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Emergent iambs: stress in Modern Hebrew☆

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Abstract

A comprehensive analysis of stress in nouns and verbs in Modern Hebrew has eluded metrical phonologists for some time. This is most likely due to the fact that on the surface, Modern Hebrew appears to employ quantity-insensitive iambic feet. By contrast, developing the typology of feet in Modern Hebrew appears to result in syllabic trochees for the purpose of secondary stress assignment. Here, we propose a metrical constraint hierarchy that generates the correct footing for forms of any number of syllables and assigns main stress on a final syllable and secondary stress on alternating syllables to the left. No foot-type is explicitly demanded by any constraint; iambic structure is not imposed through any specific constraint on foot form, but rather *emerges* as the result of the interaction between constraints on prosodic structure. Additional complications arise in the verbal system, in which main stress is no longer necessarily final. In our analysis, we adopt the framework of Optimality Theory (OT; Prince, Alan, Smolensky, Paul, 1993. Optimality Theory: Constraint Interaction in Generative Grammar. Ms, Rutgers University and University of Colorado, Boulder). We provide an OT account of these facts, connecting them to the well-known observation regarding the relation between the seemingly irregular verbal stress pattern and a pattern of vowel deletion. We argue that the Modern Hebrew metrical system does not make any explicit reference to particular foot types. Our proposal also accounts for rhythmic secondary stress. To our knowledge, this is the first analysis that successfully accounts for Modern

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Hebrew stress in both verbs and nouns, showing that a unified approach captures important empirical generalizations concerning the prosodic organization of the language.

Keywords: Modern Hebrew; Stress; Optimality Theory

1. Introduction

The metrical structure of Modern Hebrew (MH) has consistently posed a difficult challenge to phonologists and to phonological theory. This challenge arises due to the interaction of various factors in determining stress location in the language. Previous accounts concentrated on the observation that the MH stress system is morphologically and lexically controlled; as summarized in Hayes (1995: 32), in this type of system, "surface stress is the result of a complex interplay of stem type (accented vs. unaccented) and diacritic properties of affixes.(...) Such systems often have a rhythmically determined default pattern, which is found where none of the morphemes of the word asserts its own accentual preferences". For MH, attention has been given to the relevant morphological processes and/or lexical specifications of accented morphemes and to the sets of controlled items, i.e., the so-called exceptional stress patterns. Little attention, however, has been given to the phonological mechanism of stress assignment, particularly to the observation that MH seems to be one of the few studied languages of the world displaying a system of the *leftward, weight-insensitive iambic type*.

The analysis we present in this paper focuses on the phonological mechanism of stress assignment; in other words, on the assignment of regular stress. Analyzing regular stress implies systematically defining the sets of items which are necessarily morphologically or lexically controlled, as opposed to the rest of the lexical items, which are considered to be regularly stressed. A welcome consequence of our analysis is that most of what earlier analyses dealt with as exceptions—that is, morphologically/lexically controlled cases—is actually brought under the default stress pattern under our account, thus greatly simplifying the structure of the MH lexicon, while allowing for a unified account of the stress pattern of the majority of the MH vocabulary. In particular, it provides a unified account of stress in both nouns and verbs, a result which has until now eluded previous research on MH metrical structure.

Most earlier accounts of MH stress (Rosen, 1977; Bolozky, 1978; Melčuk and Podolsky, 1996; Falk, 1996; Bat-El, 1993) concentrate to a large degree on explaining exceptional or lexical stress in the language. Regular stress was taken to be word-final, such that all deviating items were treated as exceptions. These analyses were concerned with the generation of *deviating* stress patterns via various special rules or devices, and failed to analyze concretely regular stress and all patterns that might be a part of it. As a result, these previous investigations disagree as to the foot structure of MH (iambic vs. trochaic) and are unable to provide a unified account of nominal and verbal stress.

In this paper, we put forth an account of the regular pattern of MH stress, which can be summarized as word-final, or right-headed stress. The account is couched within the constraint-based approach of Optimality Theory (OT; Prince and Smolensky, 1993). This framework allows for a principled, unified account of both the morphological/lexical and the phonological components of the stress assigning system by way of universal principles.[1]

The phonological component of stress assignment is characterized by generating surface quantity-insensitive iambic feet from right to left. Although the even iambic foot is considered to be a universally dispreferred structure, in the analysis presented here, the right-headed character of the language is not bypassed through the imposition of a trochaic analysis for the sake of theory-preservation. Rather, it is accounted for by familiar prosodic principles. In cases where the appearance of iambic feet is warranted, we claim, they arise through the desire to satisfy particularly high-ranking constraints on the alignment between clearly motivated morphological and prosodic categories in the verbal system, or through purely rhythmic principles in the nominal system. We achieve this result without necessitating such feet through constraints explicitly demanding iambic structure: such feet turn out to be *emergent* under the correct ranking of markedness constraints. A desirable consequence of the analysis is that the quantity-insensitive iambic foot, a universally dispreferred prosodic structure, is not referred to at all. We show that there is no need to enrich metrical theory by positing this foot type.

In the verbal system, the correlation between the morphological category of stem and stress placement is empirically robust, as recognized by several earlier accounts (Rosen, 1977; Bolozky, 1978), but in our account no lexical marking is required: this fact is accounted for through well-motivated constraints on the prosody–morphology interface. There is no need, in our system, to treat the most common stress pattern observed in the verbal system as exceptional, and so a unified account of nouns and verbs is achieved.

To briefly sketch the structure of the remainder of the paper, Section 2 below contains some theoretical background, followed by a discussion of the data, showing the quantity-insensitive nature of stress assignment in nominal and verbal forms in MH. In Subsection 2.4. we touch on the cases which are not regularly stressed and are excluded from our analysis. Section 3 establishes the metrical constraint hierarchy in the language through the interaction of well-established constraints. Additionally, the analysis accounts for the placement of both primary and secondary stress. In Section 4 we turn to the cases of morphologically complex forms in the verbal paradigm of MH, which seem to exhibit an irregular stress pattern: rather than the typically Hebrew pattern of final stress, some verbal forms exhibit penultimate stress. These data, we show, are explained through a single high-ranking alignment constraint, which interacts with elementary prosodic

[1] The component of the grammar treating lexically assigned stress is treated in detail in Graf (2000), where it is also shown that both components are compatible subsets of one unified grammar.

well-formedness demands to produce the attested pattern. Finally, Section 5 concludes the paper.

2. The data: final stress and quantity-insensitivity

In his discussion of the varying ways in which prominence is expressed, Hayes (1995) develops a typology of foot patterns based on rhythmic principles. The result is the well-known Iambic–Trochaic law:

(1) Iambic–Trochaic Law (Hayes, 1995: 80)
   a. Elements contrasting in intensity naturally form groupings with initial prominence (i.e., trochees).
   b. Elements contrasting in duration naturally form groupings with final prominence (i.e., iambs).

We focus here on the clause in (b), which is relevant to MH given the word-final stress pattern which is presented below. One way in which to interpret this statement is that languages with iambic systems are predicted to be quantity-sensitive, since (b) states explicitly that iambic systems involve contrasts in duration. Given this conclusion we do not expect to encounter a language that forms groupings with final prominence without also having "elements contrasting in duration". In this respect, MH has always been puzzling to metrical phonologists: it is a quantity-insensitive language, yet seems to display iambic stress.

2.1. Bisyllabic forms

Beginning our empirical survey of MH stress, we first see that the all regular two-syllable words in the language display final stress,[2] regardless of the weight of the final syllable, and also regardless of the weight of the first syllable.[3] This is demonstrated in (2):

[2] We ignore all nominal forms which display exceptional penultimate stress in the singular and final stress in the plural, particularly *Segolate* noun forms such as *kélev* 'dog' / *klavím* 'dogs'. Segolates are additionally exceptional in that they fit in a fixed pattern of the form CeCeC (where C = consonant) in the singular and the form CCaC-*pl.* in the plural. Such forms compose a distinct class of nouns. An analysis of segolate stress depends strongly on the assumptions made on the lexical representation of these nouns, representations that have to account for the peculiarities briefly sketched above (cf. Bat-El, 1993; Graf, 1999, 2000). We set such cases aside here; see Section 2.4.

[3] Although the forms given in (2i) are vowel-final, most Hebrew stems are consonant-final. For historical reasons, certain final consonants (gutturals) in Hebrew have been lost. The requirement that words end in consonants is also seen in Arabic stems, as well as in some dialects of English, and has been formalized as FINAL-C by McCarthy (1993) and Gafos (1998) for Modern Hebrew, and Wiese (2001) for German.

(2) Stress in two-syllable words: consistent final stress

(i) .(C)CV.CV. words

		Hebrew word	*Gloss*
Nominal	a.	kalá	'bride'
	b.	tipá	'drop'
	c.	galí	'wavy'
	d.	sadé	'field'
	e.	kfi͡tsá	'jump'
Verbal	f.	ro?é	'see, masc.sg.pres.'
	g.	milé	'fill in, 3.masc.sg.past'
	h.	baná	'build, 3.masc.sg.past'
	i.	nedá	'know,1.pl.fut.'

(ii) .CV.CVC. words

		Hebrew word	*Gloss*
Nominal	a.	madáf	'shelf'
	b.	t͡sibúr	'public'
	c.	xolít	'dune'
	d.	raxú͡ts	'washed'
Verbal	e.	gadál	'grow, 3.masc.sg.past'
	f.	mevín	'understand, masc.sg.pres.'
	g.	munáx	'lying down (masc.part.)'
	h.	torid	'take down, 3.fem.sg.fut.'

