Pariente, Itsik. "Grammatical paradigm uniformity." *Morphology* 22.4 (2012): 485-514.

Grammatical Paradigm Uniformity

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This paper develops a formal model of correspondence between words sharing a Morphological Structure, but not sharing a lexeme. The empirical data used to advocate for this relation is explored using an analysis of nouns and verbs containing /a/ as a Root Vowel in General Modern Hebrew in positions where the corresponding form in Sephardic Modern Hebrew has a voiced pharyngeal. The emergence of Root Vowels reveals mora related generalizations: Root Vowels emerge only if their parallel paradigmatic consonant (consonant that occupies the same prosodic position in other roots of the same Morphological Structure) is in a coda position, i.e. it is moraic. The theory presented in this paper employs Output-to-Output constraints in order to account for surface phenomena which cannot be explained by standard Paradigm Uniformity theory.

1. Introduction

This paper develops a formal model of paradigmatic relations between words not sharing a lexeme. This idea was first introduced by Burzio (1998), following whom it is argued that similarity relations between words that do not share a lexeme can also be a factor in the morphology-phonology interface. The main idea is that words with the same Morphological Structure (MS) are subject to certain similarity demands. A case study on the manifestation of Root Vowels (RV) in Modern Hebrew will be discussed to support these paradigmatic relations.

1.1 The problem

RVs do not appear at the surface level in all forms. The data given below lists both the environments in which RVs emerge and those in which they do not. The forms containing RVs are compared to other forms in the language which have the same Morphological Structure, i.e. the same conjugation (Vocalic Pattern and Prosodic Structure and derivational affixes of the conjugation if they exist), the same affixes, the same gender, number and person, and for verbs also the same tense. The forms in comparison do not have a RV, but rather a consonant in the same prosodic position. If a RV does not emerge in a specific environment, a different word of the same lexeme, which does contain a manifested RV, is given in the table in order to illustrate that the alternation is synchronic, which means that these lexemes did not lose the RV completely but that it is present in the Underlying Representation (UR).

Roots in Modern Hebrew usually consist of three consonants in a fixed order. In RV forms, a vowel occupies one of the positions of these consonants, i.e. instead of the regular triconsonantal root CCC, a RV form has one of the following structures: VCC, CVC or CCV. While the consonants in these structures always appear on the surface, the vowel may appear or not. The alternation in the manifestation/omission of the RV is argued to mirror the moraic structure of triconsonantal verbs.

In the examples in (1a) a RV is parallel to a final consonant in triconsonantal forms. Since the final consonant in the triconsonantal forms is in coda position, it is moraic. In these cases the RV appears on the surface to mirror the moraic structure of the triconsonantal form:

(1a) RVs emerge at word final position

UR	Surface Form	Gloss	A form with the same Morphological Structure and a consonant at the same prosodic position of the RV	Gloss
*ʃavu**a***	*ʃa.vú.**a***	*'week'*	*ta.pú**z***	*'orange'*
*liʃmo**a***	*li.ʃmó.**a***	*'to hear'*	*liʃmó**ʁ***	*'to guard'*
*titpare**a***	*tit.pa.ré.**a***	*'she will misbehave'*	*tit.ka.dé**m***	*'she will advance'*

The generalization in (1a) has one exception; if the RV is preceded by *a*, it will not manifest. This behavior is assumed to be the result of an OCP effect:

(1b) RVs do not emerge at word final position when they are preceded by *a*.

UR	Surface Form	Gloss	A form with the same Morphological Structure and a consonant at the same prosodic position of the RV	Gloss	A form of the same lexeme with a manifested RV	Gloss
*nasa**a***	*na.sá*	*'he drove'*	*la.má**d***	*'he studied'*	*no.sé.**a***	*'he is driving'*
*jiʃma**a***	*jiʃ.má*	*'he will hear'*	*jil.má**d***	*'he will study'*	*ʃo.mé.**a***	*'he is hearing'*
*mikta**a***	*mik.tá*	*'section'*	*mig.dá**l***	*'tower'*	*ko.té**.a***	*'he is cutting'*

In the examples in (2) a RV is parallel to an initial consonant in triconsonantal forms. Since the initial consonant in the triconsonantal forms is in onset position it is not moraic. In these cases the RV does not appears on the surface to mirror the moraic structure of the triconsonantal form

(2) Word initial RVs do not emerge

UR	Surface Form	Gloss	A form with the same Morphological Structure and a consonant at the same prosodic position of the RV	Gloss	A form of the same lexeme with a manifested RV	Gloss
***a**amad*	*a.mád*	*'he stood up'*	***j**a.ʃáv*	*'he set down'*	*ne**.e.**mád*[1]	*'he stood up'*
***a**oneg*	*ó.neg*	*'pleasure'*	***k**ó.deʃ*	*'holiness'*	*ta**.a.**núg*	*'pleasure'*
***a**eved*	*é.ved*	*'slave'*	***j**é.led*	*'boy'*	*he.**e**.víd*	*'he employed'*

Word medial RVs create vowel hiatus consisting of the RV and a preceding/following vocalic pattern vowel. The manifestation of the RV is again predictable according to the moraicity of its parallel consonant in the triconsonantal form; if the consonant that is parallel to the RV in other forms with the same Morphological Structure is in coda position (i.e. moraic), the RV will emerge (3a). If the parallel consonant is in onset position (i.e. non-moraic), the RV will not emerge (3b).

(3a) Word medial RVs emerge when their parallel segment in other forms with the same Morphological Structure is in coda position.

UR	Surface Form	Gloss	A form with the same MS and a consonant at the same prosodic position of the RV	Gloss
*hi**a**vid*	*he.**e**.víd*	*'he employed'*	*hi**ʃ**.tík*	*'he silenced'*
*ni**a**mad*	*ne.**e**.mád*	*'he stood up'*	*ni**ʁ**.dám*	*'he fell asleep'*
*ji**a**mod*	*ja.**a**.mód*	*'he will stand up'*	*ji**g**.nóv*	*'he will steal'*
*mi**a**mad*	*ma.**a**.mád*	*'status'*	*mi**g**.dál*	*'tower'*

(3b) Word medial RVs do not emerge when their parallel segment in other forms with the same Morphological Structure is in onset position

UR	Surface Form	Gloss	A form with the same Morphological Structure and a consonant at the same prosodic position of the RV	Gloss	A form of the same lexeme with a manifested RV	Gloss
*pa**a**am*	*pa.ám*	*'he/it throbbed'*	*ʃa.**m**áʁ*	*'he guarded'*	*pa.**a**.món*	*'bell'*
*ni**a**er*	*ni.ér*	*'he shook'*	*di.**b**éʁ*	*'he talked'*	*hit.na.**a**.ʁút*	*''shaking oneself '*
*jitpa**a**el*	*jit.pa.él*	*'he will be impressed'*	*jit.ka.**t**év*	*'he will correspond'*	*hit.pa.**a**.lút*	*'impression'*

The correspondence relations are one to one relations between segments of the triconsonantal forms and of RV forms. That is to say that in triconsonantal forms such as *katáv* every segment is compared to its parallel segment in the same prosodic position; first root segment, first Vocalic Pattern vowel, second root segment, second Vocalic Pattern etc. For example, the triconsonantal verb in *dibéʁ* is compared in Figure (4) with

RV verb of the same Morphological Structure *ʃigeá* with a final manifested RV and *niéʁ* with a medial un-manifested RV:

(4)

ʃ i g é a
| | | | |
d i b é ʁ
| | | | |
n i   é ʁ

The data in (1-3) reveals a remarkable generalization: *RVs emerge only when their parallel segment in other forms with the same Morphological Structure is in coda position* (though a higher ranked constraint can prevent RV from emerging (1b)). I argue that in fact RVs emerge when their parallel segment in other forms with the same Morphological Structure is *moraic*.

2. Brief relevant language background

2.1 The emergence of Root Vowels in Modern Hebrew

RVs emerged from historical pharyngeals which do not have a phonemic status in Modern Hebrew. At the time of the revival of Hebrew, pharyngeals were not adopted by the (originally European) revivers of the language or by the native speakers that followed them. That is, historical *ħ* emerged as *(a)x* and historical ʕ emerged as *a*.

Following Faust (2005) I do not assume underlying pharyngeals in the grammar of the language. Pharyngeals never appeared at the surface of General Modern Hebrew (as opposed to Sephardic Modern Hebrew); so assuming they exist at the lexical level poses the question of how they are learned by children[2].

For an analysis using underlying pharyngeals (and even geminates) that are never realized at the phonetic level, see Bar Lev (1977). Bar Lev's analysis is greatly influenced by the phonology of Tiberian Hebrew, imposing its phonological structures and inventory on General Modern Hebrew to account for opaque phenomena in the language. However as Bat El (2006) points out: "Modern Hebrew was not transmitted but rather (at best) revived … Modern Hebrew adopted the morphological paradigms of Tiberian Hebrew, including the morpho-phonological alternations. However, it did not adopt the phonology of Tiberian Hebrew…"(Bat El ibid. p.7). Pharyngeals were not surface true at any stage of the language and assuming they exist at the UR level and are subsequently deleted seems improbable.

Sephardic Modern Hebrew is a dialect with surface true pharyngeals (Pariente 2010). One can argue that both dialects have the same phonological lexicon containing pharyngeals but that in General Modern Hebrew they simply disappear at the surface level. Such a scenario would have been plausible had Sephardic Modern Hebrew been the major dialect of Hebrew; however as Pariente (2010) points out Sephardic Modern Hebrew is the minor dialect of Hebrew (which has only two dialects) and it is dying out.

In reality most children acquiring General Modern Hebrew are never exposed to surface true pharyngeals, so assuming they are somehow acquired by children appears unlikely.

2.2 Semitic Morphology

One approach to Semitic morphology is *Root-and-Pattern* morphology (McCarthy 1979, 1981). The root usually consists of three consonants that appear in a fixed order. According to McCarthy, the conjugations, called binyanim (sg. binyan) for verbs and mishkalim (sg. mishkal) for nouns, consists of the Vocalic Pattern (the morpheme that determines the quality and the order of the conjugation vowels), the Prosodic Template, which determines the prosodic structure of the conjugation (number of syllables, syllable structure and stress), and a derivational affix, if it exists in a specific conjugation. The Prosodic Template governs the interdigitation of the root consonants and the Vocalic Pattern. The consonantal root encodes the core semantic properties, while the conjugation encodes aspect, mood, voice and other grammatical properties.

