case study will be presented in Section 2, Cairene Arabic will be examined in Section 3, and suggestions for further applications of the concept of prosodic repulsion will be provided in Section 4, along with a summary of the major points of the paper.

2. Moraic resistance in English: A reanalysis of word-final tensing

2.1 Data and previous accounts

An old problem of English phonology, discussed first by Chomsky and Halle in *The Sound Pattern of English* (1968, hereafter referred to as SPE), is the distinction in stress patterns between words such as *kangaroo* [ˌkæŋgəˈɹu:], which have stressed final syllables with long vowels or diphthongs in their nuclei, and words such as *buffalo* [ˈbʌfəloʊ], whose final syllables appear to have corresponding prosodic structures yet are unstressed. The former group includes words such as *Kalamazoo*, *fondue*, *cartoon*, *balloon*, *tycoon*, *referee*, *chimpanzee*, *smithereens*, *magazine*, *canteen*, *brassiere*, *chandelier*, *brigadier*, *cocaine*, *plantain*, *domain* and *police*, and a representative set of the latter group is presented in Table 1 below, grouped according to the vocalic makeup of their final syllables.

Table 1. Final Unstressed Bimoraic Syllables

[i:]	[u:]	[eɪ]	[oʊ]	[ɔ:]
monkey	*emu*	*relay (n.)*	*tomato*	*seesaw*
enemy	*voodoo*	*entrée*	*buffalo*	*Utah*
fallacy	*Oahu*	*melee*	*mosquito*	*Esau*
parody	*tofu*	*Pelé*	*albino*	*Brokaw*

The set of words in Table 1 accords largely with the one presented in SPE, but additionally includes words ending in unstressed [eɪ], claimed in SPE to represent a lexical gap, as well as words ending in stressless [ɔ:], predicted not to occur. It should be noted that the specific membership of this group of words characterized by final unstressed bimoraic syllables may show considerable variation according to the speaker consulted, the dictionary or other reference source used, and other factors such as regional pronunciation, speech style, and so on. For example, in a survey of seven online English dictionaries carried out by the author,[1] only words ending in a final high front vowel were unanimously listed as lacking stress, while all other words in Table 1 and others of their type either lacked final stress or had such a variant listed in at least three of the sources, most of them five or six.[2] While the issue of variation is acknowledged as significant and worthy of discussion, it is not the focus of the current investigation. The analysis presented here is based on varieties of English, including that of the author, in which the final syllables of these words are long, open and unstressed.

One traditional rule-based analysis of this apparent disparity in the metrical prominence of final heavy nuclei is that the final vowels of kangaroo-type words are underlyingly long and those of buffalo-type words underlyingly short, with the former becoming stressed through such mechanisms as the Weight-to-Stress Principle (Hayes 1989), and the latter lengthening due to a rule that targets word-final non-low vowels (Roca and Johnson 1999). The same targeting of non-low vowels is at the center of the SPE account as well, though the quality of the final vowel is handled by a tensing rule that applies after stress assignment. While the merits of these analyses are recognized, an alternative constraint-based account is suggested here within the framework of classic OT, with the intention of providing a theoretically motivated justification for the phenomena rather than a merely descriptive rule-based account.

2.2 A constraint-based analysis

The descriptive generalizations to be captured here are specifically that *kangaroo*-type words contain a final bimoraic syllable that is stressed, with or without a final consonant, while *buffalo*-type words contain a final bimoraic syllable that is unstressed and open. The relevant portion of the constraint ranking accounting for the pattern of the former type is simply **WSP** >> **NONFIN** >> **ENDSTRESSR**, and a representative tableau is provided in (1). Note that foot boundaries are marked by parentheses (here and throughout the paper), that light and heavy syllables are represented as L and H, respectively, and that only primary stress is indicated.

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[1] These dictionaries include the Carnegie Mellon University Pronunciation Dictionary (http://www.speech.cs.cmu.edu/cgi-bin/cmudict), Merriam-Webster (http://www.merriam-webster.com), Collins (http://www.collinsdictionary.com), the Oxford English Dictionary (http://www.oed.com), Dictionary.com (http://dictionary.reference.com), the Cambridge Free Dictionary and Thesaurus (http://dictionary.cambridge.org) and Oxford Dictionaries (http://www.oxforddictionaries.com).

[2] An exception is *Brokaw*, the surname of an American television journalist, which is listed as unstressed in the CMU Pronunciation Dictionary yet is absent from all remaining sources.

(1) Final stressed bimoraic syllables

macaroon	**WSP**	**NONFIN**	**ENDSTRESSR**
a. (ˈLL)H	*!		*
☞ b. (LL)(ˈH)		*	

According to the basic pattern of English stress, the head of a prosodic word is a moraic trochee aligned at its right edge, with the final syllable being "extrametrical" (Halle and Vergnaud 1987), or subject to the constraint **NONFINALITY**, which prohibits the alignment of a prosodic word with its head at its right edge (Prince and Smolensky 1993/2004), and specifically requires a syllabic buffer in order to satisfy it. Although this **NONFINALITY** constraint can itself be considered an instantiation of the concept of prosodic repulsion, as suggested in the introduction to this paper, it is not the major subject of examination here. The input forms of *kangaroo*-type words, including *macaroon* shown in (1), are considered to be bimoraic and thus subject to **WSP**, a constraint version of the Weight-to-Stress Principle (Prince 1980, 1990), which in OT can be formally instantiated as a Markedness constraint that bans unparsed heavy syllables (Kager 1999). While candidate (1a) satisfies **NONFINALITY**, its unparsed final heavy syllable incurs a violation of the more highly ranked **WSP**, thus rendering it suboptimal. The winning candidate is then (1b) since it minimally violates the lower constraint **NONFINALITY** in order to satisfy the more highly ranked **WSP**.