(iii) .CVC.CVC. words

		Hebrew word	*Gloss*
Nominal	a.	kartís	'ticket'
	b.	mispár	'number'
	c.	kaftór	'button'
	d.	maslúl	'route'
	e.	potxán	'can opener'
Verbal	f.	hitxíl	'begin, 3.masc.sg.past'
	g.	nixnás	'enter, 3.masc.sg.past'
	h.	huxlát	'be decided, 3.masc.sg.past'
	i.	magdíl	'enlarge, masc.sg.pres.'

(iv) .CVC.CV. words

		Hebrew word	*Gloss*
Nominal	a.	simlá	'dress'
	b.	dugmá	'example'
	c.	mi͡tspé	'viewpoint'
	d.	xofʃí	'free'
Verbal	e.	kantá	'buy, 3.fem.sg.past'
	f.	mufné	'directed (masc.part.)'
	g.	dibrú	'speak, 3.pl.past'
	h.	nirgá	'calm down, 3.masc.sg.past'
	i.	lakxá	'take, 3.sg.fem.past'

Given the uniformity in stress placement throughout all possible combinations of two-syllable words, we conclude that MH cannot be quantity-sensitive. This claim is not novel, and has been advanced in earlier work (e.g., Bolozky, 1982; Bat-El, 1994; Graf, 1999). In contrast to earlier stages of the language, e.g., Tiberian Hebrew, which was a quantity-sensitive system displaying a moraic structure as shown in the works of Prince (1975), McCarthy (1979) and Rappaport (1984), MH has lost the distinction between long and short vowels as well as between geminated and non-geminated consonants. This generalization holds throughout the language; except for a number of lexicalized items, there is no basis to assume moraic structure under a synchronic view.[4] From these observations we conclude that MH has no prosodic structure below the level of the syllable; in particular, there is no evidence for moraic structure in the language. A CV syllable is as heavy as a CVC syllable, and there are no CVV syllables. From the data above we see that the pattern of stress for bisyllabic forms can be described as invariant final stress, shown in (3):

(3) Regular stress in bisyllables
σσ́

2.2. Trisyllabic forms

Moving on to words with three syllables, we encounter the following generalizations: in trisyllabic words, primary stress is final, and there is secondary stress on the initial syllable. This is illustrated by the data in (4) below.

[4] There are many words in MH that are monosyllabic. The majority of these words display the structure CVC or CCVC, though there are some rare exceptions of the structure CV. We assume the minimal word to have been bimoraic in Tiberian Hebrew, exemplified in words like *dod* 'uncle'. MH preserved these words as part of the lexicon, but with the change in the language the minimal word became bisyllabic and restricted to derived forms.

(4) Stress in trisyllabic words: final primary stress, initial secondary stress

		Hebrew word	*Gloss*
Nominal	a.	jìsraʔél	'Israel'
	b.	tàxaná	'station'
	c.	pàʔamón	'bell'
	d.	xàlomí	'fabulous'
	e.	tàvliním	'spices'
Verbal	f.	hìtkatév	'correspond, 3.masc.sg.past'
	g.	nìftexá	'to be opened, 3.fem.sg.past'
	h.	yìgamrú	'to be finished, 3.masc.pl.fut.'
	i.	màvtixím	'promise, masc.pl.pres.'

This pattern is pervasive in all regular trisyllabic words, the majority of which are morphologically complex. According to our findings morphological complexity—whether a word is monomorphemic vs. polymorphemic—does not play any role for regular stress assignment. We have not included any examples here involving lexically marked stems, which preserve their main stress even under affixation, nor examples with lexically marked suffixes, which force stress to fall on a certain syllable in the complex word. We are only concerned here with establishing the behavior of regular, non-lexically marked stress. For such forms, the stress pattern may be schematized as in (5):

(5) Stress in trisyllables
ὸσσό

2.3. *Quadrisyllabic forms*

The pattern of stress in forms with four syllables is not surprising: we observe final primary stress with secondary stress appearing on the antepenultimate syllable. This shows that secondary stress is truly of the rhythmic alternating type, as shown by Bolozky (1982). Descriptively, secondary stress is iterative and is assigned to every other syllable to the left of the main stressed syllable. Some examples of such forms follow in (6):

(6) Stress in quadrisyllabic words: final primary stress, antepenultimate secondary stress

		Hebrew word	*Gloss*
Nominal	a.	jisràʔelí	'Israeli'
	b.	mevùgarím	'adults'
	c.	histàʔarút	'attack'
Verbal	d.	memàharót	'hurry, fem.pl.pres.'
	e.	metàlfením	'phone, masc.pl.pres.'

This pattern is schematized in (7) below.

(7) Stress in quadrisyllables
σσ̀σσ́

So far we have presented cases of regular stress, which can be summarized as follows: Primary stress always occurs on the final syllable, with secondary stress occurring on alternating syllables to the left.

It should be noted that most of the quadrisyllabic forms consist of nominals. Verbal forms usually consist of no more than three syllables, as a consequence of templatic effects. The language prefers to leave stem material unparsed ('vowel deletion') rather than remain faithful to input material in order to meet rigid prosodic size restrictions. In this way, a verb form can be 'squeezed' into a bisyllabic or a trisyllabic structure, known in the literature as a *template*. Even nominals display vowel deletion for similar reasons, though the restrictions on the prosodic form of a nominal are much less rigid than those on the form of a verb. For this reason it is difficult to find examples of quadrisyllabic verbs, and it is even more difficult to find examples of any words longer than four syllables.[5]

As mentioned above, the data provided here include many polymorphemic forms, e.g. adjectives such as *gal-i* 'wavy' which are denominal, or inflected nouns such as *tavlin-im* 'spice-pl.' In the case of nominal forms, there is no evidence that the location of main stress is influenced by the morphological structure of the word, unless one of the morphemes carries lexically specified stress. These may involve lexically marked stems cf. *miljón* 'million, sg.'/*miljónim* 'million, pl.' or a set of lexically marked suffixes cf. *kibúts* 'kibbutz'/*kibútsik* 'kibbutz member.' As mentioned in Section 2.4, such cases will not be discussed in this paper. The examples given here involve only formatives that do not carry any lexical information on stress. The verbal forms are morphologically complex, since all stems have to be inflected. As we will show in Section 4, the notion of the stem plays a crucial role in the assignment of stress for verbs, but there is no indication of sensitivity to syllable weight.

[5] Loan words are a possible exception to the generalization. However, loan words usually preserve their stress pattern from the source language, and this deviating stress pattern must be learned; that is, they are lexically marked. Since loan words do not tend to obey the regular stress pattern of MH they do not concern us further here, though see Graf and Ussishkin (2002). Note further that even for nominals the number of suffixes that can be attached in a chain to a stem is restricted to three.

To account for the data shown in this section we turn in Section 3 to the analysis of default stress in MH: that is, primary stress on the final syllable, and in words with three or more syllables the assignment of secondary stress on alternating syllables to the left. However, before our analysis of the default stress system, we take a short excursion through exceptional stress patterns, and the reasons for their exclusion from our analysis.

2.4. Exceptions to regular stress

Earlier, we established the distinction between the phonological and the morphological/lexical mechanism of stress assignment. Further we claimed that in order to analyze regular stress it is crucial to define all items that are stressed *by necessity* due to some kind of lexical specifications, as opposed to the rest of the vocabulary which is stressed by default. In this section we touch briefly on all items in the language that are systematically excluded from being assigned stress by the regular, phonological stress mechanism.

2.4.1. Lexically marked morphemes

All previous work on the stress system have shown that some morphemes in MH must have accentual marking in order to explain deviating stress patterns or immobile stress (see especially Bat-El, 1989, 1993; Graf, 1999). These morphemes can be either stems or suffixes, mostly found in the nominal system, and are characterized as either accented or preaccenting. In words containing one or more such morphemes, word stress is not predictable. Rather, it is the result of an interaction between the lexically marked properties of different types of morphemes. Many of the nominals in MH display deviating stress resulting from the influence of lexical specification. Many, though not all, are borrowings which maintain the stress pattern of the source language. Consider the following, which illustrates a case of immobile stress.

(8) Immobile stress: final in the singular, non-final when suffixed

Hebrew form	*Gloss*	*Suffixed form*	*Gloss*
ʒakét	‘jacket’	ʒakét-im	‘jackets’

Compare this with the case of an unmarked noun and its stress pattern under plural suffixation:

(9) Regular stress: final in the singular, final when suffixed

Hebrew form	*Gloss*	*Suffixed form*	*Gloss*
xavér	‘friend’	xaver-ím	‘friends’

Immobility of stress does not depend on the position of stress in the singular. Rather, it is obvious that stress should remain in the same position in the stem even when derived and/or inflected.

(10) Deviating stress: non-final in the singular, immobile when suffixed

Hebrew form	*Gloss*	*Suffixed form*	*Gloss*
ʔuniversita	'university'	ʔuniversit-ot	'universities'
doktor	'doctor'	doktor-it	'female doctor'

Graf (2000) proposes an analysis in which the idiosyncratic properties of morphemes are specified in the lexicon in terms of prosodic structure. The analysis shows that faithfulness to lexically specified structure outranks all other prosodic demands of the grammar with the result of preserving the location of lexically specified stress. In other words, lexical stress has priority over phonological stress.