The following table overviews the verbal paradigm and some nominal conjugations of some consonantal roots. The verbs are given in the third person singular forms. Prefixes are underlined. The binyanim are abbreviated as B1, B2 etc.

(5) *Root and Pattern paradigms*

root→ binyan (B)/mishkal ↓	{p,g,ʃ}	{k,t,v}	{ʃ,t,k}
B1 CaCaC	*pagáʃ 'bump into'*	*katáv 'write'*	*ʃaták 'be quiet'*
B2 niCCaC	*nifgáʃ 'meet'*	*nixtáv 'be written'*	-----------------------
B3 hiCCiC	*hifgíʃ 'to bring together'*	*hixtív 'dictate'*	*hiʃtík 'silence'*
B4 CiCeC	----------------------	*kitév 'address'*	*ʃiték 'paralyze'*
B5 hitCaCeC[3]	----------------------	*hitkatév 'correspond'*	*hiʃtaték 'become silent'*
miCCaC	*mifgáʃ 'meeting'*	*mixtáv 'letter'*	-----------------------
taCCiC	----------------------	*taxtív 'dictate'*	-----------------------

Some elements of this approach were criticized by several later studies. For example, McCarthy and Prince (1986, 1995) in their Prosodic Morphology theory argued that the Prosodic Template can be derived by general prosodic constraints and thus not need be specified as an independent property in Semitic languages. The prosodic structure is determined by specific language rankings of universal prosodic constraints. According to this approach, the prosodic template is *not* an arbitrary structure, but rather the result of the interaction of universal prosodic constraints.

Bat-El (1994, 2002, 2003) and Ussishkin (1999, 2000) offer an approach which is surface-based and eliminates the Consonantal Root completely from the grammar, using stems and words as the base for derivation. Ussishkin (2000) argues that a B1 verb (CaCaC) is the base of every verb paradigm, even if none of the verbs in a specific lexeme is conjugated in B1. Bat El (2003) argues for different bases in different paradigms (co-phonology). In this word base approach to Semitic morphology, an existing word is always the base of derivation (Output-to-Output correspondence). The Vocalic Patterns can be viewed as an affix (Ussishkin 2003) or as a constraint-affix (Bat El 2003) that overwrites the vowels of the base (Melodic Overwriting).

(6) l **i** m **e** d + Vocalic Pattern {u,a}→ l **u** m **a** d

This debate is outside the scope of this paper (see Shimron 2003). It is worth mentioning that each approach defines the term *lexeme* differently. In the Root & Pattern approach a lexeme is equivalent to the Consonantal Root. In Melodic Overwriting a lexeme is a stem or a word that is considered as the base for derivation.

To sum up, every word in Nonconcatenative Morphology has to be specified for a binyan or a mishkal in the lexicon (Bat El 1989), i.e. /g.d.l., B4 (CiCeC)/ → [gi.dél] (Root & pattern) or /gadál., B4{ie}/ → [gi.dél] (Melodic Overwriting) The interdigitation and the prosodic structure (stress and syllabic structure) are determined by constraint interaction.

Both approaches to Semitic Morphology yield the same outputs but assume different lexical representation of inputs. Since the current study deals with relations between output forms, *any approach regarding the formation of the output (Root & Pattern or Melodic Overwriting) can be assumed.*

I adopt the root & pattern view in this study however, the UR in the rest of the paper will be given with interdigitation and vocalic pattern for simplicity reasons, i.e. /gadál., B4/ or /g.d.l., B4/ will be given as /gi.del/. The tableaux below demonstrate how this system works.

(7) Syllable structure

/gidel/	ONSET	DEP	MAX	FINALC	*CODA
(a) gid.él	*!				**
☞ (b) gi.dél					*
(c) gi.dé			*!	*	
(d) gi.dé.le		*!		*	
(e) gid.lé				*!	*

(8) Stress

/gidel/	TROCHEE	ALIGNR	FINALSTRESS	FTBIN
(a) [gí.del]			*!	
(b) [gi.dél]	*!			
☞ (c) gi[dél]				*

Tableau (7) and (8) give a fragment of Hebrew grammar regarding syllable structure and stress. The phonology of the language is, of course, more complex (including, for example, morpheme position, moraicity etc.), but the mechanism is the same.

3. From Paradigm Uniformity to Grammatical Paradigm Uniformity

It has been observed that surface resemblance arises between words that share a paradigm (Benua 1997; Steriade 2000; McCarthy 2005 among many others). A paradigm is a network of interconnected words sharing a lexeme, but having different Morphological Structure.

To account for surface resemblance effects in morphological truncation, Benua (1997), based on McCarthy and Prince (1995), developed the Transderivational Correspondence Theory (TCT) in which inflected forms can be forced to resemble simplex forms via Output-to-Output constraints. In this theory the simplex form serves as the *base* to which complex forms are required to resemble.

Another theory of paradigmatic relations between words was developed around the same time by Kenstowicz (1996). This theory, called Uniform Exponence (UE), deals with paradigms which are not built on a single morphological simplex base. In this theory, Output-to-Output constraints militate for minimizing the difference between the members of a paradigm. Since no base is identified (or can be identified), the constraints are symmetric in the sense that they demand similarity from all members equally. UE demands to minimize the difference between the realizations of the same lexical item in all its appearances within a paradigm.

McCarthy (2005) developed a model of Paradigm Uniformity, called Optimal Paradigms (OP). In OP candidates consist of entire inflectional paradigms and constraints are symmetric with no privilege base. (Other studies on paradigmatic relations with similar ideas can be found in Steriade 1999, 2000)

In a series of studies Burzio (1994, 1998, 2002a, b, 2005a, b) argued for a radical surface approach to morphology. His approach reduces morphology to Output-Output Faithfulness constraints. Burzio proposes a mechanism of "Representational Entailment Hypothesis" (REH). REH demands that the more two words overlap structurally, the more similar they should be. Words are taken to be connected (as in a paradigm) only via Output-to-Output constraints and no mutual Underlying Representation is assumed to exist. The theory proposed by Burzio regulates relations between different allomorphs of the same lexeme (for a similar idea, see Steriade's Lexical Conservatism 1999).

None of the approaches mentioned above can account for the alternation of RVs given in (1-3) due to the simple fact that the manifestation of RVs is not lexeme dependent, and no generalizations can be drown by regarding only a lexemic paradigm. All the theories mentioned above explain phonological opacity by imposing similarity demands to other members of a paradigm that share the same lexeme. However, the data in (1-3) shows that RV manifestation is not consistent throughout a lexemic paradigm, but rather it is regulated by similarity to other words with the same Morphological Structure regardless of the lexemic paradigm.

The correspondence relations developed in this study are in line with Burzio (1994, 1998, 2002a, b, 2005a, b). Burzio studies similarity relations within the domain of verbal conjugations in Italian. In a detailed analysis he shows that output forms are subject to 'Multiple Correspondence' relations. Some of these correspondence relations are lexemic in nature; however, some of them are correspondence relations between forms of the same Morphological Structure (Italian participles) and even between words sharing a suffix.

Following Burzio's scheme of Multiple Correspondence, this study illustrates how such a mechanism of paradigmatic relation imposes similarity over lexemic paradigms. This notion is developed in more detail in the next section.

3.1 The Proposal

3.1.1 The Grammatical Paradigm

This paper argues for correspondence relations between words sharing a *Morphological Structure* (Halle and Marantz 1993). Forms which share a Morphological Structure have the same feature value in all *Grammatical Categories.* Grammatical Categories refers to the set of all possible values of a Morpho-Syntactic Feature (Bybee 1985, Crystal 1985, Hopper 1992, Iscrulescu 2006). For example, the feature *Gender* is represented in inflected forms by the Grammatical Category {female, male}. In addition to the Grammatical Categories Person, Number and Gender, in Semitic morphology the morpho-syntactic system contains the Grammatical Category *conjugation {binyan (B1, B2, B3, B4, B5) or mishkal}.* All forms sharing a Morphological Structure (same value for all Grammatical Categories) construct the Grammatical Paradigm (G-Paradigm). For example, all forms sharing the Grammatical Categories values: Conjugation {B1}, Person {3rd}, Tense {past}, Gender {male} and Number {singular} compose a G-Paradigm.

Forms inflected in B1 3rd.past.masc.sg. are subject to Output-to-Output constraints militating that they all have the same shape (prosodic structure, number of syllables and the value and order of the vocalic template vowels) as the base.

3.1.2 The base

Grammatical Paradigm Uniformity is an asymmetric theory, and Grammatical Paradigm Uniformity constraints demand similarity between a base and all other output forms, but not vice versa. However, verbs (and indeed words) employ multiple shapes for each G-

Paradigm. I argue that *the base is the most frequent shape in the paradigm*. The most frequent shape contains a triconsonantal form (Chomsky 1957 p.122 among many others). In the case of 3rd.masc.sg.past. of B1, triconsonantal forms of verbs have the shape *ka.táv 'write', ʃa.máʁ 'guard'*, *ʁa.ʃám 'write'* etc. All these forms are identical to one another aside from the root consonants. Since the root (lexeme) is irrelevant to the G-Paradigm, we can mark it with a capital C. For example, the base of 3rd.masc.sg.past. of B1 is C_1a.C_2áC_3. Forms that deviate from this shape like *baxá 'wept'* violate a Grammatical Paradigm Uniformity constraint, in this case *baxá* fail to fill the position of the third consonant of the root.

Why Output-to-Output constraints and not templatic constraints? At this point some terminology needs to be clarified. I have formulated the base in templatic terms such as C_1a.C_2áC_3; however, this formulation is used for simplicity reasons only. Grammatical Paradigm Uniformity does not assume that words are subject to identity demands to a template, but rather to identity demands to the shape of other frequent members of the G-Paradigm. For example, the irregular verb *ʃatá* 'drink' does not violate any constraints demanding it will be identical in its shape to C_1a.C_2áC_3, but it violates some Output-to-Output constraints demanding it will be identical in its shape to the frequent regular verbs in the G-Paradigm (*katáv*, *ʃamár* etc.), *which are constructed in this shape.*

This approach does not make any reference to templates as arbitrary structures, but rather it coincides with the idea that the structure of the template is governed by general and language specific constraints that relate to prosodic units (Prosodic

Morphology - McCarthy and Prince's 1986, 1995; for Hebrew see Ussishkin 2000; Adam 2002; Bat El 2003).