In contrast, the analysis of buffalo-type words offered here essentially involves the interaction of a Markedness constraint "sandwiched" between two Faithfulness constraints, one context-dependent and the other context-free. This is a typical pattern of interaction which can be generally stated as $\mathbf{FAITH_{CD}}$ >> **MARK** >> $\mathbf{FAITH_{CF}}$ and has been used to account for various phonological phenomena in several languages (Kager 1999). While the Markedness constraint is at the center of this investigation and will be examined in more detail below, the context-dependent and context-free Faithfulness constraints are **HEADDEP-μ-IO** and **DEP-μ-IO**, respectively. The latter, a general anti-lengthening constraint which can be informally described as "no epenthetic morae," militates against vowel lengthening of any kind. The former, a context-sensitive version of the anti-lengthening constraint that can be informally described as "no epenthetic morae in prosodic heads," bans the occurrence of lengthened vowels parsed as heads of prosodic constituents such as feet and words.

This proposed context-dependent markedness constraint is an application of **HEADDEPENDENCE** (Alderete 1995, 1999) to the anti-epenthesis constraint **DEP-μ-IO**, with the key concept involved in the interaction being *positional faithfulness*, according to which certain prosodic positions, such as root-initial syllables (Beckman 1998) and prosodic heads (Alderete 1999, Yip 1999), enforce stronger faithfulness demands than context-free positions. While epenthetic vowels appear to resist stress in some languages, in English it is epenthetic morae rather than vowels that are banned from prosodic heads. It is this context sensitive ban against epenthetic morae that is embodied in the proposed constraint **HEADDEP-μ-IO**, and the key interaction is demonstrated in (2) below. Note once again that only primary stress is indicated.

(2) Final unstressed bimoraic syllables

/bʌfalo/	**HEADDEP-μ-IO**	**M**	**WSP**	**PARSE**
a. (bʌfə)(ˈloʊ)	*!			
b. (ˈbʌfə)lo		*!		*
☞ c. (ˈbʌfə)loʊ			*	*

Candidate (2a) satisfies **WSP**, since its final heavy syllable is parsed. However, since that syllable contains an epenthetic mora within a prosodic head, it crucially violates the context-dependent Faithfulness constraint **HEADDEP-μ-IO**. Candidate (2b) satisfies this constraint, since its prosodic head does not contain any epenthetic morae, but it crucially violates the Markedness constraint "**M**" which shall be discussed below. Candidate (2c) emerges as the most optimal candidate since it satisfies **M**, but avoids violation of **HEADDEP-μ-IO** by leaving the final syllable unparsed and hence unstressed. Not shown but certainly active are the highly ranked Faithfulness constraints that militate against other types of change, such as deletion and consonantal epenthesis, to avoid violation of **M**. Also excluded from the tableau is the context-free Faithfulness constraint **DEP-μ-IO**, which is ranked lower than **PARSE** and is thus effectively inactive.

2.3 The markedness constraint

The big question is of course: what is **M**? This is the crucial constraint in the interaction since without it there would be no motivation for moraic epenthesis or any other change to occur, no reason for any lack of correspondence between the input and output forms. It can thus be seen as the "trigger" in a traditional sense, and is the main focus of this discussion. Yet what is the substance of this constraint? What exactly does it militate against, and what is the precise nature of the marked structure involved?

To answer such questions, it often helps to look first at the structures that satisfy a constraint in order to see more clearly which ones do not. It has been shown already that *kangaroo*-type words, with final bimoraic stressed syllables (with or without final consonants) satisfy it, as do buffalo-type words, with final open syllables which are bimoraic and unstressed. In addition to these, "*gorilla*-type" words, with final reduced vowels, "*tamarin*-type" words, with final closed syllables, and "*kitten*-type" words, with final syllabic consonants, all satisfy **M** as well. These structures are summarized in (3) below.

(3) Word-final structures satisfying the Markedness constraint "**M**"

a. long vowels (e.g. *kangaroo*)
b. diphthongs (e.g. *buffalo*)
c. schwa (e.g. *gorilla*)
d. consonants (e.g. *tamarin*)
e. syllabic consonants (e.g. *kitten*)[3]

The key observation to be made here is that all conceivable types of word-final structures satisfy **M**, with the sole exception being final unreduced or "full" short vowels. This observation is partially captured in the lengthening and tensing rules mentioned above that target non-low vowels, but the constraint appears to target low vowels as well, since the presumably low input vowels of *gorilla*-type words never correspond to fully faithful output forms. Although the "fate" of low and non-low input vowels differs in output forms, it would be preferable to handle the ill-formed nature of their structure with a single, generally stated Markedness constraint, rather than dividing the work up into two more specific ones. Indeed, the fact that low and non-low input vowels emerge differently in output forms is not surprising, since Markedness constraints only ban ill-formed structures, without specifying how violations are to be avoided. This is of course left to other constraints, and in this case it is clear that the Faithfulness constraints specific to low vowels are ranked differently than those for non-low vowels, resulting in their reduction. For this reason a single Markedness constraint can be proposed to account for all possible outcomes.

Yet how can this constraint be formalized? Since it seems to target only full vowels, one possibility would be to ban a major vowel feature word-finally in a constraint taking a form such as ***[HIGH] $]_{PW}$**, ***[BACK] $]_{PW}$** or ***[ROUND] $]_{PW}$**. With such a formalization, any vowel specified as plus or minus for the relevant feature would be banned word-finally, ruling out all of the full vowels yet letting featureless schwa pass through. However, there are a few major weaknesses to this proposal. First of all, the constraint would prove problematic for any account relying on privative features or underspecification, since final vowels lacking a specification for the relevant feature would emerge unscathed, so to speak. Besides, even with fully specified features, it is typically only one value of a feature that is singled out as illformed in Markedness constraints, which would predict that words ending in vowels containing the unmarked specification for the relevant vocalic feature would have fully faithful final vowels in their output forms. Yet clearly they do not. Finally, long vowels and diphthongs would still violate any formalization of the **M** constraint based on [high], [back] or [round], rendering the possibility untenable.

Alternatively, assuming representations such as [ow, aj, ij, uw] for diphthongs and long vowels, another way to formalize the constraint would

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[3] I would like to express my gratitude to Chang-beom Park of Seowon University for recommending that I consider words with final syllabic consonants.

be ***[ATR]]$_{PW}$***, with the additional stipulation that glides be unspecified for tenseness. However, this approach, an OT analog of the original SPE analysis is fraught with several problems as well. First, the same problematic issues of underspecification and markedness discussed in the previous paragraph still apply. Second, the constraint only works given the assumption that long vowels and diphthongs end in glides, so if fully vocalic representations (e.g. [oʊ, aɪ, i:, u:]) are used, as they often are, this form of the constraint must be abandoned. A final point to be made is that using [ATR] to formulate the constraint seems like a loophole, technically accounting for the marked structure under one particular representational interpretation, yet seeming to sidestep the essential descriptive generalization of the marked structure targeted by the **M** constraint.

