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THE OPTIMAL ACRONYM WORD IN HEBREW*

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This paper calls attention to the hitherto neglected members of the lexicon - acronym words (hereafter AWs). It is rather surprising that AWs are rarely considered in linguistic studies (see, however, McCully and Holmes 1988), especially in the presence of studies on language games (see in particular Begemihl 1987), where the representation of words often violates constraints of natural languages. I will show in this study of Hebrew AWs that the grammar of AWs is a grammar of a natural language.

I believe that AWs have been almost ignored so far because their underlying representations seem to be written material. Any theory which assumes that underlying representations are subject to well-formedness constraints would, indeed, face some discomfort in analyzing AWs. However, theories where only surface representations are evaluated by well-formedness constraints, such as Optimality Theory (Prince and Smolensky 1993), allow, in principle, any sort of underlying representation. Therefore I adopt Optimality Theory (hereafter OT) in the analysis of Hebrew AWs.

Before proceeding it is necessary to clarify what AWs are, and to emphasize the distinction between acronyms and an AWs. Consider the English data below:

(1) a. Acronyms but not words: FBI, CIA

b. Acronym words:

	Acronym	*AW*	*Acronym base*
i.	RADAR	re:dær	RAdio Detecting And Ranging
	LASER	le:zər	Light Amplification by Stimulated Emission of Radiation
	PIN	pIn	Personal Identification Number
	NATO	ne:to:	North Atlantic Treaty Organization
ii.	WCCFL	wIkfIl / wIkfUl	West Coast Conference on Formal Linguistics
	FLSM	fUlsUm	Formal Linguistic Society of Mid-america

The acronyms in (1a) do not have corresponding AWs, and therefore will not be considered here. The AWs in (1b) are of two types: Those in (i) correspond to acronyms that include vowels and are therefore more likely to surface as AWs (though, not all acronyms that include vowels have corresponding AWs; CIA, for example, does not have a corresponding AW **sia.*). Those in (ii) correspond to acronyms without vowels, nevertheless they manage to surface as AWs with the supporting epenthetic vowels.

The WCCFL type AWs (1bii) are rare in English. In Hebrew, however, most of the AWs are of this type, where vowels are inserted to form a word.

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The major difference between English and Hebrew is in the epenthetic vowel. In English the vowel inserted to form an AW from an acronym is the same epenthetic vowel inserted to rescue other impermissible consonantal sequences (see Yip 1988). In Hebrew, however, there is a clear distinction between the "phonological" epenthetic vowel *e*, inserted to rescue consonants that cannot be syllabified, and the "morphological" epenthetic vowel *a*, which is used to form an AW from an acronym.

The paper begins with the essentials of the morphology and writing system of Hebrew (1.1.), and a short overview of Optimality Theory (1.2.). The analysis of Hebrew AWs is then developed in terms of constraint interaction, on the basis of strong AWs. The phonological properties to be taken under consideration are the syllable inventory (2.1.), the distribution of syllables (2.2.), and the epenthetic vowel (2.3.). Further elaboration on the constraint hierarchy is then provided to capture weak AWs, that is, AWs with glides (3.1.) and AWs with glottals (3.2.). The concluding remarks in Section 4 point out some differences between AWs and non-AWs.

1. Background

1.1. Language Background: A better understanding of the formation of Hebrew AWs requires minimal familiarity with the language's morphology and writing system. Morphological relations between all verbs and some nouns in Hebrew are expressed by morphologically conditioned vowel alternation (ablaut). The examples in (2) below show that semantically related words share the same consonants, but they differ in their affixes (if any) and vowels.[1]

(2) a.	séfer	'book'	b.	gódel	'size'
	sifr+i	'my book'		gadol	'big'
	sifr+ut	'literature'		mi+gdal	'tower'
	safr+an	'librarian'		gidel	'to raise'
	siper	'to tell'		hi+gdil	'to enlarge'

The writing system reflects, in a sense, the different status of vowels and consonants. As exemplified in (3) below, consonants are written as letters while vowels are indicated by points or strokes below or above the consonants.