This approach raises the question of how the base is exactly represented in the grammar of speakers. One approach is to assume that it is represented as a general scheme such as C_1a.C_2áC_3 with no specification of the root consonants. This form resembles a template; however, it is fully specified for prosodic structure (syllable structure, stress etc.). Since prosodic structure is a surface property, this form cannot be regarded as identical to binyan or mishkal or any other sort of template which are lexically specified. This form has to be considered as an output form since its structure is predictable and can be accounted for by the grammar of the language. Every G-Paradigm has such a base. If C_1a.C_2áC_3 is the base of 3rd.masc.sg.past. of B1. C_1a$C_{2.}$$C_3$á is the base for of 3rd.fem.sg.past. of B1 (*kat.vá, ʃam.ʁá* etc.). The base is created by adding the feminine suffix *–á* to the masculine form and syncope of the second vowel (*katáv-a* → *katvá)*. The derivation of 3rd.fem.sg.past. of B1 can be accounted for by the grammar of the language as well and thus does not need to be specified in the lexicon.

To summarize, a base is not a template (or conjugation). It is an output form which is composed of the conjugation with unspecified root consonants and morphological structure (tense, gender etc.)

Another possibility of representing the base in the grammar is to assume that speakers simply choose a specific triconsonantal verb as a base for RV (and potentially other sub-paradigms). For example $k_1a.t_2áv_3$ for 3rd.masc.sg.past. of B1.

The editor suggests yet a third possibility along the lines of the REH: there is no UR at all, but rather all 3rd.masc.sg.past. of B1 compose a paradigm. In this paradigm the largest group of verb consists of the triconsonantal verbs. This largest group influences the smaller groups of verbs (RV verbs and other irregular verbs). As the editor points out this is a version of the "real verb" possibility with all real verbs as the base.

At this point all ways (scheme or a real verb(s)) seem plausible and which one is the correct one will be left as a matter for further study. For simplicity reasons I will use a real verb as the base when comparing a RV to a triconsonantal root.

3.1.3 The constraints

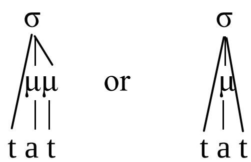
Identity to the base is regulated by Output-to-Output constraints. These constraints are asymmetric, and can relate only to prosodic structure, number of syllables and the value and order of the templatic vowels These constraints do not regulate the quality of the root consonants (or RVs in this study), since these constraints do not relate to the lexeme, but only to the shape of words.

4. Moraic structure in Hebrew

The current analysis assumes the representation of segments linked to a timing tier. In X-slots theory (Levin 1985), every segment is linked to the syllable via X-slots. The X's are time units and lack information about the nature of the segment (vowel or consonant) as opposed to CV theory (Clements & Keyser 1983).

As phonological theory evolved, most phonologists abandoned the X-slots theory in favor of Moraic theory (Hyman 1985; Itô 1986), since Moraic theory makes more accurate predictions regarding weight related phenomena. Hebrew is a quantity insensitive language, so most of the analyses of it dismiss the presence of moras in the phonology of the language (though see Landau 1997 for a different view). However, Moraic theory proves most adequate in the analysis of Hebrew RV related processes, because it differentiates between non-moraic segments and moraic segments. Onsets are presumed universally non-moraic (Hyman 1985; Hayes 1989 among many others) (though see Topintzi 2006), nuclei are always moraic, and codas can be either moraic or weightless.

(10) Moraic representation



The emergence of RVs reveals mora related generalizations: a RV emerges only if its parallel paradigmatic consonant is in a coda position, i.e. it is moraic. In other words, RVs will never appear when their parallel paradigmatic segment is in an onset position.

An important point to mention is that codas and vowels are parsed differently in the language; while they are both moraic, a vowel will always create a syllable, but a moraic coda will be parsed as part of the syllable whose nucleus is the preceding vowel. This fact means that every emergence of a RV necessarily violates a Grammatical Paradigm Uniformity constraint militating for corresponding segments to have the same syllabic value. However, since the impact of such a constraint is never noticeable, I assume it is ranked low in the language, and I will not include it in the tableaux.

A less formal notion of Grammatical Paradigm Uniformity is argued by Faust (2005) to analyze RV verbs in Hebrew (though in his terminology it is regarded as regular Paradigm Uniformity). The current analysis is based on Faust's observation that the manifestation of RVs cannot be explained by Paradigm Uniformity constraints that connect words sharing a lexeme, and that another type of constraints that connect words that do not share a lexeme is needed.

The current analysis differs from Faust's analysis in a few crucial points:

(a) The scope of the paradigmatic relations: As in Faust, this study assumes that RV forms are subject to constraints militating for similarity to triconsonantal forms with the same Morphological Structure (Faust's analysis deals only with the verbal system and triconsonantal verbs are called ‘whole verbs’ in his terminology). In addition, Faust assumes that the past form is the base for the future form, so the future form is also subject to similarity demands to the past form. Furthermore, regular Paradigm Uniformity constraints are also employed in Faust's study. Finally, only the base is assumed to have a UR and all inflected forms are created by inflection of the base form.

The current analysis does not employ any Paradigm Uniformity constraints, nor does it employ any past/future relations. It is not to say that such relations do not exist (Paradigm Uniformity constraints certainly exist, see Bat El 2008), but rather the analysis does not require such relations. All phenomena are explained in means of IO and Grammatical Paradigm Uniformity constraints.

(11) Constraint scheme

dibéʁ	dibáʁti
(3rd.sg.mas.past.)	(1st.sg.fem/mas.past.)
↓ GPU	↓ GPU
ʃigéa	ʃigáti
(3rd.sg.mas.past.)	(1st.sg.fem/mas.past.)
↑ IO	↑ IO
/ʃigea/	/ʃigea-ti/

(b) The motivation for the alternation: Faust analyzes verbs as iambic and binary. The motivation for the manifestation or the non manifestation of the RVs is foot size and alignment. Such an analysis can deal with margin RV (i.e. initial and final) but not with medial RVs. In the current analysis I argue that moraicity and prosodic structure of a trochaic system explain the alternation better. Moraicity indeed explains all the alternations in the manifestation of RVs, margin and medial.

4.1 OT Analysis: moraic structure without weight sensitivity

As mentioned above, the manifestation of RV depends on the moraic structure of the corresponding segment in the G-Paradigm. The constraint in (12) encodes this similarity demand.

> (12) IDENTMORAICSTRUCTURE^{GPU} (IDμ^{GPU})
> Let A be a segment in S_1 and B be a segment S_2. If A and B are in a correspondence relationship, then B have the same moraic structure as A.
> (S_1 = the base. S_2 = any output form sharing the G-Paradigm of the base).

The theoretical assumptions given above make the analysis extremely simple. By ranking IDμ^{GPU} above MAX we get the right outcome for most forms in the language.

(13) Initial RV[4]

/**a**omed/ base: **k**o.tév	IDμ^{GPU}	MAX
a. **a**$^{\mu}$.o.méd	*!	
☞b. o.méd		*

In tableau (13) the UR contains *a* at the beginning of the word. In the faithful candidate (a) it emerges and so it violates the high ranking constraint IDμ^{GPU} since its corresponding segment is in onset position. The emergence of the vowel creates a mismatch in the moraic structure between the two segments. The winning candidate (b) omits the UR *a* violating MAX but satisfying IDμ^{GPU}.

(14) Word medial RV that is parallel to moraic segment in the paradigm

/niamad/ base: ni**x**$^{\mu}$.táv	IDμ^{GPU}	MAX
a. ni.mád		*!
☞b. ne.**e**$^{\mu}$.mád		

In tableau (14) the UR contains *a* in the middle of the word in a position that is occupied by a coda segment in the G-Paradigm. In the faithful candidate (b) it emerges creating a mora and satisfying both IDμ^{GPU} and MAX. Candidate (a) omits the UR *a* thus violating MAX and being ruled out.

(15) Word medial RV that is parallel to non-moraic segment in the paradigm

/niaeʁ/ base: si.**p**éʁ	IDμ^{GPU}	MAX
a. ni.**a**$^{\mu}$.éʁ	*!	
☞b. ni.éʁ		*

In tableau (15) the UR contains *a* in the middle of the word in a position that is occupied by an onset in other forms in the G-Paradigm. In the faithful candidate (a) it emerges creating a mora and violating the high ranking constraint IDμ^{GPU}. Candidate (b) omits the UR *a* thus satisfying IDμ^{GPU}, so it wins, although it violates MAX.

(16) Word final RV

/ʃavu**a**/ base: ta.pú**z**$^{\mu}$	IDμ^{GPU}	MAX
a. ʃa.vú		*!
☞b. ʃa.vú.**a**$^{\mu}$		
☛c. ʃa.vu.**á**$^{\mu}$		

By the ranking given so far, the two candidates (a) and (c), which preserve the UR *a*, are more optimal than candidate (b), which omits the UR *a*. Candidates (b) and (c) are both optimal under this ranking. The actual form in the language exhibit penultimate stress however, the default stress in Hebrew is final, making candidate (c) the better choice.

In candidate (b), *ʃa.vu.**á**$^{\mu}$*, the last radical of the root (RV) serves as the stress bearing unit. I argue that such a situation violates a Grammatical Paradigm Uniformity constraint, which demands that stress will fall at the same vowel throughout the G-Paradigm (in this case; the final vowel of the vocalic pattern):

> (17) IDENTSTRESS^{GPU} (IDSTRSS^{GPU})
> Let A be a vowel in S_1 and B be a vowel S_2. If A and B are in a correspondence relationship, then if A is stressed B is stressed and if A is unstressed B is unstressed.
> (S_1 = the base. S_2 = any output form sharing the G-Paradigm of the base).

IDSTRSS^{GPU} must outrank the constraint responsible for final stress in Hebrew i.e. FINALSTRESS. ALIGNR(Ft, PrWd) rules out any candidate that satisfy IDSTRSS^{GPU} but creates a non-aligned foot.

> (18)FINALSTRESS
> The final syllable in the prosodic word is stressed

> (19)ALIGNR(Ft, PrWd)
> The right edge of the foot aligns with the right edge of the prosodic word.