Once again, the basic generalization to be captured is that full, short vowels are disallowed word-finally. Ultimately, something like "**$*V_{FULL,SHORT}]_{PW}$**" is needed, but with a more canonical formal notation. The proposal offered here is that the key Markedness constraint involved in this interaction can be formalized and stated descriptively as the "moraic resistance" constraint indicated in (4) below.

(4) A moraic resistance constraint[4]

$$*\left.\begin{array}{c}\mu_s\\ |\\ x\end{array}\right]_{PW}$$

A word-final segment cannot be associated with a word-final strong mora.[5]

What this constraint essentially says is "no final strong morae," and for this reason the shorthand form **$*\mu_S]_{PW}$** will be used henceforth. Considering once again the structures listed above in (3), long vowels & diphthongs satisfy **$*\mu_S]_{PW}$** since in *kangaroo*- and *buffalo*-type words it is a *weak* (or sister) mora that is aligned with the right edge of the prosodic word. Second, the schwa of gorilla-type words satisfies it if the mora of a reduced vowel is interpreted as weak, or even if, as Crosswhite (2004) suggests, reduced vowels can be considered nonmoraic. Third, the final consonants of tamarin-type and kitten-type words satisfy **$*\mu_S]_{PW}$** as well, since they are nonmoraic.[6]

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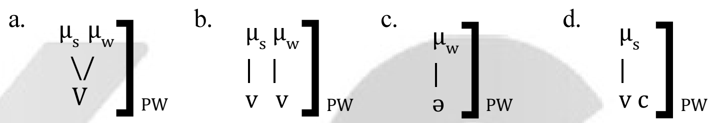
[4] An anonymous reviewer has pointed out the need for some kind of phonetic or functional motivation to be provided for this constraint, as this is typically recognized as a key desideratum of newly introduced constraints in OT, alongside typological predictions. While the current investigation deals strictly with the formal aspects of this constraint, the necessity for a phonetic or functional motivation behind prosodic resistance is fully acknowledged and recognized as a fruitful area for future exploration.

[5] Here and throughout, the informal use of the term *word* refers specifically to the phonological constituent known as the Prosodic Word, abbreviated as PW in formal representations and tableaux in the remainder of the paper.

[6] The nonmoraicity of final consonants in English, the result of highly ranked ***FINALC-μ** (Kager 1999), tentatively presumed to be another instantiation of prosodic repulsion, will be explored in future work.

Yet crucially, $*\mu_S]_{PW}$ is violated by full, short, word-final vowels. Since this is precisely the generalization with which the discussion of the constraint began, this formalization of the constraint appears to capture the essence of the marked structure involved. To demonstrate formally the various ways in which $*\mu_S]_{PW}$ can be satisfied, representations of the word-final structures from (3) above are given in (5) below. For final long vowels, diphthongs and reduced vowels, shown in (a), (b) and (c) respectively, a final weak mora serves as a buffer between the edge of the prosodic word (marked as PW in all following representations) and any preceding strong morae, while the buffer in final closed syllables is a nonmoraic final consonant, as shown in (d). Though not presented here, the representation of a final syllabic consonant is essentially the same as that shown in (d) yet of course without any preceding vowel.

(5) Representations of structures satisfying $*\mu_S]_{PW}$



2.4 Summary of English case study

To conclude this section, let us take another look at the interaction shown previously in (2), but this time with the proposed form of the markedness constraint added.

(6) Final unstressed bimoraic syllables revisited[7]

		/bʌfalo/	**HEADDEP-μ-IO**	$*\mu_S]_{PW}$	**WSP**
	a.	(bʌfə)(ˈloʊ)	*!		
	b.	(ˈbʌfə)lo		*!	
☞	c.	(ˈbʌfə)loʊ			*

Looking at the tableau in (6), it now becomes clear why candidates (6a) and (6c) satisfy the proposed moraic resistance constraint. In these two candidates, which both end in a diphthong, the strong mora of the final syllable is repelled from the edge of the word, with a weak mora serving as a buffer to hold them apart. In contrast, the final strong mora of candidate (6b)

7 Although the edges of Prosodic Words have been omitted for simplicity's sake, it should be pointed out that, in every candidate in every tableau presented in this paper, the edges of the Prosodic Word completely contain all of the segmental content and foot boundaries of the word. That is to say, the representations in (6a, b, c) should be understood as $[(\text{bʌfə})(\text{ˈloʊ})]_{PW}$, $[(\text{ˈbʌfə})\text{lo}]_{PW}$ and $[(\text{ˈbʌfə})\text{loʊ}]_{PW}$, respectively. I heartily extend my gratitude to an anonymous reviewer for asking for clarification on this point.

is left exposed directly to the edge of the word that it needs to resist, fatally rendering the candidate suboptimal. This resistance of a moraic element to the edge of a prosodic constituent can be seen as a form of *prosodic repulsion.*

3. Moraic resistance in Cairene Arabic: A re-analysis of superheavy syllables

3.1 Data and descriptive generalizations

The concept of prosodic repulsion in general and its more specific instantiation as a moraic resistance constraint also play a crucial role in an alternative analysis of the Cairene Arabic metrical system. A representative set of words demonstrating the stress pattern of the language is provided below in (7) taken from Hayes (1995), followed by an explanation of his descriptive generalizations for each subset of words presented.

(7) Stress in Cairene Arabic (Hayes 1995; glosses from McCarthy 1979)

a. *katábt*	'I wrote'	*hajǰá ː t*	'pilgrimages'
b. *ha ː ðá ː ni*	'these'	*katábta*	'you wrote'
c. *ʔinkásara*	'it got broken'	*ʔadwiyatúhu*	'his drugs'
d. *šaǰarátun*	'tree'	*šaǰarátuhu*	'his tree'

Stress in Cairene Arabic always lies within a three-syllable window at the right edge of the word. As shown in (7a), the final syllable is stressed if it is "superheavy," meaning that it is closed by two consonants, as in *katábt*, or by a single consonant but with a long vowel in its nucleus, as in *hajǰá ː t*. In the absence of a final syllable meeting either of these two structural descriptions, the penultimate syllable is stressed, provided that it is heavy. This is demonstrated by the words in (7b), of which the penultimate syllable of *ha ː ðá ː ni* is open with a long vowel, and that of *katábta* closed.