The issue of the present paper is to explore the *phonological mechanism* of stress assignment, i.e., the phonological pattern. The OT grammar we develop generates stress for all items which have no specification for stress in their lexicon entry. The exclusion of the component of the grammar which generates stress location for lexically marked items can be shown to proceed systematically. This is done on the basis of the principle that "lexical stress has priority over phonological stress". In a nutshell, the grammar of Hebrew involves constraints expressing faithfulness to lexically specified prosodic structure (lexical stress) which outrank general faithfulness constraints, alignment constraints and prosodic well-formedness constraints (together labeled the *metrical constraint hierarchy*). Thus, the metrical constraint hierarchy, which is the issue of the current paper, is a subset of the general constraint hierarchy responsible for stress assignment (and other prosodic structures) in Hebrew.

In the case a morpheme has *lexical* specification for stress, the lexical faithfulness constraints apply and generate a form which is as faithful as possible to its input in that respect. For example, a constraint such as MAX-HEAD-FT, which demands that "Every head-foot of the input has a correspondent head-foot in the output", would correctly preserve lexically specified stress. If, however, the morpheme has no lexical specification, the lexical faithfulness constraints have no focus of operation and are thus irrelevant. The decision regarding the location of stress is transferred to the lower-ranking constraints, i.e., the metrical constraint hierarchy. This is schematized in the following ranking:

(11) LEXICAL FAITHFULNESS CONSTRAINTS ≫ METRICAL CONSTRAINT HIERARCHY

2.4.2. Nouns classes with deviating stress patterns

In this section we discuss nouns which can be systematically grouped in classes according to their semantics or their morphological structure. All groups discussed here are productive classes.

Words with more than one stress pattern include proper names or children's word games. The typical situation for these items is that stress location is the principal and salient cue in a nuance of their meaning. Otherwise the language does not allow for a change in meaning via stress shift. In *children's games*, there exist words such as *kláfim* 'cards', where stress lies on the penultimate syllable. In the standard use of the word stress lies on the final syllable: *klafím*. The word *klafím* signifies cards in a general sense of the word. Children's *kláfim,* however, refer only to the cards the children are playing with at the time. This, and similar cases, can be straightforwardly explained by assuming that it is possible to assign a word a new meaning, or at least a new nuance of meaning by changing stress location. *Proper names* show a similar phenomenon. Almost all proper names in Hebrew are also lexemes: each name carries a distinct meaning apart from its property as a proper name. Here too, stress is used for a semantic distinction. The standard meaning of the word *dafná* 'laurel' is expressed by the standard stress location, whereby the property of being a proper name is expressed by shifting stress one syllable to the left *dáfna*. The same thing can be observed for the word *ʔadám* meaning 'human being, person' as opposed to the proper name *ʔádam* with penultimate stress. This is a similar situation to the well-known phenomenon in English, where stress location functions as the sole factor in determining a word's lexical class: *súspect* (noun) vs. *suspéct* (verb).

In any theoretical framework the same observation can be made: changing stress location causes a change in meaning. We suggest that this strategy is available to speakers, and that it is used only in a specific domain. This domain belongs in a periphery of the lexicon, and its nature can be described according to a lexical model along the lines of Paradis and LaCharité or after Ito and Mester, which differ not so much in the proposed structure of the lexicon, but rather in the analysis of the mechanisms active in the various domains (see Paradis and LaCharité, 1997; Ito and Mester, 1994, 1995). For the OT analysis, change in stress location can be expressed by demoting the constraint which binds primary stress to the right edge [RIGHTMOST($\acute{\sigma}$)] concretely for this purpose.

Acronym words are stressed according to the general rules of the language on the final syllable, just as predicted by the grammar. However, once stress is 'fixed' for the singular form, it becomes immobile even when neutral suffixes are attached.

(12) Examples of Hebrew acronym words

Acronym word	*Gloss*	*Inflected form*	*Gloss*
magád	'commander of a regiment'	magád-im	'pl.'
mankál	'general director'	mankál-it	'fem.'
samankál	'vice general director'	samankál-im	'pl.'

Acronym formation seems to obey the core grammar of MH (see Bat-El, 1994) with regard to constraints on the prosodic structure of the syllable, including the assignment of stress. What is exceptional is the immobility of stress under suffixation, which can be analyzed as an output–output relation between words. Acronym words belong in a peripheral domain of the lexicon, where the word's similarity to the base is kept as close as possible. Stress location is a property which allows easier identification of the base and as such should be kept in place. In this respect acronym words are similar to loanwords, and could even be said to share a part of a domain with them. We assume that OO-IDENTPEAK outranks RIGHTMOST(σ́) in this domain. This ranking holds for loanwords as well.[6]

It is beyond the scope of this paper to develop a complete model of the lexicon including all sub-domains. However, this brief overview aims to show that it is possible not to solely *list* the exceptions to the stress rules, but also to analyze them systematically. Within the appropriate model of the lexicon this is accomplished through defining lexical domains according to their specific properties and connecting these properties to particular constraint rankings. The defined domains may overlap and lay the foundations for a complete domain map of the lexicon.

Segolates is the traditional term for a group of nouns with penultimate stress in the singular, such as *mélex* 'king'. This class contains a large number of items and is very productive. This seems to be a problem for all descriptions and analyses of the language, which claim that regular stress lies on the final syllable. How can we explain the location of stress on the penultimate syllable for these nouns? Segolates all exhibit the following properties which define them as a nominal class:

(13) Properties of Segolates

	Property	*Example*	
(i)	they fit in a fixed pattern in the singular: CeCeC or CoCeC	kélev	'dog'
(ii)	they fit in a fixed pattern in the plural: CCaC-pl.	klav-ím	'dogs'
(iii)	they build a different stem form for derivational purposes CVCC	kalb-á	'bitch'
(iv)	stress is penultimate in the singular	kélev	
(v)	stress is final in the plural	klavím	
(vi)	stress is final in the derived form	kalbá	

Since the Segolates comprise a well-defined, productive class, penultimate stress in the singular cannot be a lexical property of a singular item: it is obviously a characteristic of the entire class and does not have to be learned for every single item. Based on facts from Tiberian Hebrew, the traditional explanation for the stress pattern has been that the second [e] in the singular form of a Segolate is epenthetic,

[6] For further details concerning this domain, especially for loanwords, see Graf and Ussishkin (2002).

inserted in order to break the impermissible CC-coda cluster. Several theoretical treatments are found in the literature explaining why an epenthetic vowel cannot be stressed, such that the only stressable syllable remaining is the penultimate syllable. In a synchronic analysis, however, there is not much support for the claim that the second vowel of the singular stem is epenthetic. Some other mechanism is needed to explain the systematic assignment of stress to the penultimate syllable in dependency on morphological information. An analysis of Segolate stress depends strongly on the assumptions made regarding the lexical representation of these nouns, representations that have to account not only for stress assignment but for stem alternations as well. Previous studies have dealt with the class of the Segolates (cf. Bat-El, 1993; Bolozky, 1995; Graf, 1999) but a satisfactory, comprehensive account is yet to be given.

2.4.3. Verbs

Stress location in the verbal system is not very homogenous. Verbal paradigms display final as well as penultimate stress in different environments, such that surface observations may lead to a complicated classification of verbal forms. Previous treatments have allocated the assignment of stress to diverse minor rules (e.g., Bolozky, 1978). The analysis we present in this paper shows that the largest pattern of "exceptional stress" for verbal forms is in fact a case of regular stress assignment (see Section 4). There are, however, two patterns of deviating stress which are not predicted by our grammar. These patterns surface systematically and seem to depend on segmental and morphological information.

Hifʕil forms—the verbal forms formed in the *hifʕil* derivational class (or *binyan*; plural = *binyanim*) display penultimate stress where we expect final stress:

(14) Deviating *hifʕil* stress (inflected forms of *sagár* 'he closed' and *hisgír* 'he turned in')

	Past	Present	
	paʕal	*hifʕil*	*hifʕil*
1.sg.	sagár-ti	hisgár-ti	masgír
3.sg.fem.	sagr-á	**hisgír-a**	masgirá

In (14) a partial paradigm makes a comparison between the *paʕal* and *hifʕil* forms where person, number, gender and tense are equal. When the suffix is consonant-initial the forms in both binyanim behave alike. However, when the suffix is vowel-initial, the *paʕal* form is stressed on the suffix, whereby the *hifʕil* form is not. Our grammar predicts the wrong form here, namely **hisgir-á*. A possible explanation for the form *hisgíra* with stress on the penultimate syllable is connected to the nature of the vowel [i]. There is evidence that high vowels in general and the vowel [i] in particular cannot be subject to deletion or reduction, in contrast to the other three non-high vowels of the language [a], [e], [o]. Notice, though, the comparison of the *hifʕil*

form in the past tense with the *hifʕil* form in the present tense, which shows that the location of stress cannot be solely a result of phonological or prosodic considerations. The syllabic structures of *masgirá* and *hisgíra* are exactly the same. The segmental structure is the same except for the prefix (*ma-*/*hi-*) which is the marker of tense. We must conclude that stress location is partly dependent on morphological information.

Monosyllabic stems display a systematic deviation in stress location. In these cases (known in the literature as stems of biradical roots) stress lies on the penultimate syllable even when we expect it to fall on the final syllable, in a similar manner to the case of *hifʕil* discussed above:

(15) Monosyllable *paʕal* forms vs. regular *paʕal* forms

Paʕal form	*Gloss*	*Inflected form*	*Gloss*
kám	'he got up'	**káma**	'she got up'
sagár	'he closed'	sagrá	'she closed'

Comparing the feminine form of a biradical stem with the common case of a triradical stem we can see that a grammar that generates default final stress predicts the wrong form (**kamá*). There is, however, no obvious phonological or prosodic reason for stress to remain on the prefinal syllable in forms like *káma*. Thus, we conclude that some morphological information is crucial for stress location in this restricted class of stems.