(20) Word final RV with stress constraints

/ʃavu**a**/ base: ta.pú**z**$^{\mu}$	IDSTRSS^{GPU}	ALIGNR (Ft, PrWd)	IDμ^{GPU}	MAX	FINAL STRESS
a. ʃa[vú]				*!	
☞b. ʃa[vú.**a**$^{\mu}$]					*
c. ʃa.vu[**á**$^{\mu}$]	*!				
d. ʃa[vu.**á**$^{\mu}$]	*!				
e. ʃa[vú]**a**$^{\mu}$		*!			*

The ranking employed in (20) predicts that forms with final RV will manifest it as an unstressed vowel. This ranking fail in explaining forms with final RV that is preceded by another *a* as shown in (21):

(21) Word final position *a* that is preceded by another *a*

/nasaa/ base: ka.tá**v**$^{\mu}$	IDSTRSS^{GPU}	ALIGNR (Ft, PrWd)	IDμ^{GPU}	MAX	FINAL STRESS
☞a. na[sá**]**				*!	
☛b. na[sá**.a**$^{\mu}$]					*
c. na.sa[**á**$^{\mu}$]	*!				
d. na[sá]**a**$^{\mu}$		*!			*

By the ranking given so far, candidate (b), which preserves the UR *a*, is more well formed than the actual form in the language (a), which omits the UR *a*. In candidate (b) *na[sá**.a**$^{\mu}$]* the stress pattern is faithful to the base, i.e. the last syllable of the vocalic pattern serves as the stress bearing unit, thus it must be parsed as a binary trochaic foot. I argue that this form is ruled out by $OCP_{foot}[V_iV_i]$.

(22) $OCP_{foot}[V_iV_i]$[5]
'Identical vowels are forbidden within the domain of a foot'

(23) Word final position *a* that is preceded by another *a* with $OCP_{foot}[V_iV_i]$

/nasaa/ base: ka.tá**v**$^{\mu}$	IDSTRSS^{GPU}	ALIGNR (Ft, PrWd)	OCP_{foot} $[V_iV_i]$	IDμ^{GPU}	MAX	FINAL STRESS
☞a. na[sá**]**					*	
b. na[sá**.a**$^{\mu}$]			*!			*
c. na.sa[**á**$^{\mu}$]	*!					
d. na[sá]**a**$^{\mu}$		*!				*

4.1.1 Suffixed forms

In the verb system vowel initial suffixes attract stress whereas consonant-initial suffixes do not. The analysis is shown to work for both cases:

(24) Evaluation of verbs with vowel initial suffixes

/ʃamaa-u/ base: lam.**d**ú	IDSTRSS^{GPU}	ALIGNR (Ft, PrWd)	OCP_{foot} $[V_iV_i]$	IDμ^{GPU}	MAX	FINAL STRESS
a. ʃa.m**a**$^{\mu}$[ú]				*!		
☞b. ʃa[mú]					*	

In tableau (24) the UR is *ʃamaa-ú* with *a* (RV) and *-u*. The faithful candidate (a) contains the UR *a*, and thus violates $\text{ID}\mu^{GPU}$. At this point it is important to notice that in the regular paradigm the second *a* of the stem is deleted (**lam**a**-dú*→ *lamdú*). This syncope is argued by Bat El (2008) to emerge due to the impact of the OO constraint DEPσ ('A derived form has the same number of syllables as its base'). The winning candidate (b) omits the UR *a*, creating a violation of MAX, but satisfying the $\text{ID}\mu^{GPU}$.

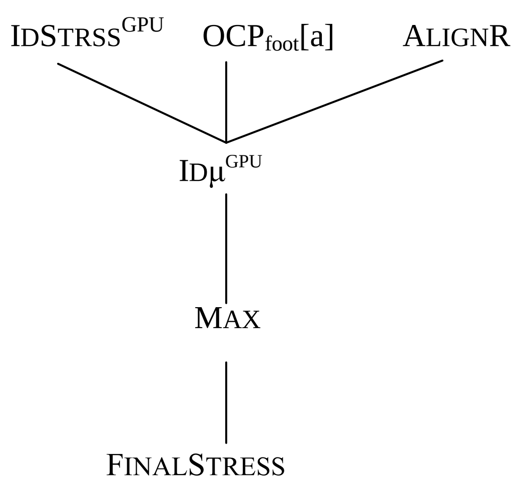
(25) Evaluation of verbs with consonant-initial suffixes

/ʃamaa-ti/ base: ka[tá**v**$^{\mu}$.ti]	IDSTRSS^{GPU}	ALIGNR (Ft, PrWd)	OCP_{foot} $[V_iV_i]$	$\text{ID}\mu^{GPU}$	MAX	FINAL STRESS
☞a. ʃa[má.ti]				*	*	*
b. ʃa.ma[**á**$^{\mu}$.ti]	*!					*
c. ʃa[má.**a**$^{\mu}$]ti		*!	*			*

In tableau (25) the UR is *ʃamaa-ti* with RV *a*. The faithful candidates (b) and (c) contain the UR *a* satisfying $\text{ID}\mu^{GPU}$, however, candidate (b) violates IDSTRSS^{GPU} and candidate (c) violates $\text{OCP}_{foot}[V_iV_i]$ and they are both ruled out. In the winning candidate (a) the RV *a* is omitted, satisfying the high ranked constraints IDSTRSS^{GPU} and $\text{OCP}_{foot}[V_iV_i]$ though violating $\text{ID}\mu^{GPU}$ and MAX.

The final ranking is given in (26):

(26) The Ranking



4.1.2 Exception: The future form of B2

The analysis given above has one exception; in the future form of B2, the sequence *ea* becomes *a* (and does not stay *ea*).

(27) *ea →a iʃam**á** 'he will be heard' (UR jiʃam**ea**) cf. ikanés 'he will enter'*

*ea →a ikan**á** 'he will surrender' (UR jikan**ea**) cf. ikanés 'he will enter'*

A possible solution is mentioned in Faust (2005), following Dor (1995). If we assume that the *e* in the regular paradigm is epenthetic, i.e. */ji-gamʁ/ → jigam**é**ʁ*, then a root with a final RV will not require this vowel: */ji-ʃam**a**/ → jiʃam**á***. This solution raises two problems: (a) as Faust mentions, speakers will have to deduce the structure of the regular paradigm from the sub-paradigm of the irregular RV roots. The regular paradigm gives no phonological cue that this vowel is epenthetic. (b) In the regular paradigm this vowel is stressed (*jigam**é**ʁ*) whereas in Hebrew epenthetic vowels are never stressed.

The second solution given by Faust formulates a special constraint for B2 future. I agree with Faust that the above mentioned two solutions are inadequate and a better explanation is yet to be proposed.

4.2 The quality of Root Vowels

Another issue to be dealt with is the quality of the vowels in the vowel sequences created by the adjacency of a RV and a following/preceding vowel. As shown in (28), *ia* sequence changes to *ee* in the verb system (a) and to *aa* in the noun system (b). If the cluster of vowels is within a foot, it does not change (c).

(28) Vowel sequences
*a. n**ee**[mád] 'he stood up' (UR n**ia**mad) cf. niʁdám 'he fell asleep'*

*b. m**aa**[mád] 'status' (UR m**ia**mad) cf. migdál 'tower'*

c. ʃa[vú.a] 'week' (UR ʃavua) cf. ta[púz] 'orange'

hiʃ[pí.a] 'he influenced' (UR hiʃpia) cf. hixtív 'he dictated'

I argue that in Hebrew *a sequence of two vowels of non-identical height is forbidden*. Using Local Conjunction (LC) (Smolensky 1995), a combination of the height demands for the features [+high] and [+low] can be formulized as a single constraint. In LC two constraints can be combined, a combined constraint is violated only by candidates that violate both combining constraints. The combined constraint is ranked above its combining constraints. The relevant constraint to be combined in this case are the IDENT height constraints IDENT[high] and IDENT[low] into IDENT[high]&IDENT[low]. The other relevant constraints are AGREE[high] and AGREE[low] (as formulated in Baković 2000).

(29) IDENT[high]&IDENT[low]: Corresponding segments have the same value of the features [high] and [low]

(30) AGREE[high]: adjacent vowels must agree in the feature [high]

(31) AGREE[low]: adjacent vowels must agree in the feature [low]

(32) Verb system evaluation

/n**ia**mad/	AGREE[high]	AGREE[low]	IDENT[high] &IDENT[low]	IDENT[high]	IDENT[low]
☞a. n**ee**mád				*	*
b. n**ea**mád		*!		*	
c. n**ie**mád	*!				*
d. n**ia**mád	*!	*			
e. n**aa**mád			*!	*	*
f. n**ii**mád			*!	*	*

Tableau (32) demonstrates this ranking: all candidates containing a sequence of two vowels that differ in the value of [high] and [low] (b, c and d) are ruled out by AGREE[high] or AGREE[low]. Candidates changing the UR value of [high] and [low] in the same locus (i.e. the same vowel) are ruled out by IDENT[high]&IDENT[low] (e changes the affix vowel from +high to -high and from -low to +low, and f changes the RV from -high to +high and from +low to -low). The winning candidate (a) changes the value of [high] in the first vowel and the value of [low] in the second vowel, thus violating IDENT[high] and IDENT[low] but not the combined constraint IDENT[high]&IDENT[low], since the violations are not in the same locus.

In the noun system the output also contains two identical vowels, e.g. *m**aa**mád*, although both vowels are *a* and not *e*. I argue that the indent quality of both vowels is the impact of AGREE height constraints which demands identity between adjacent vowels regarding height. However, *the quality of the RV does not change in the noun system.* This demand of faithfulness of height to a RV can be encoded in the positional faithfulness constraint in (33) (Beckman 1998). This constraint is indexed for nouns (McCarthy & Prince 1995, Pater 2000):

(33) IDENTROOT[low]$_{nouns}$
'A root segment and its output correspondent must have identical specifications for the feature [low]

This constraint must outrank IDENT[high]&IDENT[low] as shown in tableau (34):

(34) Noun system evaluation[6]

/m**ia**mad/	AGREE [high]	AGREE [low]	IDENTROOT [low]$_{nouns}$	IDENT[high]& IDENT[low]	IDENT [high]	IDENT [low]
a. m**ee**mád			*!		*	*
b m**ea**mád		*!			*	
c. m**ie**mád	*!		*			*
d. m**ia**mád	*!	*				
☞e. m**aa**mád				*	*	*
f. m**ii**mád			*!	*	*	*

In tableau (34) all candidates containing a sequence of two vowels that differ in the value of [high] and [low] (b, c and d) are ruled out by AGREE[high] or AGREE[low]. Candidates (a and f) change the value of [low] (+low to –low) in the second vowel (a RV), thus violating IDENTROOT[low]$_{nouns}$ and being ruled out. The winning candidate (e) does not change the RV values for [low], thus not violating IDENTROOT[low]$_{nouns}$.