If a word lacks both a final "superheavy" syllable and a penultimate heavy syllable, then the location of stress is apparently determined by the structure of the preceding syllables, an essential aspect of the metrical system. If there are any non-final heavy syllables in the word, then stress falls on either the penultimate or antepenultimate syllable, whichever has a gap between it and the nearest preceding heavy syllable that is an even number of syllables long.[8] Thus in *ʔinkásara* of (7c) it is the antepenultimate syllable that is stressed, since it lies directly adjacent to the nearest (and only) preceding heavy syllable, i.e. zero syllables away from [ʔin]. In contrast, in *ʔadwiyatúhu* it is the penultimate syllable that receives stress, since two syllables lie between it and [ʔad], the closest preceding heavy syllable.

Finally, in the case that the final syllable is not "superheavy" and none of

[8] Note that zero is considered an even number.

the other syllables in the word are heavy, then stress falls on either the penultimate or antepenultimate syllable, whichever has a gap between it and the left edge of the word whose length is an even number of syllables. Hence the third syllable [rá] is stressed in both *šaǰarátun* and *šaǰarátuhu* of (7d) because it is separated from the left edge of each word by a gap two syllables long, though because the post-tonic syllabic count differs between *šaǰarátun* and *šaǰarátuhu*, it is the penultimate and antepenultimate syllable that gets stressed, respectively. As demonstrated below, this apparent sensitivity to the structure and number of preceding syllables can be accounted for in constraint-based theories through the parsing of binary feet. Furthermore, it should be clear from the account provided here that without such sensitivity to preceding prosodic structure, stress in Cairene Arabic cannot be accurately predicted.

3.2 Preliminary discussion and previous research

Upon presenting the data summarized above, Hayes (1995: 68) immediately comments that "the complexity of this pattern is striking", and indeed, it inevitably appears so to those encountering this case for the first time. Yet it will be demonstrated here that the generalizations described in section 3.1 above can all be accounted for simply and straightforwardly with a few basic, universal constraints plus a proposed markedness constraint invoking the concept of moraic resistance.

It might be wondered why such a reanalysis is needed when so many accounts have been provided already. Indeed, as Aquil (2012) notes, Cairene Arabic has played quite a significant role as an illustrative case in the development of metrical stress theory in generative phonology, with representative studies analyzing its stress system being Halle & Vergnaud (1987) and Hayes (1995), to name just a few. With such exhaustive coverage of the issue having already been provided by some of the most prominent authors of the field, analyses of the Cairene Arabic stress system from constraint-based perspectives are in contrast somewhat difficult to come by, yet can certainly be found (e.g. Aquil 2012, Al-Jarrah 2008, Al-Mohanna 2004). The most recent of these (Aquil 2012) will not be critiqued here, as it appears to rely on a set of data that differs from all other studies of the language. Specifically, in Aquil (2012) stress is claimed to fall not only on final "superheavy" CVCC and CVVC syllables, but on final heavy CVV syllables as well, a claim that is stated explicitly in the list of generalizations in the introduction and illustrated through an example (i.e. *banáa* 'he built it') in tableau form. In all other accounts of the language reviewed by the present author, final heavy syllables resist stress in Cairene Arabic, whether closed or open.

Excellent accounts of the Cairene Arabic stress system have been provided by both Al-Jarrah (2008) and Al-Mohanna (2004), yet each of these suffers from inadequacies that the present account seeks to address. Al-

Mohanna (2004) presents an analysis of the stress system that depends on association of final consonants in "superheavy" syllables directly to the PW node. This is an effective step to take and similar to Hayes' (1995) account of final consonant extrametricality, yet any motivated explanation for why such association occurs, and only with final consonants, is unfortunately lacking. What kind of constraint could make such a structure more well-formed than one in which the segment is canonically parsed into appropriate constituents at each level of the prosodic hierarchy? This question goes unanswered. Much like accounts of extrametricality, the stipulation that final consonants lie outside the boundaries of both syllables and feet is used effectively as a tool to make the analysis work, but its substance is never put under scrutiny. In contrast to this analysis, the present account will interpret the final consonants of "superheavy" syllables in Cairene Arabic as syllabified yet nonmoraic, making all the correct predictions while providing a theoretical motivation for such structure through the concept of prosodic repulsion.

Al-Jarrah (2008) also presents a neat analysis of the Cairene Arabic metrical system, yet one which relies crucially on the formalization of "superheavy" syllables as trimoraic. In particular, the relevant portion of the proposed ranking (**P**$\boldsymbol{\sigma >_{\mu\mu}}$ >> **NF** >> **P**$\boldsymbol{\sigma \leq_{\mu\mu}}$) sets the nonfinality constraint between one foot-parsing constraint that applies to syllables with more than two morae, and another parsing constraint that applies only to those with two or less. The result of this interaction is that all final syllables in Cairene Arabic resist stress unless they are "superheavy," since the constraint demanding that such syllables be parsed outranks the constraint militating against final parsed syllables. Yet the constraint needed to do this work (i.e. **P**$\boldsymbol{\sigma >_{\mu\mu}}$) necessarily demands recognition of trimoraic syllables in the language, a controversial formal representation that has long been considered by some theorists to be universally avoided and by others nonexistent, since it represents an egregious violation of the acknowledged preference for the "magic number two" in phonological theory and other branches of linguistics.