3. Establishing the metrical constraint hierarchy

We begin with a sketch of an analysis in the framework of the parametric theory following Hayes (1995). This is done in order to demonstrate the problems connected with MH stress assignment from the standard point of view as well as to ascertain the limitations of the parametric theory in solving those problems. As an alternative, we propose an OT analysis, demonstrating how the peculiarities of MH stress are accounted for by a simple constraint hierarchy. This analysis will be shown to solve the theoretical and empirical problems that arise in the parametric analysis, thus exposing these problems as being conditioned by the theory itself.

In a parametric theory (Kager, 1993; Hayes, 1995), the construction of feet in MH is determined by setting the parameter 'Directionality' for 'right-to-left', the parameter 'Iterativity' for 'iterative' and the parameter 'Degeneracy' for allowing degenerate feet. The setting of the parameters 'Manner of Parsing' (top-down or bottom-up) and 'Prominence' (iambic vs. trochaic) is, in contrast, not dependent on empirical facts but rather on theoretical considerations anchored elsewhere, as will be shown below. The setting of the parameter 'Foot Type' for 'syllabic' will be taken

for granted here, based on the data shown in section 1 which demonstrates the quantity-insensitive nature of MH, and based on research done elsewhere (Bolozky, 1982; Bat-El, 1994; Graf, 1999).

MH stress poses a basic problem for the parametric theory of Hayes, together with a small number of other languages displaying a similar kind of system (e.g., Turkish, Tübatulabal, Javanese, Weri). These systems demand exhaustive footing from right-to-left, but place primary stress on the final syllable, thus excluding the common pattern of trochaic structure (...σσσσ...)[σ́σ]. This observation thus suggests assigning iambs from right-to-left, but as Hayes (1995: 262 ff.) demonstrates, the existence of such systems is hard to prove. A further complication for the intuitive observation is the fact that MH is quantity-insensitive. In his discussion of the varying ways in which prominence is expressed, Hayes (1995) develops a typology of foot patterns based on rhythmic principles. As discussed above, the result is the well-known Iambic–Trochaic law.

Given these universal tendencies, iambic systems are expected to be quantity-sensitive. Moreover, according to the Iambic–Trochaic Law quantity-insensitive iambs do not belong to the universal foot inventory. If we accept this theoretical move, MH should not be analyzed as an iambic system, no matter how any other parameters might be set. We are thus confronted with an apparent iambic system which, according to metrical theory, cannot be iambic. The other possibility is to posit a trochaic system, which would be permitted by the theory since quantity-insensitive trochees are attested cross-linguistically. A trochaic system, however, can hardly account for the empirical observations presented above. Note that this paradoxical state of affairs does not even take into consideration all additional lexically and morphologically conditioned complications attested in the system. Previous treatments of the MH stress system are confronted with the questions of whether it is an iambic or a trochaic system, and how to unify the analysis of the nominal system (displaying mostly final stress) with the analysis of the verbal system (displaying both final stress and penultimate stress), but until now, none have yielded a satisfactory solution.

An attempt to analyze the MH regular stress pattern after Hayes (1995) is presented in Graf (1999). Here we will only point out the main relevant points of this earlier work, in which the analysis is based on trochaic feet.

With respect to bisyllabic forms [as presented in (2) above], it is clear that there is no way to assign canonical trochees to forms with only two syllables and final main stress. According to Graf (1999), the only possible footing parses such forms with the highly-marked structure σ[σ́], with one unfooted syllable and one degenerate foot. Longer, even-numbered forms (which have secondary stress) are assigned a similar structure, whereby one canonical trochee can be created: σ[σ̀σ][σ́].

Odd-numbered forms such as the trisyllabic words reviewed in Section 2 show a subset of the same marked structure: [σ̀σ][σ́]. The general form for foot construction consists of a final degenerate foot preceded by a canonical trochee if there is enough material to build one, and/or an unfooted syllable.

One difficulty for this type of analysis is that the majority of words in the language display a highly marked foot structure within this analysis: namely, a

degenerate foot. Such a structure can only be constructed on the basis of the following conditions:

i) Degenerate feet are allowed to stand only in a strong and not in a weak metrical position, following the Weak Prohibition on Degenerate Feet of Hayes (1995: 87).
ii) A strong metrical position must be licensed by bearing main stress.

The final degenerate foot cannot be automatically licensed, since under the trochaic account the language parses trochees from right to left. We might thus expect all such cases to contain a bisyllabic trochee at the right edge, but instead we find a foot containing a single syllable. What putatively forces the licensing of the final syllable as a degenerate foot is *top-down parsing*. This marked parsing manner (vs. the more common *bottom-up parsing*) imposes word stress on the final syllable as a first step in the derivation of footing. Thus, a marked foot structure must be licensed by a marked parsing mechanism.

Importantly, the setting of the parameter Headedness (or Prominence) of feet, for MH, a non-trivial matter, is only partially based on the Iambic–Trochaic Law ruling out syllabic iambs. The decision in favor of a trochaic analysis rises out of the necessity to comply with the limitations of the theory, especially the problematic issue of disallowing degenerate feet in weak metrical positions. Thereby the potential structure *[σ̀][σσ́] is blocked, in which the degenerate foot occupies a metrically weak position.

One way to account for this problem is the approach given in Kiparsky (1991), which proposes catalexis, a strategy essentially involving an invisible syllable at a word edge. This would result in a structure such as (16):

(16) Catalectic structure for trisyllabic forms
[σ̀σ][σ́*σ*]

The final syllable (appearing in an italic font) is catalectic, serving as a way to fill out and optimize the word-final trochaic foot. As a consequence, under a Kiparsky-type approach, MH would have trochaic feet in final position, with an invisible final catalectic syllable. Inkelas (1999) proposes a similar analysis of Turkish default stress, which is also final, assuming that the system is trochaic and involves a final trochaic foot composed of the word-final syllable followed by a catalectic syllable. We consider this approach to be problematic in general. For instance, catalexis would have to be restricted to applying in unmarked cases. This is because penultimate stress in MH, although attested, is a marked pattern. Restricting a structure as marked as a catalectic syllable to the unmarked pattern seems an unlikely explanation.

A trochee-based attempt at an analysis of MH stress results in serious faults, generating highly marked structures which are justified only by internal theoretical arguments. As we have already seen, an iambic attempt is theoretically undesirable. Thus we turn to the alternative, an OT analysis, where all evaluations are calculated

in parallel, and where serial derivations as manifested in a parametric theory are neither possible nor desirable.

3.1. OT analysis

Without defining the parameter 'Foot-Form' at the outset of the analysis, it is necessary to account for at least two properties of foot parsing: (i) the distribution of feet across the material in the word, accomplished here through a general ranking developed by Crowhurst and Hewitt (1995); and (ii) headedness of feet, which will be shown to be a result of constraint interaction rather than by any particular constraint stipulating foot form.

Work by Crowhurst and Hewitt (1995) has shown that the effects of directionality, iterative vs. non-iterative footing, as well as the existence and the location of degenerate feet, are due to the interactions between three constraints: AllFootRight (or Left), FtBin and Parse-σ.

(17) AllFootRight/Left (McCarthy and Prince, 1993b)

The right (or left) edge of every foot is aligned with the right (or left) edge of the prosodic word.

(18) FtBin (e.g., Prince, 1976, 1980; Liberman and Prince, 1977; McCarthy and Prince, 1986)

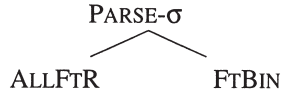
Feet are binary.[7]

(19) Parse-σ (e.g., Liberman and Prince, 1977; Prince, 1980; Hayes, 1987; Mester, 1994)

Every syllable is contained in a foot.

Crowhurst and Hewitt demonstrate how the relative rankings of these three constraints suffice to establish a typology of metrical stress patterns, which in the parametric theory are based on the independent parameters 'Iterativity', 'Directionality', and 'Degeneracy'. Right-to-left iterative footing in MH can be accounted for by the ranking given in (20):

(20) MH metrical constraint hierarchy



[7] Given the fact that MH has no moras (as established above), this constraint applies at the level of the syllable. However, see below for a more precise formulation of this constraint which will be adopted throughout the remainder of this paper.

This ranking provokes two structural consequences: (i) the construction of a foot in final position, an effect arising from the force of ALLFTR, and (ii) the construction of as many feet as possible from the available material, an effect due to high-ranking PARSE-σ. For bisyllabic forms, this ranking generates a structure with a single foot containing both syllables, thus satisfying all three constraints, as seen in tableau (21) (brackets indicate foot boundaries).

(21) Optimal parsing of bisyllabic forms

/σσ/	PARSE-σ	ALLFTR	FTBIN
a. [σ][σ]		σ!	*
b. σ[σ]	*!		*
c. [σ]σ	*!	σ	*
☞ d. [σσ]			

In the case of odd-numbered forms, where not all feet can be binary, the language strives for exhaustive footing, even at the cost of allowing degenerate feet. This is expressed explicitly in the above ranking by undominated PARSE-σ. This claim is borne out in trisyllabic forms, where main stress as well as secondary stress are found as in the structures in (22).