(3) גֹדֶל *godel* 'size'; ג = *g*, ד = *d*, ל = *l*, ֹ = *o*, ֶ = *e*

Most written material does not include vowel symbols, and therefore the word גדל, for example, can be read as either *gódel*, *gadol*, or *gidel*. The only way to get the correct reading is by referring to the context.

Acronyms can be easily identified in the written material since the consonant letters are accompanied by a double quote between the last two consonants. Thus, if גדל were an acronym it would have been written as ג"דל (Hebrew is written from right to left). The interesting fact is that there is very little ambiguity in the reading of acronyms; most speakers would pronounce ג"דל as *gadal* (the other

[1] The alternation *p* ~ *f* (2a) is due to spirantization (see Adam 1993), and a vowel in the syllable at the edge of the base is deleted when an affix is added at this edge.

option is *gédel*; see fn. 3) because the phonological shape of AWs is rather restricted, much more than that of non-AWs.

More crucial information will be provided when relevant .

1.2. Optimality Theory: When a native speaker sees an acronym she/he can easily pronounce it, namely, turn it into an AW, even without knowing its meaning (as the relation between the acronym base and the acronym is not part of linguistic knowledge). Assuming that every word has an underlying representation, it must be the case that the speaker translates the written consonants of the acronym into the underlying representation of the AW. The translation probably involves installing a new formative in the lexicon, where each segment in the formative is an abstract realization of a concrete written letter (AWs acquired not via reading go through the same path of learning as non-AWs). So we may simply say the the underlying representation of ab AW, at least at the stage of acquiring this word, is written material.

Linguistic theories that impose well-formedness constraints on underlying representations would need to weaken their approach in analyzing AWs by admitting written material as the source of underlying representations. OT, however, allows, in principle, any sort of underlying representation, as its constraints are imposed on surface representations only. Therefore OT has been selected in this study for the analysis of Hebrew AWs. The rest of this section outlines the principles and working procedures of OT developed in Prince and Smolensky (1993) (see also McCarthy and Prince (1993a) and others).

The approach taken by OT is to view a grammar as equipped with a set of universal well-formedness constraints. Distinctions between grammars are based on language particular constraint hierarchies. What is probably the most distinctive principle of OT is that constraints are violable, though violation must be minimized. The way a grammar works is as follows. A 'generator' provides all the possible output candidates of a given input, which are then evaluated by the constraints. The candidate that wins to be the surface form, i.e. the optimal candidate, is the one that minimally violates, or best satisfies, the constraint hierarchy. Minimal violation is not equated with violation of a minimal number of constraints but rather with violation of lower ranked constraints. When two constraints are in conflict with a particular representation, that is, respecting one would force violation of the other, the one that is ranked higher would be respected by the optimal candidate.

Consider the syllabification of ...VCCV... in Arabic and Spanish. Arabic does not allow complex onsets or codas, and therefore syllabifies VC.CV (a dot indicates a syllable boundary). Spanish prefers complex onsets (as long as the Sonority Sequencing Generalization is not violated) and therefore syllabifies V.CCV. This distinction between the two languages stems from the different ranking of two constraints, NOCODA and *COMPLEX.

(4) a. NOCODA: Syllables do not have codas (Prince and Smolensky 1993:34)

b. *COMPLEX: No more than one C or V may associate to any syllable position node (Prince and Smolensky 1993:87)

As illustrated in the tableaux below, in Arabic *COMPLEX dominates NOCODA while in Spanish NOCODA dominates *COMPLEX. The different outputs follow the basic tenet of the theory, that it is better to satisfy a higher ranked constraint even at the cost of violating a lower ranked one.

(5) a. Arabic: *COMPLEX >> NOCODA b. Spanish: NOCODA >> *COMPLEX

/VCCV/	*COMPLEX	NOCODA
1. ☞ VC.CV		*
2. V.CCV	*!	