As shown in (28) if the vowel sequence contains a stressed vowel, the vowels do not agree in the values of [high/low]. I argue that this is the result of IDENTITY[high/low]$_{Foot}$ which are undominated and militate against changing the height values of vowels within a foot.

(35) IDENTITY[high]$_{Foot}$
Correspondent segments contained in a prosodic head must be identical for high.

(36) IDENTITY[low]$_{Foot}$
Correspondent segments contained in a prosodic head must be identical for low.

(37) Vowel cluster within a foot

/ʃavua/	IDENT [high]$_{Foot}$	IDENT [low]$_{Foot}$	OCP$_{foot}$ [V_iV_i]	AGREE [high]	AGREE [low]	IDENTROOT [low]$_{nouns}$	IDENT[high]& IDENT[low]	IDENT [high]	IDENT [low]
a. ʃa[vú.u]	*!	*	*			*	*	*	*
☞b ʃa[vú.a]				*	*				
c. ʃa[vá.a]	*!	*	*				*	*	*
d. ʃa[vú.e]		*!		*		*			*
e. ʃa[vó.a]	*!				*			*	

At this point any reader familiar with the structure of Hebrew will notice that this analysis cannot account for numerous instances of existing un-identical vowel sequences in the language, for example, the forms *ni[ér]* 'he will shake' in B4 and *jitpa[él]* 'he will be impressed' in B5. The lack of agreement between the vowels in the sequence in these instances cannot be attributed to $OCP_{foot}[V_iV_i]$, since the first vowel does not belong to the foot.

The data reveals that agreement is forced on some binyanim and mishkalim, but not on others. For example, in the verb system agreement is active in B1, B2 and B3, but never in B4 and B5. The explanation of these different behaviors can be found in the work of Bat El (2003) who argues that Vocalic Patterns (VP) are to be viewed as constraints, and "An input has to be specified for the binyan required in the output, and the specification on the VP constraint has to match this requirement" (ibid. p.10). For example, the VP of B4 is {ie}, as in the regular verb *n**i**ʃ**é**k* 'he kissed'. Any change in the vowel’s quality will violate the B4 VP constraint.

Using examples from denominative verbs Bat El shows that VP constraints are violable (as any OT constraints). The data from Hebrew exhibits an interesting generalization: *agreement affects only RVs and affix vowels, but not VP vowels*. Agreement effects take place only in B2 and B3. In these binyanim an infix is added before the VP; *ni-* in B2 and *hi-* in B3. The vowels affected by AGREE are never part of the VP, they are always part of the infix or the root. This behavior suggests that all VP constraints are ranked above the agreement constraints. Tableau (36) demonstrates this ranking using B4. B4{ie} must outrank the agreement constraint. (Remember that the RV is omitted in the surface).

(38) B4 evaluation

/niaer/	B4{ie}	OCP$_{foot}$ [V_iV_i]	AGREE [high]	AGREE [low]	IDENTROOT [low]$_{nouns}$	IDENT[high]& IDENT[low]	IDENT [high]	IDENT [low]
a. ne[eʁ]	*!						*	
☞b ni[eʁ]			*					
c. ni[iʁ]	*!							*

The vocalic patterns of past tense Hebrew verbs are given in (39).

(39) Vocalic Patterns

B1 CaCaC VP{aa}
B2 ni-CCaC {a}
B3 hi-CCiC {i}
B4 CiCeC {ie}
B5 hit-CaCeC {ae}

This list of vocalic patterns is different than the one presented at Bolozky and Schwarzwald (1992) and Bat El (2003), who consider all vocalic patterns as disyllabic and thus consider only the consonant as a prefix in B2 and B3.

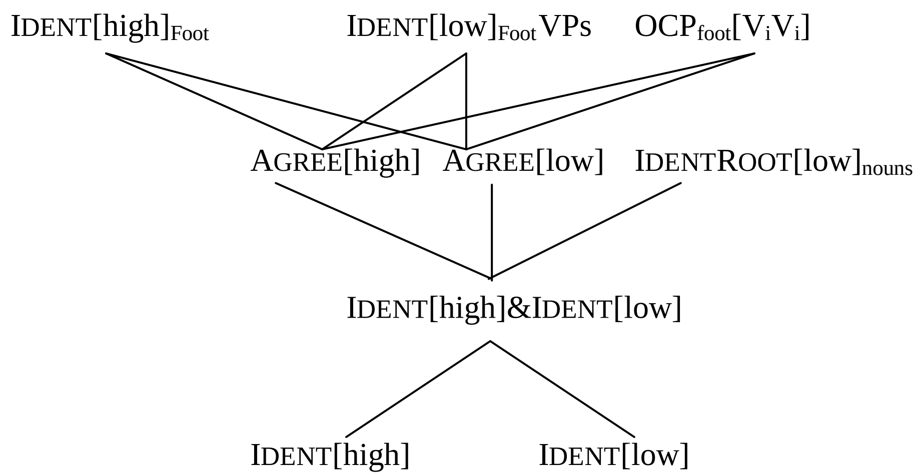
(40) Vocalic Patterns (Bolozky and Schwarzwald 1992, Bat El 2003)

B1 CaCaC VP{aa}
B2 n-iCCaC {ia}
B3 h-iCCiC {ii}
B4 CiCeC {ie}
B5 hit-CaCeC {ae}

However as was shown above, the division offered in this paper captures the different behavior of the Vocalic Patterns on one hand and of the prefix vowels on the other hand, with regard to agreement restrictions[7].

As mentioned above, only RVs and affix vowels are affected by agreement. RVs are always *a*, however, the values of affix vowels are also restricted in the language. Affix vowels are always *i* or *a*. This means that vowel sequences affected by agreement are *ia* and *aa* (the latter is, of course, already in agreement)[8].

(41) Ranking of vowel quality constraints



4.2.1 Exception: The future form of B1

In the future form of B1, the sequence *ia* becomes *aa* (and not *ee*):

(42) *ia→aa: j**aa**mód 'he will stand up' (UR j**ia**mod) cf. iʃmóʁ 'he will guard'*

jaazóv 'he will leave (UR jiazov) cf. iʃmóʁ 'he will guard'

The historical reason for this behavior is that the original vowel was *a* and at some point *a*'s in unstressed syllables became *i*. This did not happen before a pharyngeal. The alternation was adopted in Modern Hebrew even though the pharyngeal was not (see §2.1).

Faust (2005) argues that the prefix is actually *jV*, i.e. the vowel is not specified for height or backness in the lexicon. The resulting *aa* sequence is achieved by agreement to the RV. To explain why the prefix vowel is *i* in regular (triconsonantal) roots and not the default epenthetic vowel *e* (*j**i**ʃmóʁ not *j**e**ʃmóʁ)*, Faust assumes it is influenced by the glide.

This outcome is predicted under the ranking given in (43):

(43) B1 future

/*j**V**-**a**mod*/	OCP$_{foot}$ [V_iV_i]	AGREE [high]	AGREE [low]	IDENTROOT [low]$_{nouns}$	IDENT[high]& IDENT[low]	IDENT [high]	IDENT [low]
a. *j**ia**[mód]*		*!	*				
☞b *j**aa**[mód]*							
c. *j**ee**[mód]*							*!
d. *j**ii**[mód]*					*!	*	*

Candidate (a) violates agreement and is ruled out. All other candidates satisfy agreement; however, candidate (b) is the optimal one since it does not violate any identity constraint.

This analysis is problematic for a few reasons: (a) All other prefixes have *i* as their vowel (*t**i**ʃmóʁ*, *n**i**ʃmóʁ* etc.). This *i* has to be lexical and not represented as just *V* in the UR. Were this vowel just *V* in the lexicon, it would not surface as *i*, since these prefixes do not begin with a glide. The expected vowel would be the default vowel in Hebrew *e*.

Faust indeed assumes that only the 3rd.masc.sg. prefix has no vowel specification and all other prefixes are specified for *i* in the UR (*ti*-, *ni*).
However, such a division between the 3rd.masc.sg. prefix and all other prefixes raises the question of why only this prefix is unspecified for the vowel quality, while all others are fully specified? Furthermore, in all other binyanim the 3rd.masc.sg. prefix is also fully specified, e.g. B2 *je*- B3 *ja*- B4 *je*- (We cannot assume these vowels not to be fully specified, since had they been, they would have surfaced as *i* due to the glide according to Faust's analysis). Again, such a division between the 3rd.masc.sg. prefix in B1 and the 3rd.masc.sg. prefix in all other binyanim seems arbitrary.

(b) A more serious problem is that this analysis assumes that speakers (and children acquiring the verbal system of Hebrew) have to deduce that the structure of the

3rd.masc.sg. prefix of B1 is *jV-* from irregular verbs (RVs verbs), while there is no phonological cue in the regular paradigm that suggests that this vowel has no value specification.

It seems that speakers have to learn that 3rd.masc.sg. of B1 acts differently than other verb paradigms and actually acts like the noun system. This behavior may suggest that the difference between verbs and nouns is collapsing in the language.