Morén (1999) presents a brief history of the controversy surrounding the postulation of trimoraic syllables, concluding ultimately that they are universally marked yet not entirely banned, providing Hindi and Kashmiri as cases that depend on their recognition. Davis (2011) similarly explores both sides of the issue and concludes that trimoraic syllables are marked yet occasionally necessary. Some authors have come out entirely in support of their recognition, with Clark (1990) using trimoraic syllables as the basis for key constraints in the tonal system of Igbo, Lavoie and Cohn (1999) arguing for their existence in English, and Hall (2000) presenting evidence for the occurrence of final trimoraic syllables in English and German. On the other hand, other authors have been just as adamant in refuting the need for trimoraic syllables in formal phonological representations. Van Oostendorp (2000: 184) presents an analysis of Dutch in which he assumes that "superheavy syllables as such do not exist," while Bye (1997) reinterprets the three-way length contrasts in Estonian and Saami in a paper revealing titled “Representing Overlength: Against Trimoraic Syllables.” Closer to the aims of the present study, Broselow et al. (1995) and Watson (1999) argue against trimoraic analyses of CVVC syllables in varieties of Arabic, and Bernhardt et al. (2011) reference several older accounts in which the very existence of superheavy syllables in Arabic is disputed.

Rather than taking a definitive position on the debate over trimoraic syllables, a stance of critical neutrality is adopted here. Generally speaking, if the behavior of entities and structures that appear to defy universally recognized phonological patterns and constraints cannot be accounted for by other means, then they can be tentatively acknowledged for the sake of allowing other aspects of an analysis to be understood. However, if this behavior can be accounted for by an alternative analysis, without recourse to the recognition of such problematic entities and structures, the resulting analysis is generally considered to be theoretically preferable, as it allows apparent exceptions to these universally acknowledged patterns and constraints to be left by the wayside. In this case, if the Cairene Arabic metrical system can be analyzed without the need for trimoraic syllables to be formally recognized, then the universal desideratum of maximal binarity can be satisfied. This is precisely what will be done here.

3.3 Another moraic resistance constraint proposed

Despite its apparent complexity, the Cairene Arabic stress pattern involves simply the parsing of maximally bimoraic feet from the left, alignment of the head foot to the right, and a markedness constraint preventing so-called superheavy syllables from being parsed. This markedness constraint is a moraic resistance constraint similar to the one proposed for English in Section 2.3, and is provided formally and descriptively in (8) below.

(8) A moraic resistance constraint for Cairene Arabic

$$*\left.\begin{array}{c}\mu\\ |\\ x\end{array}\right]_{FT\cap PW}$$

A word-final mora cannot be parsed.

Similarly to the constraint $*\boldsymbol{\mu_S]_{PW}}$ proposed in Section 2.3, the motivation for this constraint involves the resistance of moraic elements to the edges of prosodic constituents. Though its precise formal representation is presented above, the shorthand representation $*\boldsymbol{\mu]_{FT\cap PW}}$ will be used for convenience in the ensuing discussion. Essentially, what this constraint militates against is the alignment of a mora with the right edge both of a foot and of a prosodic word. It is violated by structures such as (CVV) $]_{PW}$ and (CV) $]_{PW}$ with final moraic elements parsed into word-final feet, as well as by (CVC) $]_{PW}$ if a

Weight-by-Position constraint is highly ranked in the language, as it is in Cairene Arabic.[9] The high ranking of $*\mu]_{FT\cap PW}$ thus accounts for the apparent pattern of final syllable extrametricality in Cairene Arabic, as final syllables of the types just mentioned cannot be parsed without violating it.

Importantly, the constraint $*\mu]_{FT\cap PW}$ is satisfied by forms such as CVC $]_{PW}$, CVV $]_{PW}$ and CV $]_{PW}$, whose final syllables are left unparsed, and by forms such as (CVVC) $]_{PW}$ and (CVCC) $]_{PW}$, whose final consonants lie within the boundaries of the final syllable, the foot and the prosodic word, yet are compelled into nonmoraicity by the highly ranked constraint **MAXBIN** (Maximal Binarity), which demands a maximum of two morae in a syllable. In other words, word-final (CVVC) and (CVCC) feet have a non-moraic final consonant which serves as a kind of buffer between the moraic elements of the foot and the edge of the Prosodic Word, once again reflecting the concept of *prosodic repulsion* as revealed through the phenomenon of moraic resistance.

The essential constraint interaction for footing can be found in the ranking **MAXBIN** >> **WBP** >> $*\mu]_{FT\cap PW}$ >> **PARSE**, with representative examples provided in tableau form in 9, 10 and 11 below. Note that the moraicity of segments in final syllables is indicated by underlining, with underlined segments being moraic and non-underlined ones nonmoraic. It should also be reiterated that, for simplicity's sake, this ranking accounts only for the pattern of foot parsing; the constraint interaction that determines the location of primary stress is analyzed and discussed further below, along with the restriction of words to a single stressed syllable and other aspects of the Cairene Arabic metrical system that are somewhat orthogonal to the main discussion.

(9) *sakakíin*

	MAXBIN	WBP	$*\mu]_{FT\cap PW}$	PARSE
☞ a. (saka)(k i ː n)		*		
b. (saka) (k i ː n)	*!		*	
c. (saka) k i ː n		*		*!

(10) *fihim*

	MAXBIN	WBP	$*\mu]_{FT\cap PW}$	PARSE
a. (fi) (h im)			*!	
b. (fi h i m)		*!		
☞ c.(fi) h im				*

9 The Weight-by-Position constraint, represented as **WBP** in Tableaux 9, 10 and 11, assigns a violation mark for any non-moraic coda consonant.

(11) *katabítu*

	MaxBin	**WBP**	**$*\mu]_{FT\cap PW}$**	**Parse**
☞ a. (kata)(bi)t$\underline{u}$				*
b. (kata)(bit$\underline{u}$)			*!	
c. (kata)bit$\underline{u}$				**!

While the final syllable of candidate (9b) violates **MaxBin** with its three morae, that of candidate (9c) has the requisite maximal bimoraicity but is fatally unparsed. The optimal candidate is (9a), with a parsed final bimoraic syllable that has a nonmoraic consonantal buffer preventing contact between the moraic content of the foot and the word edge. Although (a) violates **WBP** as well with an unparsed coda consonant, this violation is rendered irrelevant by (c)'s equal violation of the constraint.

The tableau in (10) accounts for the observed "extrametricality" of final syllables, which is a result not of a separate **NonFinality** constraint, but of the proposed moraic resistance constraint. Candidate (10a) fatally violates **$*\mu]_{FT\cap PW}$** since its final mora is directly aligned with both foot and word edges, while (10b) escapes such fate but is ruled out by a deadly **WBP** violation. The optimal candidate is thus (10c), which leaves the final syllable unparsed. Interestingly, all three candidates result in the same location of stress, with the only difference among them being the structure. But of course structure matters, since it is what allows us to predict stress accurately on a system-wide basis.