(22) Alternative footings for trisyllabic forms
(i) [σ̀σ][σ́] (ii) [σ̀][σσ́]

A further possible parsing posits a single ternary foot for such cases (i.e. [σ̀σσ́]). This alternative does not exist for MH as can be deduced from the existence of secondary stress in odd-numbered forms, which is indicative of the fact that there must be (at least) two feet present. This means that MH feet should be *maximally*, but not minimally binary. In order to distinguish between different cases of exhaustive parsing, FTBIN can be split into two separate constraints (cf. Hewitt, 1993, 1994; Everett, 1996, for a similar division):

(23) FTBIN decomposed
a. FTMIN[8]

A foot must branch into at least two syllables.

b. FTMAX[9]

Within a foot, every syllable must be aligned to some edge of that foot.

[8] The constraint FTMIN is based on work of Ussishkin (2000), where a similar constraint is proposed to account for minimal word effects in MH.

[9] The constraint FTMAX is based on Ito et al.'s (1996) Hierarchical Alignment, a concept developed to account for a Japanese ludling. The constraint also follows work of Ussishkin (2000) on the maximal size of prosodic structures in MH.

MH is an example of a language where degenerate feet are preferred over ternary feet, showing that violations of FtMin are tolerated, while violations of FtMax are not. Given this, we assume the ranking FtMax ≫ FtMin. Languages displaying metrical systems where ternary feet are attested support the opposite ranking FtMin ≫ FtMax. Since FtMax is never violated in MH, we will not include this constraint in subsequent tableaux. We will use the constraint FtMin as a more specific and precise version of the constraint FtBin in all subsequent evaluations.

Tableau (24) shows how so-called 'top-down parsing right-to-left' is generated with this OT grammar. The proposed ranking evaluates the construction of a degenerate foot on the final syllable and not on the initial syllable in trisyllabic forms as the optimal candidate, due to the effect of AllFtR.

(24) Optimal parsing of odd-numbered forms

/σσσ/	Parse-σ	AllFtR	FtMin
a. [σ][σσ]		σ!σ	*
b. [σ][σ][σ]		σ!σσ	* * *
☞ c. [σσ][σ]		σ	*

All three candidates exhibit exhaustive footing. Since all the candidates violate FtMin, and since all the candidates parse all syllables (such that Parse-σ is not violated), the decision about the optimal distribution of feet is transferred to the constraint AllFtR. Violations of this constraint are counted as the number of syllables that separate a foot edge from the edge of the prosodic word. Candidate (c), with a final degenerate foot, violates AllFtR only once and wins over candidate (a), which violates AllFtR twice, and candidate (b), which violates AllFtR three times. This is an important result considering the theoretical arguments and typological evidence brought forward in the parametric theory in favor of a structure such as [σσ][σ] in a leftward parsing language. As we have seen before, the correct footing for a leftward parsing language, as manifested in candidate (c), can be constructed only at the cost of the marked top-down parsing mechanism. The incorrect footing of candidate (a), which would have been the result of the unmarked bottom-up parsing from right to left, is prevented due to additional assumptions about the necessary licensing of degenerate feet. This result demonstrates the superiority of the OT analysis over the parametric analysis in several respects:

(i) There is no need for additional assumptions about licensing conditions. In fact, nothing is said about the location of stress at all. The optimal distribution of feet and the location of degenerate feet is achieved due to general, independently motivated principles of the theory. Hence, the controversy regarding degenerate feet in weak metrical positions is eliminated in a straightforward manner.

(ii) Although the direction of footing in the language is undoubtedly right-to-left (accounted for here by AllFtR), the correct footing for odd-numbered

forms seems to be the result of the inversion of footing direction, for which the parametric theory has no explanation.

(iii) The proposed constraint hierarchy generalizes the dependency between degenerate feet and the seeming inversion in the direction of footing (Crowhurst and Hewitt, 1995: 7ff.; Ussishkin, 2000: 75).

A further important result of the constraint hierarchy is that the resulting optimal structure does not relate to the issue of headedness at all—neither the issue of which syllable is head of a foot, nor the issue of which foot is head of the PrWd. There is no need in this framework to determine prominence of feet on a pre-analytical, theoretical basis, as was the case in the framework of parametric theory. As we shall see, headedness of feet is a result of interacting constraints.

The phonologically determined stress pattern in the language, apart from iterative footing, consists of assigning main stress consistently to the final syllable. This makes the final syllable the head of the head foot in the prosodic word as long as no morphological factors intervene. The proposed constraint hierarchy does not account for headedness yet, but generates only the general scheme of foot parsing. Assignment of main stress is achieved through a high-ranking constraint RIGHTMOST(σ́).[10]

(25) RIGHTMOST(σ́) (Cohn and McCarthy, 1994)
ALIGN-R (σ́; PrWd)
The main stressed syllable is final in the PrWd.

RIGHTMOST forces main stress to occur at the right edge of the prosodic word, resulting in the correct stress patterns shown in (26) and (27):

(26) Final main stress in bisyllabic forms

/σσ/	RIGHTMOST
a. [σ́σ]	σ!
☞ b. [σσ́]	

(27) Final main stress in trisyllabic forms

/σσσ/	RIGHTMOST
a. [σσ́][σ]	σ!
b. [σ́σ][σ]	σ!σ
☞ c. [σσ][σ́]	

[10] Kager (1999: 167 ff.) poses a different version of the same principle, whereby his RIGHTMOST constraint refers to the head *foot* and not to the head syllable.

3.2. Assignment of secondary stress

Secondary stress is assigned iteratively to every other syllable to the left of the main stress, marking the head of a non-head foot in a word longer than two syllables. Given that stress is alternating, we can account for this purely rhythmic pattern in a very straightforward manner by assuming unviolated *CLASH, which mandates against adjacent stressed syllables, and *LAPSE, which assess violations for adjacent stressless syllables, following Kager (1993).[11] These constraints are never violated in the language, so we assume their effects in subsequent tableaux even though they may not always appear. The correct metrical structure for the trisyllabic noun *jìsraʔél* 'Israel' is shown in (28) below.

(28) Trisyllabic nouns (*jisraʔel* 'Israel')

/jisraʔel/	*CLASH	RIGHTMOST	PARSE-σ	ALLFTR	FTMIN
a. [jisrá]ʔel		*!	*	σ	
b. jis[raʔél]			*!		
c. [jisrà][ʔél]	*!			σ	
d. [jìs][raʔél]				σσ!	*
☞ e. [jìsra][ʔél]				σ	*

Candidates (a) and (b), which fail to parse all syllables into feet are ruled out by PARSE-σ. Candidate (c) has one iambic foot preceding the final, main stressed foot. In this case two stressed syllables are adjacent such that *CLASH rules this candidate out. The remaining candidates (d) and (e) are a concrete image of the 'abstract' evaluation given in (21): the winning candidate (e) displays a final degenerate foot. The initial foot preceding this degenerate foot demonstrates that in this structure a left-headed foot is better than a right-headed one. Thus we find a trochaic foot followed by a final degenerate foot which is the head-foot of the PrWd. The same ranking accounts for the right-headed stress pattern in quadrisyllables, shown in (29):

(29) Quadrisyllabic nominals (*jisràʔelí* 'Israeli')

jisraʔel+i	*CLASH	RIGHTMOST	PARSE-σ	ALLFTR
a. jisra[ʔelí]			*!*	
b. [jìsra][ʔéli]		*!		σσ
c. [jisrà][ʔéli]	*!	*		σσ
☞ d. [jisrà][ʔelí]				σσ

[11] As the reviewer of this paper notes, *CLASH might be violated in Hebrew in compounds such as *tar.míl.-gáv*. 'backpack'. However, we take this observation to serve as evidence that a compound consists of two prosodic words, since a clash within *one* prosodic word is not possible.

In this case, one more candidate must be considered: one which correctly places primary stress on the final syllable, and which places secondary stress on the initial syllable: a candidate like [jìsra][ʔelí]. However, this candidate violates *LAPSE. Candidate (b), composed of left-headed feet—parallel to trisyllabic forms—is ruled out because of its violation of RIGHTMOST. The optimal candidate (d) parses two right-headed feet.

So far we have correctly generated the stress patterns in bisyllabic, trisyllabic, and quadrisyllabic forms. We have seen that in bisyllabic forms, main stress falls on the final syllable of the word. In trisyllabic forms, main stress falls on a final degenerate foot, and secondary stress falls on an initial bisyllabic trochaic foot. In quadrisyllables, both feet are iambic, a result of the interaction between ALLFTR and RIGHTMOST, in addition to the effects of *CLASH and *LAPSE. No syllabic iambic feet are stipulated, however, through any sort of FOOT-FORM constraint. Their presence is, rather, emergent through the interaction of constraints that the theory already needs. This accomplishes one of our principal goals in this analysis. The constraints composing the metrical constraint hierarchy are summarized in (30), with crucial rankings indicated.

(30) Constraint Ranking

We now turn to attested stress patterns in the verbal paradigm. Under suffixation some verbs display primary stress in penultimate position, a situation which our constraint ranking so far predicts to be impossible. We introduce further constraints, also well-motivated in the theory, to account for these data.