/VCCV/	NOCODA	*COMPLEX
1. VC.CV	*!	
2. ☞ V.CCV		*

The tableaux in (5) illustrate ranking arguments. The basic conventions are as follows: A >> B is read as 'A dominates (or is ranked higher than) B'. The constraints are ordered from left to right in the dominance relation. The optimal candidate is pointed out by ☞, violation of a constraint is marked by *, while satisfaction is indicated by a blank cell. Fatal violation of a constraint is marked by !, pointing out the violation that eliminates the candidate from the competition. A shaded cell indicates the irrelevance of the constraints; constraints are irrelevant after a fatal violation or when there are no more competitors.

It should be emphasized that constraints state, either negatively or positively, universally unmarked properties. Thus, languages prefer not to have codas (NOCODA) and not to have more than one segment in a syllable position (*COMPLEX). Marked properties may, however, surface when a constraint is violated. Therefore in Arabic (5a) there is a coda and in Spanish (5b) there is a complex onset. The marked representation surfaces due to the violation of the constraint induced by a competing dominant constraint which must be satisfied.

2. Strong Acronym Words

The rest of the paper provides the analysis of Hebrew AWs. To facilitate the discussion, AWs are divided into three groups. The largest group is strong AWs, that is, AWs which contain consonants that always surface as consonants (thus "strong"). The other two groups contain glides and glottals, which in some syllabic positions surface as vowels (thus "weak").[2] This section develops the constraint hierarchy responsible for the syllable inventory, the distribution of syllables, and the epenthetic vowel, on the basis of strong AWs. The other two groups are discussed in section 3.

The most common AW in Hebrew consists of the minimal number of CV(C) syllables that can accommodate all the acronym's consonants; the nucleus of each syllable is filled with the vowel *a* (stress is final unless otherwise specified). Some examples are given below:

[2] The two types that are not considered here are AWs that surface like existing words (usually names), and AWs that take the shape of "segolates", a group of nouns of the shape CéCeC.

(6)

	Acronym	*AW*	*Acronym base*	
2Cs:	XK	xak	Xaver Knéset	'parliament member'
	DŠ	daš	Drišat Šalom	'regards'
	ZL	zal	Zixrono Livraxa	'the late'
3Cs:	MTX	matax	MaTbé?a Xuc	'foreign currency'
	MXT	maxat	Mefaked XaTiva	'brigadier'
	GLC	galac	GaLey Cáhal	'the army radio station'
4Cs:	SMXT	samxat	Sgan Mefaked XaTiva	'deputy brigadier'
	PLMX	palmax	PLugot MáXac	'shock troops'
	BBLT	bablat	Bilbul Beycim Lelo Tá?am	'baloney'
5Cs:	SMNKL	samankal	Sgan MeNahel KLali	'deputy director general'
	RMTKL	ramatkal	Roš MaTe KLali	'chief of general staff'

The properties characterizing the phonological shape of the AWs in (6) are:

(7) a. Syllable inventory: Only CV and CVC syllables are permitted.
b. Minimality: The number of syllables in AWs is minimal; two consonants in the acronym correspond to one syllable in the AW, three and four consonants correspond to two syllables, and five consonants in the acronym correspond to three syllables in the AW.
c. Distribution of syllables: The CVC syllables are as close to the right edge as possible.
d. Epenthetic vowel: The epenthetic vowel is *a*.

The rest of this section demonstrates that these properties are derived from the interaction of several constraints, all independently motivated in OT literature.

2.1. The Syllable Inventory: The syllabic inventory in Hebrew AWs is very limited, consisting of only CV and CVC syllables (there are only two exceptions with complex onset or coda). The constraints responsible for this limited syllabic inventory are ONSET (8), NOCODA (4a), and *COMPLEX (4b).