Finally, (11) demonstrates an interaction with a word that has a final open syllable. Candidate (11b) is ruled out by its violation of the moraic resistance constraint **$*\mu]_{FT\cap PW}$**, leaving (11a) and (11b) as the only viable candidates. Although candidate (11a) features a degenerate foot just like the optimal form of *fihim*, such a parsing is ultimately more well-formed than that of candidate (c), in which the penultimate syllable is left unparsed, incurring an additional and critical violation of **Parse**.

The interactions shown in (9), (10) and (11) also demonstrate how a single markedness constraint can account for two patterns that have previously been seen as motivated by separate processes. Instead of an "if not A then B" process, in which words with final superheavy syllables are treated as categorically different from all others, the moraic resistance constraint **$*\mu]_{FT\cap PW}$** targets the final feet in words such as *fihim, sakakíin*, and *katabítu* identically, holding them accountable to the same structural criteria. Thus, even though the location of stress differs across such words, they can all be accounted for by the same basic interaction of constraints, an interaction which significantly makes no reference to the concepts of extrametricality, nonfinality, trimoraicity or superheaviness.

In the next few sections, some further points of the Cairene Arabic stress system will be discussed, with alternative parsings covered in Section 3.4, degenerate feet and minimality in Section 3.5, leftward and rightward alignment of feet in Section 3.6, and the position and exclusivity of primary stress in Section 3.7.[10] While these "loose ends" are matters not directly related to the proposed moraic resistance constraint, they are nevertheless crucial to the analysis as a whole. Section 3.8 will then conclude the case study with a summary of the major points of the analysis.

3.4 Alternative parsings

Concerning the analysis of words such as *fihim* discussed in the previous section, it might be noticed that the candidate [(fihi)m] is absent.[11] With a final unparsed consonant, this candidate would appear to be optimal since, unlike candidate (10c), it fully satisfies **PARSE**. However, it must be noted in response to this observation that active in the ranking yet not presented in the discussion so far are two constraints that prevent the emergence of such candidates as optimal. The first is **SEGPARSE**, a highly ranked segmental parsing constraint demanding that segments be parsed by syllables, and violated by any stray segments. The second is **HIALIGN**, a hierarchical alignment constraint demanding top-down crisp alignment of prosodic constituents, violated by any word in which a prosodic constituent does not completely contain the constituents it dominates. Due to the work of these two constraints, any structural interpretation of [(fihi)m] is ruled out. If the final consonant of this candidate is an unsyllabified or "stray" consonant, as suggested by Al-Mohanna (2004), then it is killed by **SEGPARSE**, and if it is syllabified in coda position then **HIALIGN** seals its fate, since the right edge of the foot would "sever" the syllable that it dominates.[12]

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[10] Another intriguing question, pointedly posited by Tae-Jin Yoon of Cheongju University, is whether there is any corroborating evidence for the foot structure predicted by this analysis. Though I have not yet attended to this question, in the future I hope to collaborate with scholars of Arabic to see whether any evidence from phonology, poetry, or other areas can be brought to bear on the matter.

[11] Much thanks to Sung-hoon Hong of Hankuk University of Foreign Studies for bringing this point to my attention.

[12] One possible complication involved is geminate consonants in words such as *mu'darris*, which in the current proposal are predicted to be parsed (mu)('dar)ris, with a foot boundary severing the geminate consonant in two. However, segments are not ordinarily considered part of the prosodic hierarchy, so if the geminate is ambisyllablic then the "severing" would occur below the domain in which **HIALIGN** applies. Considering the complications involved with ambisyllabicity though, this issue may require further investigation.

3.5 Degenerate feet and minimality[13]

Another point that might raise some eyebrows concerning the analysis of *fíhim* above is the fact that the sole foot of this word is degenerate, as indeed the final foot in all words with stressed penultimate monomoraic syllables is predicted to be under this analysis. The reason for this is simply that no foot minimality constraint is active in Cairene Arabic. Yet without a constraint demanding minimally binary feet, it might be wondered why any disyllabic feet would be parsed at all, for binary parsing from the left is in fact essential to the analysis presented here. The answer to this is that binary parsing is merely a result of the interaction of standard alignment constraints, as demonstrated in (12) below.

(12) *satarátuhu*

	PARSE	ALLFTR	ALLFTL
☞ a. (sata)(ratu)hu	*	****	**
b. (sa)(ta)(ra)(tu)hu	*	*****!****	******

PARSE guarantees that every syllable be footed (as long $*\mu]_{FT\cap PW}$ is not violated of course, which is not shown here but more highly ranked). Alignment constraints then ensure maximal parsing of syllables into feet. Since every foot incurs an additional violation of **ALLFTR**, there is an overall pressure towards a minimal number of total feet in a word, resulting in the evaluation of candidate (12a) as optimal. Of course, the absolute minimum number of feet in any candidate is one, but if all of the syllables in the entire word were parsed into a single foot, undominated **MAXBIN** (not shown here) would be violated in any word longer than two syllables. Furthermore, if only one bimoraic foot were parsed at the right edge of the word, **ALLFTR** would be minimally violated, but violations of **PARSE** would be fatal since it dominates the foot alignment constraints. What we find, then, is that **MAX-BIN** sets the maximum size of a foot, **PARSE** guarantees maximal parsing, and the minimum size of feet is determined not by a

[13] An anonymous reviewer has questioned what appears to be a heavy reliance on degenerate feet in this analysis, and this is a point that certainly demands attention if the arguments presented here are to be considered seriously. Reserving exhaustive treatment of this issue for future work, the tentative response I will offer is simply that there is nothing fundamentally unexpected about the occurrence of degenerate feet. On the contrary, when working within a framework of phonological grammar in which prosodic structure emerges through the interaction of basic structural markedness constraints rather than being dictated by positively stated demands, it would be typologically unusual for degenerate feet *not* to appear in some languages. In OT, degenerate feet could only be predicted never to occur if it were claimed that a constraint militating against their existence were inviolable, yet violability is one of the most basic properties of constraints in the theory. It is also worth pointing out that in the present analysis, degenerate feet are still marked as ill-formed – they are not rampant, but emerge in optimal forms only when no better candidate is available.

minimal binarity constraint such as "**MINBIN**," but rather by the rightward alignment constraint. Thus, no minimality constraint is needed to account for disyllabic foot parsing, since each parsing of a non-final monosyllabic foot would invite another violation of the constraint requiring all syllables to be aligned with the right edge of the word. The initial syllable of *fihim* and the penultimate syllable in *katabítu* are parsed as degenerate feet merely because there are no further syllables in these words that can be parsed without incurring more serious violations.