4. Penultimate stress in the verbal paradigm and morphology–prosody alignment

Stress location in the verbal system of MH is not as straightforward a matter as in the nominal system described above. The verbal system displays two stress patterns, final stress and penultimate stress, whereby penultimate stress was considered before now to be the irregular pattern, to be treated as an exceptional class. In contrast to nominals, not only suffixes but also prefixes are relevant for stress location in the verbal system. Verbal stems concatenate with suffixes indicating gender, person, and number. Verbal stems may also be prefixed for various derivation classes, the *binyanim*. The distribution of main stress across the verbal paradigm is shown in the following tableaux, for binyan *paʕal* without prefixes [see (31)] and for binyan *nifʕal* with prefixes [see (32)]:

(31) *Paʕal*: PAST and PRESENT paradigm of the verbal stem *sagár* 'close'

PAST	Singular	Plural
1.	sagár-ti	sagár-nu
2. masc.	sagár-ta	sagár-tem
2. fem.	sagár-t	sagár-ten
3. masc.	sagár	sagr-ú
3. fem.	sagr-á	sagr-ú
PRESENT	Singular	Plural
masc.	sogér	sogr-ím
fem.	sogér-et	sogr-ót

(32) *Nifʕal*: PAST and PRESENT paradigm of the verbal stem *nisgár* 'be closed'

PAST	Singular	Plural
1.	ni-sgár-ti	ni-sgár-nu
2. masc.	ni-sgár-ta	ni-sgár-tem
2. fem.	ni-sgár-t	ni-sgár-ten
3. masc.	ni-sgár	nì-sger-ú
3. fem.	nì-sger-á	nì-sger-ú
PRESENT	Singular	Plural
masc.	ni-sgár	nì-sgar-ím
fem.	nì-sger-á	nì-sgar-ót

The data suggest a correlation between suffix type, vowel deletion and stress location. Forms whose suffix begins with a vowel display final stress. In these cases vowel deletion has occurred; e.g., the stem *sagár* loses its final vowel when a vowel-final suffix is added (e.g., *sagrá*).[12] Forms whose suffix begins with a consonant display penultimate stress, thus deviating from the regular pattern in MH. Note that such forms never exhibit vowel deletion (e.g., *sagárti*). Previous accounts have observed the correlation between stress location and the category *stem* (going back

[12] In contrast to *sagrá* the form *nìsgerá* (3.sg.fem.), derived from *nisgár* (3.sg.masc.), does not lose its final vowel. In fact, it seems as if the vowel [a] was reduced to [e] in this specific environment. However, we claim that in this form too, the final vowel is not parsed when a V-initial suffix is attached, in order to fulfill the demand for a bisyllabic form. The result is the form **nisgrá*, which can not be syllabified in Hebrew: Hebrew does not allow a sequence of three consonants in a row. In order to break the inadmissible sequence the vowel [e], which we claim to be the phonological epenthetic vowel in MH, is inserted between the consonants, presumably on the post-lexical level.

to Rosen, 1962, 1977: 68 ff.; Bolozky, 1978: 57 ff.), but have failed to give a unified account for both the final *and* the penultimate stress patterns. As we show below, the various stress patterns are easily explained in the constraint-based approach of OT. To give a brief preview of the analysis, we will argue that MH metrical structure is based on a constraint demanding alignment between the morphological category *stem* and the prosodic category *word*. However, this constraint is subject to a higher-ranking prosodic well-formedness constraint ONSET that blocks its effects in certain cases, such that both stem-final stress and word-final stress can be generated.

For verbs, both prefixes and suffixes are relevant for stress assignment. Suffixes are always inflectional, whereby prefixes may be derivational affixes determining a derivational class (*binyan*) or otherwise a fused form of a derivational and an inflectional affix. No matter if they are inflectional or derivational, prefixes and suffixes can be V(owel)-initial *(-a, -im)* or V-final (*hi-*); C(onsonant)-initial *(-ta, -nu)* or C-final (*hit-*). The Semitic verbal stem is obligatorily C-initial and C-final, and so there are no instances of vowel meeting vowel on the stem-affix boundary.[13] The data in (33) illustrate the full typology of affixation with respect to segment type at the relevant boundaries, including both prefixes and suffixes:

(33) Affixational segmental boundary typology ('|' indicates a stem boundary)

Boundary type	*Hebrew example*	*Gloss*
a. $C_{pref.}\|C_{stem}$	hìt|raxéc	'wash oneself, 3.sg.masc.past'
b. $V_{pref.}\|C_{stem}$	ni|rdám	'fall asleep, 3.sg.masc.past'
c. $C_{stem}\|C_{suff.}$	gamár|ti	'finish, 1.sg.past'
d. $C_{stem}\|V_{suff.}$	dibr|á	'speak, 3.sg.fem.past'

One case out of four displays penultimate stress: (33c). One case out of four displays stress *not* on the stem: (33d). How can we unify the data? When the stem boundary contacts a consonant, as in (33a) and (33c), stress falls on the rightmost syllable of the stem. When the stem boundary contacts a vowel, as in (33b) and (33d), stress falls on the rightmost syllable of the prosodic word (PrWd). Importantly, in (33b) the rightmost syllable of the PrWd is also the rightmost syllable of the stem. In both (33b) and (33d) vowel deletion has occurred. Note that derivational prefixes are relevant for stress location only in creating the 3.sg.masc. form,

[13] Due to diachronic factors some exceptions to C-finality exist in MH. Verb stems belonging to the so-called 'defective verbs' may end in a vowel, cf. *baná* 'build, 3.sg.masc.past' vs. *sagár* 'close, 3.sg.masc.past'. However, these stems contain some information which must be lexically stored about their once-transparent final consonant. This is observed in the feminine forms *bantá* 'build, 3.sg.fem.past' vs. *sagrá* 'close, 3.sg.fem.past'. The segment [t] can not be epenthetic, cf. the feminine form of the stem *kará* 'read, 3.sg.masc.past' which is *karʔá* 'read, 3.sg.fem.past'. We assume that every stem must begin and end with a consonant, even if one of these consonants is not always visible on the surface.

which then serves as the basis for further inflection in that specific derivation class (*binyan*). Thus we assume the stem *nisgár* for *nifʕal* to be derived from the unmarked *paʕal* stem *sagár*.

We begin developing this part of the analysis by looking at cases of verbs with C-initial suffixes. Our ranking so far predicts the wrong result, because the constraint hierarchy will always select a form with final stress. This is indicated in tableau (34), where the actual output is signaled by a forward-pointing hand, while the candidate incorrectly chosen as optimal by the present hierarchy is signaled by a backward-pointing hand.

(34) *dibár-ti* 'speak, 1.masc.sg.past'

dibar-ti	PARSE-σ	ALL-FT-R
a. di[bárti]	*	
☞ b. [dibár]ti	*!	σ
c. [dì][bartí]		σ!σ
☜ d. [dìbar][tí]		σ

When a C-initial suffix or a C-final prefix is attached to a verbal stem [cf. (33a) and (33c)], there is no syllabification over the stem-affix boundary and main stress is assigned to the rightmost syllable of the *stem*. A correlation of stress with the morphological category *stem* will allow us to account in a uniform manner for the difference in the distribution of stress on the surface, cf. *hìt|raxéc* vs. *gamár|ti*. The correlation is formulated in the grammar as a constraint demanding alignment of the stem with some prosodic category. This alignment constraint must be higher-ranking than the metrical constraint hierarchy that we have generated so far, so that it can override the demand to align feet to the right edge. This is precisely the case with forms such as *gamárti,* which induce penultimate stress. We must also avoid parsing the suffix as a degenerate foot, in contrast to the parsing of trisyllabic nouns. The crucial constraint is given in (35).

(35) ALIGN-WD (Cohn and McCarthy, 1994: 33; Selkirk, 1995).

The right edge of every stem coincides with the right edge of some PrWd.

Tableau (36) demonstrates the generation of penultimate stress with ALIGN-WD high-ranking:

(36) Penultimate stress: Stem + C-initial-suffix (*dibar-ti* 'I spoke')

(Henceforth, the edges of the PrWd are marked with parentheses in the cases where it makes a difference. Otherwise we assume the PrWd to encompass the whole form.)

dibar-ti	ALIGN-WD	PARSE-σ	ALL-FT-R
a. (di[bárti])	*!	*	
b. ([dì][bartí])	*!		σ σ
c. ([dìbar][tí])	*!		σ
☞ d. ([dibár])ti		*	σ

The constraint ALIGN-WD, following Cohn and McCarthy's (1994) work on Indonesian stress, causes the verbal suffixes to be analyzed as extra-prosodic. Thus, stress remains final within the prosodic word, though it is penultimate on the surface. However, affixes do not need to be explicitly specified as extra-prosodic; only C-initial suffixes, comprised of a full (CV) syllable, are affected by the constraint ALIGN-WD. This is due to the fact that these suffixes contain an onset and do not need to syllabify into the stem; as such they are not part of the prosodic word. This fact will fall out of the constraint hierarchy, or in other words, *purely prosodic principles* determine an extra-prosodic status.

A potential problem is a candidate in which the suffix-*ti* builds its own PrWd, such as *([dìbar])([tí]). Under the constraint hierarchy proposed so far this unattested candidate will emerge as optimal. To principally rule out an inflected verbal form consisting of two prosodic words we propose the following undominated constraint:

(37) PrWd ⊃ Root (McCarthy and Prince, 1993a: 86; cf. Selkirk, 1984; Kaisse, 1985; Nespor and Vogel, 1986)

Every prosodic word contains a root (or stem).

This constraint rules out *([dìbar])([tí]).