5. What happened to historical *ħ* in Modern Hebrew?

This section deals with the manifestation of the unvoiced pharyngeal in Modern Hebrew. As mention in section 2.1, Hebrew has no pharyngeal in its consonant inventory. The unvoiced pharyngeal *ħ* emerged as *x* or *ax* on the surface. I assume that the grammar of Hebrew differentiates between *x* that emerged from the shift *ħ →x* and *x* that did not. The following shifts occurred during the history of Hebrew:[9]

(44) The historical develompnet of dorsal fricatives
Tiberian Hebrew ħ ⟶ ax   Tiberian Hebrew K[10] ⟶ K

Velar fricatives have two origins in Modern Hebrew. This is of course an historical observation that bears no significance to a synchronic analysis of the language. However, the two phonemes act differently synchronically as well; the consonant that emerged from a pharyngeal always surfaces as the fricative *x* and the consonant is sometimes preceded by the vowel *a*. The consonant that emerged from /*K*/ never surfaces as *[ax]* and is subject to post vocalic spirantization (alternates between *k* and *x* - see Adam 2002). These phonological cues help a learner of Hebrew to establish two distinct phonemes: *the historical ħ became /ax/ and the historical K that stayed /K/.*

5.1 Generalizations

ax that is parallel to a moraic consonant in the G-Paradigm

[*ax*] in word final position if the preceding vowel is not [*a*]:

(45a) *[ax]* in word final position where the preceding vowel is not *a*

UR	Surface Form	Gloss	A form with the same MS and a consonant at the same prosodic position of the RV	Gloss
*ʃati**ax***	*ʃa.tí.**ax***	*'carpet'*	*ʃa.tí**l***	*'seedling'*
*hivti**ax***	*hiv.tí.**ax***	*'he promised'*	*hi.txí**l***	*'he began'*
*himli**ax***	*him.lí.**ax***	*'he salted'*	*hit.xí**l***	*'he began'*

If the preceding vowel is *a*, only the consonant will emerge:

(45b) [x] in word final position where the preceding vowel is *a*

UR	Surface Form	Gloss	A form with the same MS and a consonant at the same prosodic position of the RV	Gloss	A form of the same lexeme with a manifested RV	Gloss
*laka**ax***	*la.ká**x***	*'he took'*	*la.má**d***	*'he studied'*	*lo.ké.**ax***	*'he takes'*
*miʃta**ax***	*miʃ.tá**x***	*'surface'*	*mig.dá**l***	*'tower'*	*hiʃ.tí.ax*	*'he flattened'*

If a vowel appears before the ax coalescence occurs:

Noun system: *i* + *ax* coalesce to *a* and *a* + *ax* coalesce to *a*

(46a) Noun system coalescence

UR	Surface Form	Gloss	A form with the same MS and a consonant at the same prosodic position of *ax*	Gloss
*mi**ax**nak*	*m**ax**.nák*	*'suffocation'*	*m**ig**.dál*	*'tower'*
*mi**ax**laka*	*m**ax**.la.ká*	*'department'*	*m**iʃ**.ta.ʁá*	*'police'*
*ma**ax**beʁet*	*m**ax**.bé.ʁet*	*'notebook'*	*'m**ik**.tér.et*	*'pipe'*

Verb system: *i* + *ax* coalesce to *e* (in B2 and B3)

(46b) Coalescence

UR	Surface Form	Gloss	A form with the same MS and a consonant at the same prosodic position of *ax*	Gloss
*n**iax**nak*	*n**ex**[nák]*	*'he choked'*	*n**ig**[máʁ]*	*'it was finished'*
*h**iax**lit*	*h**ex**.lít*	*'he decided'*	*h**ig**.díl*	*'he enlarged'*

ax that is parallel to a non moraic consonant in the G-Paradigm will appear as x

(47a) Word initial

UR	Surface Form	Gloss	A form with the same MS and a consonant at the same prosodic position of *ax*	Gloss
***ax**aveʁ*	***x**a.véʁ*	*'friend'*	***g**a.déʁ*	*'fence'*
***ax**aʃav*	***x**a.ʃáv*	*'he thought'*	***l**a.mád*	*'he studied'*

(47b) Word medial

UR	Surface Form	Gloss	A form with the same MS and a consonant at the same prosodic position of *ax*	Gloss
*hat**ax**ala*	*hat**.xa**.lá*	*'beginning'*	*haʃ.**p**a.lá*	*'humiliation'*
*ma**ax**aʁ*	*ma**.x**áʁ*	*'tomorrow'*	*na.**h**áʁ*	*'river'*
*ni**ax**em*	*ni**.x**ém*	*'he comforted'*	*ki.**b**él*	*'he received'*

5.2 Analysis

5.2.1 B2 and B3 Coalescence

As mentioned above, when the *ax* phoneme is preceded by a vowel and this sequence is not in a foot (i.e. in B2 and B3), coalescence occurs. The pattern of the coalescence is as follows: ia→ e.

In features we can formulate the pattern as $V_1[_{+high-low}]V_{2[-high+low]}]\rightarrow V_{1,2}[_{-high-low}]$. Since coalescence takes place, the anti-coalescence constraint UNIFORMITY (McCarthy and Prince 1995) must be violated.

(48) UNIFORMITY
'No output segment has multiple correspondents in the input'.

I argue that manifesting both the consonant and the vowel of the *ax* phoneme violates a one to one correspondence constraint. This GPU constraint militating against additional segments in forms with *ax*:

> (49) ONETOONE ^{GPU}
> Every segment of S_1 has one correspondent segment in S_2 and every segment of S_2 has one correspondent segment in S_1.
> (S_1 = the base. S_2 = any output form sharing the G-Paradigm of the base).

(50) Verb system coalescence

/niaxnak/ base: ni**l**$^{\mu}$mád	AGREE [high]	AGREE [low]	MAX	ONETO ONE ^{GPU}	IDENT[high]& IDENT[low]	UNIFORMITY	IDENT [high]	IDENT [low]
a. ni.**a**$^{\mu}$**x**$^{\mu}$[nák]	*!	*		*				
☞b. ne$^{\mu}_{1,2}$x$^{\mu}$[nák]						*	*	*
c. ni$^{\mu}_{1,2}$x$^{\mu}$ [nák]					*!	*	*	*
d. na$^{\mu}_{1,2}$x$^{\mu}$ [nák]					*!	*	*	*
e. ni**x**$^{\mu}$[nák]			*!					
f. n**a**$^{\mu}$**x**$^{\mu}$[nák]			*!					
g. ne**.e**$^{\mu}$[nák]			*!				*	*
h. ne**.e**$^{\mu}$**x**$^{\mu}$ [nák]				*!			*	*

In tableau (50) the UR contains the phoneme *ax* in the prosodic position that is occupied by a root consonant in the GP. Candidate (a) is the faithful candidate which does not delete or change any segment of this phoneme, it thus violates the agreement constraints. Candidates (e), (f) and (g) delete the vowel of the *ax* phoneme, the suffix vowel or the root consonant respectively, so they are ruled out by MAX. Candidates (b), (c) and (d) fuse the prefix vowel and the RV. IDENT[high]&IDENT[low] is the combined constraint that militates against changing both the high and the low values of a vowel. Candidate (c) changes the RV from *a* to *i*, thus violating this constraint (+low to –low and –high to +high), and candidate (d) changes the prefix vowel from *i* to *a* (–low to +low and +high to –high), thus violates IDENT[high]&IDENT[low] as well. Candidate (h) changes the prefix vowel from *i* to *e* and the RV from *a* to *e*. these changes do not violate

IDENT[high]& IDENT[low]. However this form has two segments (*ax*) in a prosodic position that has only one segment in the triconsonantal form. Such a situation violates ONETOONE ^{GPU}. The winning candidate (b) changes the RV from *a* to *e* (+low to –low) and the prefix vowel from *i* to *e* (+high to –high), but it does not change both values in the same vowel, so it does not violate the combined constraint IDENT[high]&IDENT[low]. It does violate the uniformity constraint (as all the coalescence candidates do) which is ranked low.

In the noun system the sequence *i+a* becomes *a*. I argue that this coalescence is due to the ranking of the positional faithfulness constraint IDENTROOT[low]$_{nouns}$ over IDENT[high]&IDENT[low].

(51) Noun system coalescence

/miaxnak/ base: mi**g**^{μ}dál	AGREE [high]	AGREE [low]	MAX	ONETO ONE ^{GPU}	IDENT ROOT [low]$_{nouns}$	IDENT [high]& IDENT[low]	UNI FORMITY	IDENT [high]	IDENT [low]
a. mi.**a**^{μ}**x**^{μ} [nák]	*!	*		*					
b. me^{μ}$_{1,2}$x^{μ}[nák]					*!		*	*	*
c. mi^{μ}$_{1,2}$x^{μ} [nák]					*!	*	*	*	*
☞d. ma^{μ}$_{1,2}$x^{μ} [nák]						*	*	*	*
e. mi**x**^{μ}[nák]			*!						
f. m**a**^{μ}**x**^{μ}[nák]			*!						
g. me**.e**^{μ}[nák]			*!		*			*	*
h. ne**.e**^{μ}**x**[nák]				*!	*			*	*

5.2.2 *ax* within a foot

When the *ax* phoneme is in a word final position, it is realized as *ax* and not as just *x*. however the ranking so far predicts that the optimal candidate is the candidate that fuses the stressed vowel and the RV:

(52) Evaluation of forms with final *ax*

/tapuax/ base: kadú**ʁ**$^{\mu}$	AGREE [high]	AGREE [low]	MAX	ONETO ONE ^{GPU}	IDENT ROOT [low]$_{nouns}$	IDENT [high]& IDENT[low]	UNI FORMITY	IDENT [high]	IDENT [low]
☞a. ta[pú.**a**$^{\mu}$**x**$^{\mu}$]	*	*!		*					
b. ta[pú**x**$^{\mu}$]			*!						
c. ta[pú.**a**$^{\mu}$]	*	*!	*						
☛d. ta[pó$_{1,2}$**x**$^{\mu}$]					*		*	*	*

I argue that FTBN prevents coalescence within a foot as shown in (52):

(53) Evaluation of forms with final *ax*

/tapuax/ base: kadú**ʁ**$^{\mu}$	FTBN	AGREE [high]	AGREE [low]	MAX	ONETO ONE ^{GPU}	IDENT ROOT [low]$_{nouns}$	IDENT [high]& IDENT[low]	UNI FORMITY	IDENT [high]	IDENT [low]
☞a. ta[pú.**a**$^{\mu}$**x**$^{\mu}$]		*	*		*					
b. ta[pú**x**$^{\mu}$]	*!			*						
c. ta[pú.**a**$^{\mu}$]		*	*	*!						
d. ta[pó$_{1,2}$**x**$^{\mu}$]	*!					*		*!	*	*

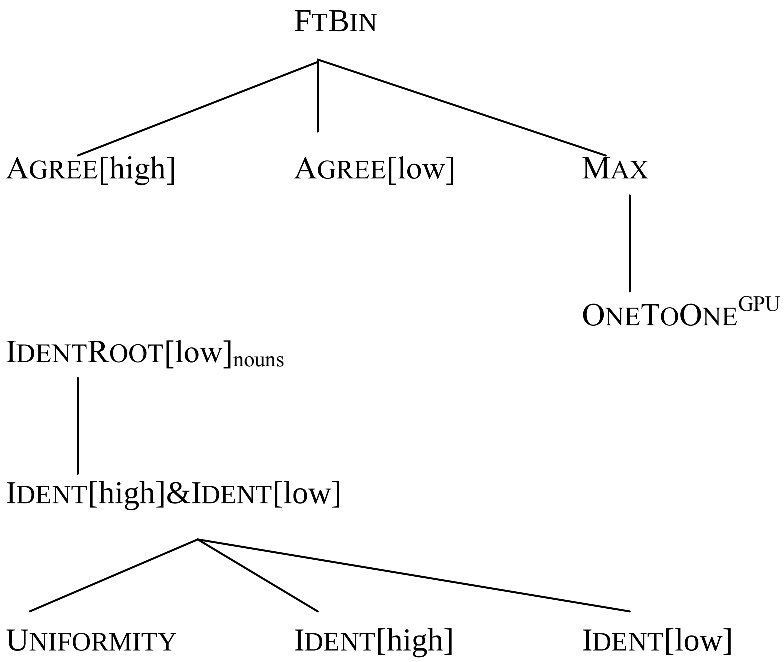
In tableau (53) candidate (a) realizes the vowel and the consonant of the UR *ax*.