3.6 Leftward and rightward alignment

Another aspect of the analysis that might appear troubling is the domination of **ALLFTL** by **ALLFTR**, which could seem odd in light of the fact that the account presented here assumes a basic alignment of feet from the left, not the right. In response to this point, consider what happens with the parsing of odd numbered pre-final sequences such as LLL, rather than even numbered pre-final sequences like LLLL, which can be neatly parsed into binary feet. In such cases two different parsings are available, one with a degenerate foot on the left edge followed by a bimoraic foot (i.e. (L)(LL)), and the other with the mirror-image order (i.e. (LL)(L)). It has already been demonstrated from words such as *katabítu* in Tableau (11) that in Cairene Arabic it is always the latter pattern that results, but if degenerate feet are allowed, what is to prevent the former? Ironically, despite the overall leftward alignment of feet in the language, it is the domination of **ALLFTR** over **ALLFTL** that crucially determines the correct parsing, as demonstrated in (13) below.

(13) Leftward alignment of feet

	$*\mu]_{FT\cap PW}$	**PARSE**	**ALLFTR**	**ALLFTL**
☞ a. (kata)(bi)tu		*	***	**
b. (kata)(bitu)	*!		**	**
c. (kata)bitu		**!	**	
d. (ka)(tabi)tu		*	***!*	*

Candidate (13b) is ruled out through violation of the moraic resistance constraint $*\mu]_{FT\cap PW}$, while candidate (13c) is fatally underparsed. The key candidates here are (13a) and (13d), which present contrary parsings of pre-final trisyllabic sequences. Somewhat unexpectedly, it is actually the dominance of the *right* alignment constraint that assures the *leftward* alignment of binary feet in all words. If the order of the two alignment constraints were reversed with **ALLFTL** dominating **ALLFTR**, the optimal candidate would actually be (13d), since it incurs fewer violations of **ALLFTL**.

3.7 Position and exclusivity of primary stress

With the phenomenon of foot parsing taken care of, two major questions remain to be addressed concerning the metrical system of Cairene Arabic. How is the head foot of a word determined? And why is there only a single stressed syllable per word? The former question is important yet simple to handle, while the latter is somewhat trickier, and appears to have been largely ignored in previous constraint-based accounts. The head of each prosodic word is the result of the generalized alignment constraint **HDFTR**, or formally **ALIGN(PRWD, R, HD(PRWD),R)** (McCarthy and Prince 1994) which attracts stress as far to the right as possible by marking the rightmost foot as the head of the prosodic word, as well as the foot form constraint **RHTYPE=T**, itself an alignment constraint of the form **ALIGN(HEAD, L, FOOT, L)** by which the head of a foot (i.e. either a strong syllable or a strong mora) is attracted to the left edge of the foot.[14]

As for the restriction to a single stressed syllable per word, the problem is less straightforward because, although the parsing of feet from the left edge of the word is a crucial aspect of the stress system, only one of these feet is marked with a head in output forms. This is problematic theoretically because, according to Halle and Vergnaud's (1987) Faithfulness Condition, every prosodic constituent must have a head, and the head of a foot is a stressed syllable. It follows then, that if a word has only a single stress, then it must have only a single foot. Yet we have already seen that without the parsing of multiple feet from the left, stress cannot be accurately predicted in Cairene Arabic. In rule-based theoretical frameworks, this kind of situation is dealt with by first building up structure and then tearing it down again once its job is complete, much like the scaffolding on a building. In other words, feet are first constructed iteratively from the left, then the foot boundaries are removed after the main stress has been assigned, leaving only a single foot per word (cf. Halle and Vergnaud 1987). However, in constraint-based frameworks such as OT, this kind of process is not recognized, since forms are evaluated in a single shot. The only representations that are relevant for any evaluation in classic OT are an input and an output, without any intermediate forms in between, so any structure necessary for the interpretation of some phenomenon must be present in one of these two.

It is therefore suggested that, at least for the analysis of Cairene Arabic, the existence of headless feet be acknowledged. The only step that needs to be taken to allow this is to formalize the functioning of the Faithfulness Condition as a violable constraint, which is a perfectly natural step to take considering the fact that *all* phonological, principles, conditions and parameters are operationalized in this manner in OT. For languages in which all prosodic constituents have heads, **FTHCON** is undominated, but for others

[14] The name of the constraint **RHTYPE=T** indicates that its satisfaction results in a left-headed foot of the trochaic rhythmic type, as opposed to **RHTYPE=I** whose satisfaction results in a right-headed foot of the iambic rhythmic type.

such as Cairene Arabic, it can be minimally violated for the sake of satisfying more highly ranked constraints.

The key interaction proposed to account for the restriction of a single stressed syllable per word involves the concept of *positional markedness* (cf. Zoll 2004), the theoretical inverse of the case involving positional faithfulness discussed in Section 2.2 above. Here we need two structural markedness constraints: context-free **FTHCON**, which demands that every foot has a head, and context-dependendent **FTHCONHD**, which demands the same yet applies only to the head foot in each word. Sandwiched between them is another markedness constraint ***PROM(INENCE)**, which militates against the existence of stressed syllables, formalizing the universally and inherently marked nature of stress. Meanwhile, **PARSE** demands that feet be parsed, whether or not they have heads. The interaction of these three constraints is illustrated in (14).