We now turn to cases involving a verbal stem followed by a V-initial suffix. In such cases, final stress is attested. In the cases of verbal stem concatenated with V-final prefixes or V-initial suffixes we observe syllabification across the stem-affix boundary. In terms of OT this observation indicates that ALIGN-WD is dominated by the constraint ONSET (Prince and Smolensky, 1993; cf. Ito, 1989). High ranking ONSET neutralizes the effect of ALIGN-WD and renders it irrelevant for these cases, since there is no way to satisfy it under the assumption that every syllable must have an onset, a generalization without exception in MH.

The following tableau illustrates the analysis of forms with vowel-initial suffixes, all of which involve vowel deletion and final stress.

(38) Stem + V-initial-suffix (*dibar-a* 'she spoke')

dibar-a	ONSET	ALIGN-WD	PARSE-σ	ALLFTR
a. ([galgál])im	*!		*	σ
b. ([gàlgal][ím])	*!	*		σ
c. ([gàl][galím])		*		σσ!
d. gal[galím]		*	*!	
☞ e. ([gàlga][lím])		*		σ!

Given undominated ONSET, the vowel-initial suffix must syllabify as part of the same syllable whose onset contains stem material (in this case, the stem-final consonant *r*). Given this demand, ALIGN-WD will never be satisfied in cases involving V-initial suffixes and the selection of the optimal candidate is passed down to lower-ranking constraints.

Stems concatenated with V-final prefixes (*binyan*-markers) show the same effects: the prefix is syllabified into the stem cf. *sagár* 'close'/*nisgár* 'to be closed'. Since we are dealing with a prefix, there is no additional material to the right of the stem and ALIGN-WD can be satisfied. This way, stress falls on the right edge of the stem which is at the same time the right edge of the prosodic word. The stem *nisgár* (stem of binyan *nifʕal*) displays vowel deletion, parallel to the form analyzed in (38), where an inflectional suffix is involved.

The decision in favor of the candidate demonstrating vowel deletion is an example of templatic effects: a bisyllabic form, perfectly aligned with the edges of both foot and PrWd, is created at the cost of deleting stem material. This option will cause a violation of the constraint MAX-V, which demands that each vowel present in an input form have a correspondent in the output (McCarthy and Prince, 1995). Violation of MAX-V is tolerated because it allows for better satisfaction of the constraint ALLFTR, as tableau (38) demonstrates [compare in particular candidates (e) and (f)], thus supporting the ranking ALLFTR $\gg$ MAX-V. MH, similarly to other Semitic languages, favors the strategy of deleting stem vowels in order to create an optimal prosodic form.

The question remains, however, of how to choose the correct vowel to target for deletion. That is, rather than delete the stem vowel *a* from *dibar* when *a* is suffixed, why not rather delete the suffix *a* itself? The answer to this question seems fairly obvious and intuitive: deleting the *a* would remove the entire content of the feminine suffix, thus rendering the masculine and feminine forms of the verb homophonous. It turns out that this issue is much more complex, and relates to vowel deletion throughout the verbal paradigm of MH, not only within the conjugation of particular verbs but also across verbal classes. We do not address this any further here, but for a more comprehensive discussion and analysis of this phenomenon, which forms a core portion of the templatic character of MH, see Ussishkin (2000).

At this point we will take a short excursion to re-examine stress assignment in nominals. As already mentioned above nominal suffixes must be divided into two groups: those that are lexically marked for stress and those that are unmarked. The lexically marked suffixes (and stems) are not at issue here. Of the unmarked suffixes, interestingly, only V-initial cases are attested: PLURAL *-im* (masc.), *-ot* (fem.); FEMININE *-a, -it, -ut, -at*; ADJECTIVAL *-i*. Since there are no unmarked C-initial suffixes, all unmarked nominal suffixes have to syllabify into the stem, just as in the verbal system. All suffixed forms display the expected final stress pattern, as shown in (39):

(39) Stress patterns for stems with unmarked V-initial suffixes

	Stem	*Gloss*	*Suffixed form*	*Gloss*
a.	ʃulxán	'table'	ʃùlxanót	'tables'
b.	galgál	'wheel'	gàlgalím	'wheels'
c.	xavér	'boyfriend'	xàverá	'girlfriend'
d.	káf	'spoon'	kapít	'teaspoon'
e.	mahír	'fast'	mèhirút	'speed'
f.	kadúr	'ball'	kàdurí	'spherical'

In a fully parallel fashion to the analysis of verbs, the evaluation of the forms stem + V-initial suffix renders ALIGN-WD irrelevant, such that these forms are actually evaluated by the default metrical constraint hierarchy. Just as in Section 3, these forms all have final stress, demonstrated in (40).

(40) stem *galgál* 'wheel' + suffix *-im* 'pl.'

dibar-a	ONSET	ALIGN-WD	PARSE-σ	ALLFTR
a. ([galgál])im	*!		*	σ
b. ([gàlgal][ím])	*!	*		σ
c. ([gàl][galím])		*		σσ!
d. gal[galím]		*	*!	
☞ e. ([gàlga][lím])		*		σ!

Nominals are different though from verbs in that they usually do not exhibit vowel deletion. The attested cases with vowel deletion, e.g., *gamál* 'camel'/*gmalím* 'camels' demonstrate a pattern of the nominal system which is no longer productive in Modern Hebrew and has to be listed in the lexicon as such.[14] We conclude that nominals are not subject to templatic demands in a strict form as evident for verbs. Nominal forms showing templatic effects are for the most part relics transferred from older stages of Hebrew.[15]

To summarize this section, we have analyzed stress assignment in the Modern Hebrew verbal system using the same ranking that accounts for regular stress in the nominal system. In order to account for patterns of penultimate stress in the verbal system, which deviate from the typical pattern of final stress, our account posits an alignment constraint that forces a prosodic word boundary to occur at the stem edge. This constraint is overridden by the prosodic well-formedness constraint ONSET, resulting in a pattern whereby only vowel-initial suffixes may induce violation of the alignment constraint. The interaction between these constraints with the rest of the constraint hierarchy generate exactly the stress facts observed in the verbal system:

(i) When the stem is followed by a consonant-initial suffix stress is penultimate; C-initial suffixes fall out of the prosodified domain.
(ii) When the stem is followed by a vowel-initial suffix stress is final; V-initial suffixes must prosodify in order to be parsed in a permissible CV-syllable.
(iii) For all other cases stress is final, obeying the metrical constraint hierarchy already proposed for nouns.

[14] This is true for all instances of vowel deletion/reduction, of which there are several patterns (cf. Bolozky, 1978; Bat–El, 1989). The only exception is the class of the Segolates, where the construction of 'broken plurals' is still productive.

[15] In Hebrew, verbs are subject to templatic effects that don't appear to hold as rigidly for nouns. This could be explained through high-ranking faithfulness constraints on nouns; we leave this issue open for future research.

5. Conclusion

In this paper, we have provided a comprehensive analysis of regular stress assignment and metrical structure of MH. The analysis proposed here accounts for the assignment of stress in both nouns and verbs in a unified system, a challenge that previous accounts have been unable to overcome. Additionally, this account provides a clear analysis of secondary stress assignment in the language. In both nouns and verbs in MH, the most common pattern of stress assignment is final stress. In words of three or more syllables, secondary stress is attested and occurs on every other syllable to the left of the main stress. This pattern holds for the majority of nouns in the language, and is also the default pattern for verbs.

Although MH stress is generally on the final syllable, positing an analysis based explicitly on iambic feet poses an important theoretical problem. Because of the Iambic–Trochaic Law any iambic system must also be quantity-sensitive. It is well known that MH is not quantity-sensitive, but nonetheless an alternative account whereby trochees are specified as the default foot type faces fatal problems. Given these considerations, our account makes no mention of foot form. Instead other constraints on prosodic structure interact to result in the emergence of both iambs and trochees in MH. Iambic feet account for the unmarked, pervasive pattern of final stress in nouns and verbs, while trochees occur in non-head feet of odd-syllabled forms, accounting for the well-known pattern of rhythmically alternating secondary stress. This result, whereby no Foot-Form constraint is mentioned, is a positive one in light of recent work in prosodic morphology whereby explicitly templatic constraints are eliminated from the theory (Spaelti, 1997; McCarthy and Prince, 1999; Ussishkin, 2000). For further work on the issue of eliminating Foot-Form constraints, see Graf and Ussishkin (in preparation).

A further point regarding MH stress is that as we have seen, morphological and prosodic complications arise in cases where stress is not final, as illustrated in the verbal system, in which verb forms with consonant-initial suffixes induce penultimate stress. We claim that prosodic principles on alignment are responsible for the appearance of penultimate stress in such cases: the alignment constraint ALIGN-WD penalizes any structure in which the right edge of the stem is not aligned with the right edge of a prosodic word. However, this alignment constraint is dominated by ONSET, thus preventing satisfaction of ALIGN-WD in cases involving a vowel-initial suffix. The interaction between these constraints provides an explanation for the phenomenon of penultimate stress in verbs with consonant-initial suffixes, while additionally explaining why verbs with vowel-initial suffixes have final stress. These results are summarized in the following table.

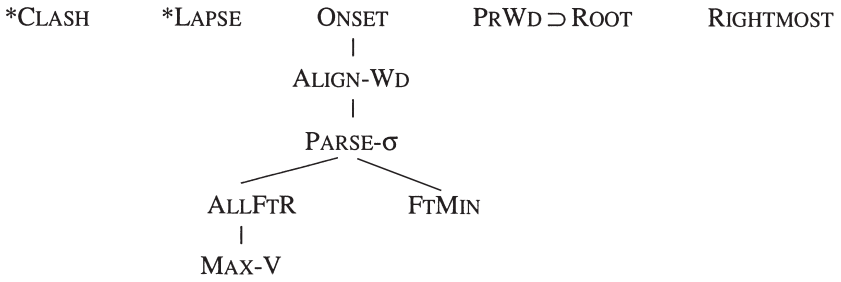
(41) Affixational typology and prosodic consequences

	ONSET	ALIGN-WD	Location of main stress
C_{stem} | $C_{suff.}$	✓	✓	penultimate
C_{stem} | $V_{suff.}$	✓	*	final

The grammar developed for capturing stress patterns additionally provides a basis of explanation for the prosodic structure of possible words in MH, and establishes a connection between prosodic restrictions and metrical structure.