Candidate (c) realizes only the consonant of the UR *ax* and is ruled out by MAX.

Candidate (b) and (d) create a unary foot and are ruled out by FTBN.

Candidate (a) is the optimal candidate though it has two segments (*a* and *x*) that are parallel to one segment the triconsonantal form (the final consonant).

(54) Final ranking



6. Discussion and Conclusions

6.1 What is the motivation for Grammatical Paradigm Uniformity relations?

Any word must contain a lexeme and a set of grammatical features that convey 'functional' meanings, such as Tense, Number, Gender etc. (Spencer 2000). These features can be expressed by inflection (I do not address the division made by Booij (1994; 1996 among others) between contextual inflection and inherent inflection). Not every language may realize every feature or realize all features in a given word. Analogical relations between words sharing a lexeme have received much treatment in linguistic theory; however, apart from a few studies (notably Burzio 1998), the claim for analogical relations between words sharing grammatical features was not strongly advocated.

The relation between words sharing a lexeme is quite straightforward: the same lexeme appears throughout the inflectional paradigm such as the English *drink, drinks, drinking* or *eat, eats, eating* paradigms. Such relations can explain under- and over-application phenomena in related words. The reason for such relations seems straightforward as well: the more similar words belonging to a lexemic paradigm are, the more transparent their connection to the base is (Bybee 1988). The data given in this study demonstrate that an opaque phonological alternation can be accounted for by relating to forms with the same morphological structure. Such an observation makes a reference to grammatical paradigms; a notion well-known and studied in linguistic literature (Stump 1993 for example), and motivated by other independent reasons (see Jackendoff 1997; Spencer 1997). The proposal here is that similarity demands exist within grammatical paradigms and not just within the lexemic paradigms. What is the motivation for such similarity relations? *The greater the phonological invariance of members of a grammatical paradigm, the more transparent their morphological structure is.* It seems that the purpose of Paradigm Uniformity and Grammatical Paradigm Uniformity is to utilize phonological structure as indication for morphological/lexical structure.

The consequence of this hypothesis is that words may be subject to similarity demands in two dimensions: lexical and grammatical. Constraints militating for identity within a lexemic paradigm will relate only to forms with the same lexeme and ignore forms that do not share the same lexeme. Constraints militating for identity within a grammatical paradigm will relate only to forms with the same morphological structure and ignore forms that do not share the same morphological structure.

6.2 Root Vowels and Richness of the Base

RVs in Modern Hebrew emerged from historical pharyngeals. This fact explains why only the low vowel *a* can be a RV. Phonetic studies on pharyngeals (Delattre 1971, Perkell 1971 among others) show that low vowels involve some pharyngeal constriction, with concomitant acoustic similarities between the vowel *a* and the pharyngeals (high F_1).

However, from a synchronic point of view it is not clear why only *a* appears as a RV. Richness of the Base (Prince and Smolensky 1993) holds that any vowel can appear in the UR. The state of affairs, as it is in Hebrew, does not contradict Richness of the Base, but is actually more restrictive than what Richness of the Base predicts.

A possible explanation can be found in the special history of the language. Modern Hebrew was revived at the end of the 19th century, i.e. it is a live language for just more than 100 years, a very short time in the life of a language. It is possible that other RVs will emerge in the language in a later stage. In other words, even though *a* is the only RV attested in the language, RVs are part of the grammar of Hebrew speakers. Other vowels as RV do not appear in Hebrew due to historical reasons and not due to any grammatical reason.

A potential *o* as a RV can be found in B4 and B5 reduplicated verbs (Bat El 2003). In these verbs the first vowel of the stem is *o*: *x**o**kek 'he made a law'* in B4, and *hitk**o**nen 'he got ready'* in B5. Bat El analyzes these verbs as having a marginal Vocalic Pattern {oe} (and not regular B4{ie} and B5{ae}). A lot of these verbs are denominative. However, theoretically these verbs can be analyzed as having the RV *o*. This claim is supported by the fact that denominative verbs with *o* are created in this way (Bat El 1994, 2003, Ussishkin 2000): *ʁóm ('height') → ʁomém, ('he uplift, raised'), kód ('code') → kodéd ('he encoded')*. It is not clear why only *o* is transmitted to verbs, why only in reduplicated verbs, why it occupies the position of the first vowel of the vocalic pattern (in regular verbs) and why only in B4 and B5. Nevertheless, it may be the case that Hebrew is changing towards allowing other vowels to be RV.

6.3 Conclusion

This paper examined the synchronic status of historical pharyngeals in Modern Hebrew. It was argued that pharyngeals do not have any phonemic standing in the system of the language, thus a more transparent account of the surface phenomena is needed. Such an analysis was laid down by using a new theoretical notion; Grammatical Paradigm Uniformity. Grammatical Paradigm Uniformity is an Output-to-Output theory which organizes similarity relations between words that share the same Morphological Structure but do not share a lexeme.

It was argued that the historical voiced pharyngeal *ʕ* was recovered as the vowel *a* and that the historical unvoiced pharyngeal *ħ* was recovered as *ax*. On the surface, however, the historical voiced pharyngeal can appear as *a* or as nothing, and the *ax* phoneme can appear as *ax* or as *x*. It was argued that the interaction of Grammatical Paradigm Uniformity constraints and of regular phonological constraints is responsible for these different behaviors.

References

Adam, G. (2002). *From variable to optimal grammar: evidence from language acquisition and language change.* PhD Dissertation. Tel-Aviv: Tel-Aviv University.
Bakovic, E. (2000). *Harmony, dominance and control.* Doctoral Dissertation, Rutgers University.

Bar-Lev, Z. (1977). Natural-Abstract Hebrew Phononology. *Folia Linguistica*, 11, 259-272.

Bat-El, O. (1989). Phonology and Word Structure in Modern Hebrew. Ph.D. Dissertation, UCLA.

Bat-El, O. (1993). Parasitic metrification in the Modern Hebrew stress system. *The Linguistic Review*, 10, 189-210.

Bat-El, O. (1994). Stem modification and cluster transfer in Modern Hebrew. *Natural Language and Linguistic Theory,* 12, 571-596.

Bat-El, O. (2003). The fate of the consonantal root and the binyan in Optimality Theory. *Recherches Linguistiques de Vincennes*, 32, 31-60.

Bat-El, O. (2005). The emergence of the binary trochaic foot in Hebrew hypocoristics. *Phonology*, 22, 1-29.

Bat-El. O. (2006). *What does the morpho-phonology say about Hebrew participles?* Ms. Thursday Interdisciplinary Colloquium. Tel Aviv University.

Bat-El, O. (2008). Morphologically conditioned V-Ø alternation in Hebrew: Distinction among nouns, adjectives & participles, and verbs. In Sh. Armon-Lotem, G. Danon & S. Rothstein (Eds.), *Generative Approaches to Hebrew Linguistics*. (pp.27-60), Amsterdam: John Benjamins.

Becker M. (2003). Hebrew Stress: Can't you hear those trochees? In E. Kaiser and S. Arunachalam (Eds.), *Proceedings of PLC* 26, 9.1: (pp. 45–58).

Beckman, J (1998). *Positional faithfulness*. PhD Dissertation. Amherst: University of Massachusetts.

Benua, L. (1997). *Transderivational identity: Phonological relations between words*. PhD dissertation. Amherst: University of Massachusetts.

Bolozky, Sh. (1982). Remarks on rhythmic stress in Modern Hebrew. *Journal of Linguistics*, 18, 275-289.

Bolozky, Sh. (1995). “Hasegoliyyim -- gzira kavit ’o mesoreget?” [The Segolates -- linear or discontinuous derivation?] In O. R. Schwarzwald and Y. Schlesinger

(Eds.), *Hadassah Kantor Jubilee Book* (pp. 17-26), Ramat Gan: Bar-Ilan University. (In Hebrew)

Bolozky, Sh. & Schwarzwald, O. (1992). On the derivation of Hebrew forms with the +*ut* suffix. *Hebrew Studies*, 33, 51-69.

Booij, G. (1994). Against split morphology. In G. Booij & J. van Marle (Eds.), *Yearbook of Morphology* 1993, (pp. 27-49), Kluwer: Dordrecht.

Booij, G. (1996). Inherent versus contextual inection and the split morphology hypothesis. In G. Booij & J. van Marle, (Eds.), *Yearbook of Morphology* 1995, (pp. 1-16), Kluwer: Dordrecht.

Bybee, J. L. (1985). *Morphology: A study of the relation between meaning and form.* Amsterdam: John Benjamins.

Bybee, J. L. (1988). Morphology as lexical organization. In M. Hammond & M. Noonan (Eds.), *Theoretical morphology* (pp. 119 – 41), San Diego, CA: Academic Press.

Burzio, L. (1994). *Principles of English stress*. Cambridge University Press.

Burzio, L. (1998). Multiple correspondence. *Lingua 103*, 79-109.

Burzio, L. (2002a). Missing players: Phonology and the past-tense debate. *Lingua 112*, 157-199.

Burzio, L. (2002b). Surface-to-Surface morphology: when your representations turn into constraints. In P. Boucher (ed.), *Many Morphologies* (pp. 142-177), Somerville, MA: Cascadilla Press.