(14) Accounting for a single stress per word with Positional Markedness[15]

	FTHCONHD	***PROM**	**PARSE**	**FTHCON**
a. (ˌσσ)(ˌσσ)(ˈσσ)		*!**		
b. σσ σσ (ˈσσ)		*	*!***	
c. (σσ)(σσ)(σσ)	*!			***
☞ d. (σσ)(σσ)(ˈσσ)		*		**

Since all of the syllables of candidate (14a) are members of feet, **PARSE** is fully satisfied. Both the context-free and context-dependent Faithfulness Condition constraints are satisfied as well, since each of its feet has a head. However, the secondary stresses on the first two feet of the word render candidate (14a) suboptimal in comparison to candidates (14b) and (14d) due to its extra violations of ***PROM**, the markedness constraint that militates against the occurrence of stress. Candidate (14b) satisfies the head-specific Faithfulness Condition since its head foot itself has a head, yet it is killed by underparsing of syllables. In contrast, candidate (14c) is fully parsed but lacks even a single stressed syllable, leading to violations of both **FAITHCONHD** and **FAITHCON**, the former of which is fatal. Candidate (14d) thus emerges as the optimal form, with all of its syllables parsed but with only a single stressed syllable, the head syllable of the head foot of the prosodic word. This constraint interaction demonstrates how a word can be maximally parsed yet lack secondary stress, a vital characteristic of the Cairene Arabic stress system, without which stress could not be accurately predicted.

[15] Note that this is a general schematic analysis, applicable to Cairene Arabic but using representations that do not correspond precisely to the specific prosodic structures of the language.

3.8 Summary of Cairene Arabic case study

In this case study it has been demonstrated that the basic pattern of Cairene Arabic stress involves simply the parsing of maximally bimoraic feet from the left, all except the final of which are headless, as well as the moraic resistance constraint $\mathbf{*\mu]_{FT\cap PW}}$, which prevents a word-final mora from being parsed (or alternatively, any parsed mora from being word-final). The various patterns predicted by the constraint rankings presented in Sections 3.3-7 are summarized in (15) below, grouped into words with final, penultimate and antepenultimate stress, in that order. While the data comes from Mitchell (1960), cited in Al-Jarrah (2008), the foot boundaries are placed in accordance with the predictions of the current proposal.

(15) Predicted parsings of stress patterns in Cairene Arabic

a. Final stress

(ka)(ˈtabt)	(duk)(ˈkaan)	(ba)(ˈbeen)	(hasa)(ˈnein)

b. Penultimate stress

(a)(ˈmal)ti	(ma)(ˈkaa)tib	(ka)(ˈtab)na	(kata)(ˈba)taa

c. Antepenultimate stress

(ˈkata)ba	(mux)(ˈtali)fa	(ˈšaja)rah	(ˈtuhu)maa

As an inspection of the data in (15) reveals, the proposed analysis predicts the location of stress in Cairene Arabic in a simple and reliable fashion, and without the need to recognize the existence of trimoraic syllables or the concepts of extrametricality or nonfinality. Most important of all for the present proposal, the analysis hinges on a constraint that embodies the concept of prosodic repulsion, in this particular case a moraic resistance constraint that bans parsed moras from occuring word-finally. As remarked in Section 3.3 above, the apparent effects of this constraint are two-fold, accounting for all of the data yet in two seemingly different ways. For words with final stress as in (15a) above, the moraic content of the final foot resists the edge of the prosodic word, with a single nonmoraic consonant in between them serving as a buffer to hold them apart. In contrast, for words such as those shown in (15b) and (15c) above, the final syllable of words with penultimate and antepenultimate stress has no nonmoraic consonant available to serve as a buffer. As a result, this final foot is unparsed, and the head foot of the word is pushed backward to the left, resisting the right edge of a word with a whole syllable serving as a buffer in between them to hold them apart. In this manner, a single moraic resistance constraint accounts for the structure of all words, demonstrating the flexibility and scope of the concept of prosodic repulsion.

4. Conclusion

This paper has provided an introduction to the concept of prosodic repulsion, a force of resistance between phonological entities that is proposed to account for several seemingly disparate and heretofore unconnected phonological phenomena across human languages. In the introduction, three basic aspects of phonological structure (i.e. nonfinality in metrical structure, onsets in syllable structure and binarity in foot structure) were re-considered through the lens of prosodic repulsion, and it was demonstrated that each of these aspects of phonological structure can be understood as the result of resistance between an element of a prosodic constituent and an edge of that constituent. This element is attracted to the edge while simultaneously being repelled from it, and the balance of these two opposing forces holds the constituent together and defines its structure. Such a view not only provides a simple, unified understanding of key aspects of prosodic structure, but also allows positively stated structural requirements to be replaced by negatively stated bans on marked structures, satisfying one of the basic desideratum of phonological theory.

Two case studies were then presented in order to demonstrate some of the ways in which the concept of prosodic repulsion can be applied to the re-analysis of old problems. In the first of these, a constraint banning word-final strong morae was proposed to account for the disparity in English between words with final stressed bimoraic syllables such as *kangaróo* and words with final unstressed bimoraic syllables such as *búffalo.* In the second case study, a constraint banning word-final morae from being parsed into feet was proposed to account for the notoriously complex pattern of stress in Cairene Arabic. Both of the proposed constraints crucially involve the resistance of moraic elements to the edges of prosodic constituents, representing a specific subtype of prosodic repulsion constraints that are referred to above as *moraic resistance* constraints.

The potential applications of the concept of prosodic repulsion appear to be many, and it is hoped that much future work with this concept lies ahead. Starting with English prosodic theory alone, a few of the phenomena that can be explored through the lens of prosodic repulsion are primary stress retraction, the lexical category prominence rule (Liberman and Prince 1977), final consonant nonmoraicity, and noninitiality. Extended to other languages, it is anticipated that the concept of prosodic repulsion can be used to revitalize our understanding of a vast range of areas, including nonfinality (and noninitiality[16]) phenomena in metrical, tonal, accentual and intonational systems, phonotactic patterns revealed in distributional regularities, and universal structural patterns of basic phonological entities such as those briefly touched upon in this paper.

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[16] Although reference to left-edge prosodic repulsion does not extend beyond the brief discussion of **ONSET** in section 1, it is contended that, much like alignment constraints, prosodic repulsion constraints are symmetrical in that their effects can be found at both left and right edges of phonological constituents. Future work on the application of left-edge prosodic repulsion constraints to metrical and tonal phenomena is in the making.

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