In contrast to earlier work, our analysis is the first to unify the stress pattern in both verbs and nouns. The robust correlation between the morphological category of stem and stress placement is recognized by some earlier accounts (Rosen, 1977; Bolozky, 1978), but in our system no lexical marking is required to capture facts which are part of the default metrical structure. We analyze stress patterns through well-motivated constraints on the prosody-morphology interface. To summarize the results of the analysis presented here, the following ranking diagram illustrates the complete hierarchy for metrical structure and stress assignment in MH.

(42) *Final ranking*



References

Bat-El, Outi, 1989. Phonology and Word Structure in Modern Hebrew. PhD Dissertation, UCLA.

Bat-El, Outi, 1993. Parasitic metrification in the Modern Hebrew stress system. The Linguistic Review 10, 189–210.

Bat-El, Outi, 1994. Stem modification and cluster transfer in Modern Hebrew. Natural Language and Linguistic Theory 12, 571–596.

Bat-El, Outi, 1994. The optimal acronym word in Hebrew. In Koskinen (Ed.), Proceedings of the 1994 Annual Conference of the Canadian Linguistic Association. Toronto Working Papers in Linguistics, pp. 23–37.

Bolozky, Shmuel, 1978. Some aspects of Modern Hebrew phonology. In: Berman, R. (Ed.), Modern Hebrew Structure. University of Tel-Aviv Publishing Projects, Tel-Aviv, pp. 11–64.

Bolozky, Shmuel, 1982. Remarks on rhythmic stress in Modern Hebrew. Journal of Linguistics 18, 275–289.

Bolozky, Shmuel, 1995. Ha-Sgoliyim—Gzera kavit o mesoreget? In: Schwarzwald, Ora (Ed.), Hadassa Kantor Jubilee Book: Language Research Papers, pp. 17–26, Ramat Gan (in Hebrew).

Cohn, Abigail, McCarthy, John, 1994. Alignment and Parallelism in Indonesian Phonology. Ms, Cornell University and University of Massachusetts, Amherst (ROA 25–0894).

Crowhurst, Megan, Hewitt, Mark, 1995. Directional Footing, Degeneracy, and Alignment. Ms, University of North Carolina and University of British Columbia.

Everett, Daniel, 1996. Prosodic Levels and Constraints in Banawa and Suruwaha. Ms, University of Pittsburg.

Falk, Yehuda, 1996. Metrical structure in Modern Hebrew. Hebrew Linguistics 40, 5–15.

Gafos, Adamantios, 1998. Eliminating long-distance consonantal spreading. Natural Language and Linguistic Theory 16, 223–278.

Graf, Dafna, 1999. Metrical Structure of Modern Hebrew Nominals. Magisterarbeit, Heinrich-Heine-Universität Düsseldorf.

Graf, Dafna, 2000. Stress assignment in the nominal system of Modern Hebrew. In: IATL 7, Proceedings of the Fifteenth Annual Conference of the Israeli Association for Theoretical Linguistics, Bar-Ilan University, pp. 51–70.

Graf, Dafna, Ussishkin, Adam, 2002. Modern Hebrew Loanword Phonology. Ms, Heinrich-Heine-Universität Düsseldorf and University of Arizona.

Graf, Dafna, Ussishkin, Adam. A Metrical Typology without Foot-Form Constraints. Ms, Heinrich-Heine-Universität Düsseldorf and University of Arizona (in preparation).

Hayes, Bruce, 1987. A revised parametric metrical theory. In: Proceedings of NELS 17, University of Massachusetts, Amherst, GLSA, pp. 274–289.

Hayes, Bruce, 1995, Metrical Stress Theory: Principles and Case Studies. University of Chicago Press, Chicago.

Hewitt, Mark, 1993. Deconstructing Foot Binarity. Ms, University of British Columbia.

Hewitt, Mark, 1994. Deconstructing Foot Binarity in Koniag Alutiiq. Ms, University of British Columbia.

Inkelas, Sharon, 1999. Exceptional stress-attracting suffixes in Turkish: representations vs. the grammar. In: Kager, R., van der Hulst, H., Zonneveld, W. (Eds.), The Prosody–Morphology Interface. Cambridge University Press, Cambridge.

Ito, Junko, 1989. A prosodic theory of epenthesis. Natural Language and Linguistic Theory 7, 217–259.

Ito, Junko, Mester, Armin, 1994. Japanese phonology. In: Goldsmith, J. (Ed.), The Handbook of Phonological Theory. Blackwell, Cambridge, MA, and Oxford, pp. 817–838.

Ito, Junko, Mester, Armin, 1995. The core-periphery structure of the lexicon. In: Beckman, J., Walsh Dickey, L., Urbanczyk, S. (Eds.), University of Massachusetts Occasional Papers 18: Papers in Optimality Theory, pp. 181–209.

Ito, Junko, Kitagawa, Yoshihisa, Mester, Armin, 1996. Prosodic faithfulness and correspondence: evidence from a Japanese argot. Journal of East Asian Linguistics 5, 217–294.

Kager, René, 1993. Alternatives to the iambic–trochaic law. Natural Language and Linguistic Theory 11, 381–432.

Kager, René, 1999. Optimality Theory. Cambridge University Press, Cambridge.

Kaisse, Ellen, 1985. Connected Speech. Academic Press, Orlando.

Kiparsky, Paul, 1991. Catalexis. Ms, Stanford University and Wissenschaftskolleg zu Berlin.

Liberman, Mark, Prince, Alan, 1977. On stress and linguistic rhythm. Linguistic Inquiry 8, 249–336.

McCarthy, John, 1979. Formal Problems in Semitic Phonology and Morphology. PhD Dissertation, MIT.

McCarthy, John, 1993. A case of surface constraint violation. Canadian Journal of Linguistics 38, 169–195.

McCarthy, John, Prince, Alan, 1986. Prosodic Morphology. Ms, University of Massachusetts, Amherst and Brandeis University.

McCarthy, John, Prince, Alan, 1993a. Prosodic Morphology I: Constraint Interaction and Satisfaction. Ms, University of Massachusetts at Amherst and Rutgers University.

McCarthy, John, Prince, Alan, 1993b. Generalized alignment. In: Booij, G., van Marle, J. (Eds.), Yearbook of Morphology. Kluwer, Dordrecht, pp. 79–153.

McCarthy, John, Prince, Alan, 1995. Faithfulness and reduplicative identity. In: Beckman, J., Dickey, L. and Urbanczyk, S. (Eds.), University of Massachusetts Occasional Papers 18, pp. 249–384.

McCarthy, John, Prince, Alan, 1999. Faithfulness and identity in prosodic morphology. In: Kager, R., van der Hulst, H., Zonneweld, W. (Eds.), The Prosody-Morphology Interface. Cambridge University Press, Cambridge.

Melčuk, Igor, Podolsky, Baruch, 1996. Stress in Modern Hebrew nominal inflection. Theoretical Linguistics 22, 155–194.

Mester, Armin, 1994. The quantitative trochee in Latin. Natural Language and Linguistic Theory 12, 1–62.

Nespor, Marina, Vogel, Irene, 1986. Prosodic Phonology. Foris Publications, Dordrecht.

Paradis, Carole, LaCharité, Darlene, 1997. Preservation and minimality in loanword adaptation. Journal of Linguistics 33, 379–430.

Prince, Alan, 1975. The Phonology and Morphology of Tiberian Hebrew. PhD Dissertation, MIT.

Prince, Alan, 1976. Applying stress. Ms, University of Massachusetts, Amherst.
Prince, Alan, 1980. A metrical theory for Estonian quality. Linguistic Inquiry 11, 511–562.
Prince, Alan, Smolensky, Paul, 1993. Optimality Theory: Constraint Interaction in Generative Grammar. Ms, Rutgers University and University of Colorado, Boulder.
Rappaport, Malka, 1984. Issues in the Phonology of Tiberian Hebrew. PhD Dissertation, MIT.
Rosen, Hayim, 1962. A Textbook of Israeli Hebrew, with an Introduction to the Classical Language. University of Chicago Press, Chicago.
Rosen, Hayim, 1977. Contemporary Hebrew. Mouton, The Hague.
Selkirk, Elisabeth, 1984. Phonology and Syntax: The Relation between Sound and Structure. MIT Press, Cambridge, MA.
Selkirk, Elisabeth, 1995. The prosodic structure of function words. In: J. Beckman, L. Dickey, and S. Urbanczyk (Eds.), University of Massachusetts Occasional Papers 18, pp. 439–470.
Spaelti, Philip, 1997. Dimensions of Variation in Multi-Pattern Reduplication. PhD Dissertation, UC Santa Cruz.
Ussishkin, Adam, 2000. The Emergence of Fixed Prosody. PhD Dissertation, UC Santa Cruz.
Wiese, Richard, 2001. The structure of the German vocabulary: edge marking of categories and functional considerations. Linguistics 39, 95–115.