Burzio, L. (2005a). Sources of paradigm uniformity. In L. J. Downing, T. A. Hall & R. Raffelsiefen (Eds.), *Paradigms in phonological theory* (pp. 65-106), Oxford: Oxford University Press.

Burzio, L. (2005b). *Lexicon and grammar: unequal but inseparable.* Ms. Johns Hopkins University.

Chomsky, W. (1957). *The eternal language*. Philadelphia, PA: Jewish Publication Society of America.

Clements, G. N. & Keyser. S. J. (1983). *CV Phonology*. Cambridge, MA: MIT Press.

Coffin E. & Bolozky, Sh. (2005). *A Reference Grammar of Modern Hebrew*, Cambridge: Cambridge University Press.

Crystal, D. (1985). *A dictionary of linguistics and phonetics*. 2nd edition. New York: Basil Blackwell.

Delattre, P. (1971). Pharyngeal features in the consonants of Arabic, German, Spanish, French, and American English. *Phonetica*, 23, 129-155.

Dor, D. (1995). Deriving the verbal paradigm of Modern Hebrew: A constraint based approach. In H. van der Hulst & J. van de Weijer, (Eds.), *Leiden in Last: HIL Phonology Papers I.* (pp. 105-144), The Hague: Holland Academic Graphics.

Faust, N. (2005). *The fate of Hebrew gutturals.* MA Thesis. Tel-Aviv: Tel-Aviv University.

Halle, M. & Marantz, A. (1993). Distributed morphology and the pieces of inflection. In K. Hale & S. J. Keyser (Eds.), *The View from Building 20. Essays in Honor of Sylvain Bromberger* (pp.111-176), Cambridge, Mass.: The MIT Press.

Hayes, B. (1989). Compensatory Lengthening in moraic phonology. *Linguistic Inquiry*, 20, 253–306.

Hayes, B. (1995). *Metrical stress theory: Principles and case studies*. Chicago: The University of Chicago Press.

Hyman, L. (1985). *A theory of phonological weight*. Dordrecht: Foris.

Iscrulescu, C. (2006). *The phonological dimension of grammatical markedness*. Phd dissertation. University of Southern California.

Itô, J. (1986). *Syllable theory in prosodic phonology*. Doctoral Dissertation. Amherst: University of Massachusetts.

Jackendoff, R.S. (1997). *The architecture of the language faculty.* Cambridge MA: MIT Press.

Kenstowicz, M. (1996). Base identity and uniform exponence: Alternative to cyclicity. In J. Durand & B. Laks (Eds.), *Current trends in phonology: models and methods* (pp. 363-393), Paris-X and Salford: University of Salford Publications.

Landau, I. (1997). Weight-by-Cycle. In B. Bruening, K. Yoonjung & M. McGinnis (Eds.), *PF: Papers at the Interface, MIT Working Papers in Linguistics 30* (pp. 183-208).

Levin, J. (1985). *A metrical theory of syllabicity*. MIT Press.

Melčuk, I. & Podolsky, B. (1996). Stress in Modern Hebrew nominal inflection. *Theoretical Linguistics 22*, 155-194.

McCarthy, J. (1979). *Formal problems in Semitic phonology and morphology*. Doctoral Dissertation. Cambridge, MA: MIT. [Published by Garland Press, New York, 1985.]

McCarthy, J. (1981). A prosodic theory of nonconcatenative morphology. *Linguistic Inquiry*, 12, 373-418.

McCarthy. J. (2005). Optimal paradigms. In L. Downing, T. A. Hall & R. Raffelsiefen (Eds.), *Paradigms in Phonological Theory* (pp. 170-210). Oxford: Oxford University Press.

McCarthy, J. J. & Prince, A. (1986/1996). "*Prosodic morphology 1986*." Report no. RuCCS-TR-32. New Brunswick, NJ: Rutgers University Center for Cognitive Science. [Excerpts appear in J. Goldsmith (Ed.), *Essential Readings in Phonology* (pp. 102-136). Oxford: Blackwell, 1999.]

McCarthy, J. & Prince, A. (1995). Faithfulness and reduplicative identity. In J. Beckman, L. W. Dickey & S. Urbanczyk (Eds.), *University of Massachusetts Occasional Papers in Linguistics 18* (pp. 249-384). Amherst, MA: GLSA.

Pariente, I. (2010). Pharyngeal related non-lexical vowels in Sephardic Modern Hebrew. *Linguistics in Amsterdam*, 3, 1-19. [Handout available as ROA-1069].

Pater, J. (2000). Non-uniformity in English secondary stress: the role of ranked and lexically specific constraints. *Phonology* 17, 237-74.

Perkell, J. (1971). Physiology of speech production: A preliminary study of two suggested revisions of the features specifying vowels. *MIT Research Laboratory of Electronics Quarterly Progress Report*, 102, 123-139.

Prince, A. & Smolensky, P. (1993/2004). *Optimality theory: Constraint interaction in generative grammar.* Malden, MA; Oxford, UK; Victoria, Australia: Blackwell.

Shimron, J. (2003). *Language, processing, and language acquisition in a root-based morphology*. Amsterdam: John Benjamins.

Smith, J. L. (1997). Noun faithfulness: On the privileged behavior of nouns in phonology. **http://www.unc.edu/~jlsmith/home/pdf/nfaith97.pdf**.

Smolensky, P. (1995). On the structure of the constraint component CON of UG. Talk presented at University of California, Los Angeles. [Handout available as ROA-86]

Spencer, A. (1997). A note on the lexeme and the paradigm. *Essex Research Reports in Linguistics,* 16, 1-16.

Spencer, A. (2000). Inflection and the Lexeme. *Acta Linguistica Hungarica* 47, 335- 344.

Steriade, D. (1999). Lexical conservatism in French adjectival liaison. In B. Bullock, M. Authier & L. Reed (Eds.), *Formal Perspectives in Romance Linguistics* (pp. 243-270), Amsterdam: John Benjamins.

Steriade, D. (2000). Paradigm uniformity and the phonetics-phonology boundary. In M. B. Broe & J. B. Pierrehumbert (Eds.), *Papers in laboratory phonology V: acquisition and the lexicon* (pp. 313-334). Cambridge: Cambridge University Press.

Stump, G.T. (1993). Position classes and morphological theory. In G. Booij & J. van Marle (Eds.), *Yearbook of Morphology 1992* (pp. 129 – 1799, Kluwer: Dordrecht.

Topintzi, N. (2006). *Moraic onsets*. Doctoral Dissertation. London: University College London.

Ussishkin, A. (1999). The inadequacy of the consonantal root: Modern Hebrew denominal verbs and output-output correspondence. *Phonology* 16, 401- 42.

Ussishkin, A. (2000). *The emergence of fixed prosody.* Doctoral Dissertation. University of California at Santa Cruz.

Ussishkin, A. (2003). Templatic effects as fixed prosody: the verbal system in Semitic. In J. Lecarme, J. Lowenstamm, and U. Shlonsky (Eds.), *Research in Afroasiatic Grammar III* (pp. 511-530) (selected papers from CAL 5), Amsterdam: John Benjamins.

[1] The quality of the RVs will be discussed on section 4.2.

[2] A similar idea of historical pharyngeal becoming RVs synchronically can be found in Prunet (1996). Prunet argues that in Gurage (Semitic) the historical *ħ* became *a* in some roots.

[3] According to Bat El (1989) /h-/ is a perfective prefix, /-t-/ is the binyan 5 morpheme, and /i/ is epenthetic. It is not relevant to this paper whether this analysis is correct or whether /hit/ is one morpheme. For the sake of simplicity the latter approach will be adopted in this paper.

[4] Throughout the analysis, I will not present candidates that change a RV into a consonant (***a***omed → ***j***omé*d*). Such candidates can be ruled out by IDENT[consonantal]. Since such a solution is never employed by the language, I leave it out for simplicity.

[5] This constraint cannot be true for words like *táam* and *náaʁ*. Such words belong to a large number of native nouns that are disyllabic, with the accent falling on the first syllable. However, most of their plurals have the form *CCaC* + the plural suffix *-ím/-ót* with final accent. Traditionally they are known as the 'Segolates'. This group of nouns is analyzed by invoking extrametricality in Bat-El (1993). Bolozky (1995) and Becker (2003) characterize its plural form as templatic. Following Bat El (1993) I assume that the last syllable is extrametrical, so the footing is *[tá]{am}*. This footing does not violate $OCP_{foot}[V_iV_i]$.

[6] Nouns are more faithful than verbs, with accordance to Smith's (1997) observations.

[7] This system however produces stems that are not disyllabic. This is of no consequences since the structure of verbs is still mostly disyllabic, composed of VP vowels in B1 and B4 and of a prefix vowel and a VP vowel in B2 and B3.

[8] A list of the most frequent affixed mishkalim is given in the following table:

Affixed mishkalim in Modern Hebrew

Mishkal	Example	Gloss	Example	Gloss
*m**a**CCéC*	*mavʁég*	*'screwdriver'*	*maʃpéx*	*'funnel'*
*m**a**CCeCá*	*makdexá*	*'drill (tool)'*	*maʦlemá*	*'camera'*
*m**i**CCáC*	*miʃtáʁ*	*'regime'*	*mivʦáʁ*	*'fortress'*
*m**i**CCaCá*	*milxamá*	*'war'*	*miʃtaʁá*	*'police'*
***ti**CCóCet*	*tiʁgólet*	*'drill'*	*tixtóvet*	*'correspondence'*
*t**a**CCíC*	*taʁgíl*	*'exercise'*	*taxtív*	*'dictate'*
*t**a**CCúC*	*taʃlúm*	*'payment'*	*tamʁúʁ*	*'road sign'*
*t**a**CCuCá*	*tavʁuʔá*	*'sanitation'*	*taxbuʁá*	*'transport'*
*m**i**CCéCet*	*mivʁéʃet*	*'brush'*	*mizxélet*	*'sled'*
*ʔ**a**CCaCá*	*ʔazkaʁá*	*'alarm'*	*ʔavxaná*	*'diagnosis'*
*m**i**CCóC*	*miʦbóʁ*	'accumulation'	*mizmóʁ*	*'psalm'*

[9] For the sake of simplicity, I skip intermediate stages in the history of the language.

[10] Capital K represents an archiphoneme: [x] post vocalically and [k] elsewhere.