(8) ONSET: Syllables must have onsets (Prince and Smolensky 1993:85)

The only syllable that respects all three constraints is the "core syllable", CV. These constraints are, however, violable in many languages, thus allowing a richer inventory of syllables. In Hebrew AWs only NOCODA is violable when in conflict with a dominating constraint, while ONSET and *COMPLEX are undominated. This accounts for the small syllable inventory, CV and CVC.

This is not sufficient to exclude all the possible candidates of a given input. As can been seen in (6) above, when the input is /CC/ the output is CaC, violating NOCODA, rather than *CaCa where no constraint is violated. Similarly, when the input is /CCC/ the output is CaCaC and not *CaCaCa. It must then be the case that another constraint is crucially involved in selecting the optimal form.

Notice that the vowels in the AWs in (6) are all epenthetic. Epenthesis, as argued in Selkirk (1981) and Itô (1989), must be minimized. Selkirk introduces vowelless (degenerate) syllables in Cairene Arabic, emphasizing that the number of this type of syllable must be minimal. Thus, a string of consonants CC would surface as C[V]C (where [V] indicates an empty nucleus) and not as C[V]C[V], since in the latter there are two vowelless syllables while in the former there is only one. Prince's (1985) Maximality Principle, adopted by Itô, has the same

effect. The Maximality Principle requires the maximization of the size of a syllable, and therefore, given a string of segments, the larger each syllable is the smaller the number of syllables.

Within the OT framework this type of minimality effect can be achieved by MORPHOLOGICAL SEGMENT which penalizes for every epenthetic segment.[3]

(9) MSEG: Morphologically unsponsored segments are prohibited (McCarthy 1993b)

Since the *a*s in the AWs are not part of a morpheme, every *a* incurs an MSEG violation. However, the fewer the *a*s the better the candidate (the selection of the epenthetic vowel is discussed in section 2.3. below). This is clarified in the tableaux below (this is not a ranking argument).[4]

(10) Minimal violation of MSEG

a. /CC/	MSEG
1. ☞ C[a]C	*
2. C[a]C[a]	**

b. /CCC/	MSEG
1. ☞ C[a]C[a]C	**
2. C[a]C[a]C[a]	***

c. /CCCC/	MSEG
1. ☞ C[a]CC[a]C	**
2. C[a]C[a]C[a]C	***

d. /CCCCC/	MSEG
1. ☞ C[a]C[a]CC[a]C	***
2. C[a]C[a]C[a]C[a]C	****

The fact that /CC/ surfaces as CaC and not *CaCa (10a), and, similarly, that /CCC/ surfaces as CaCaC and not *CaCaCa (10b), indicates that MSEG dominates NOCODA. That is, it is better to violate NOCODA than to increase the number of MSEG violations.

(11) MSEG >> NOCODA

a. /CCCC/	MSEG	NOCODA
1. ☞ C[a]C.C[a]C	**	**
2. C[a].C[a].C[a]C	***!	*

[3] The same effect can be achieved by FILL (Prince and Smolensky 1993:25), which penalizes for every empty syllable position, assuming that an epenthetic segment is filled in the phonetics, while in the phonology it is represented as an empty syllable position. In languages which have two epenthetic vowels, as in Hebrew (see section 2.3. below), the selection of the particular epenthetic vowel must be evaluated by the phonology, and therefore it is impossible for the nuclear position to remain empty. Or, as suggested by Glyne Piggot (p.c.), it is possible that one vowel is evaluated by the phonology (MSEG), while the other is an empty position (FILL). This view is presented in a recent paper by Piggot that was not available to me at the time of writing this paper.

[4] For space reasons I do not provide here arguments for why the *a* is not a morphological unit, like the vocalic patterns in Arabic (McCarthy 1981) and Hebrew verbs (Bat-El 1994a).

(14) ALIGNCODA: Align (Coda, PrWd, R)

Violation of ALIGNCODA is gradient, determined by the number of syllables between each non-aligned coda and the right edge of the prosodic word (marked by]). The fewer the violations of ALIGNCODA the better the candidate is (see a similar approach in Mester and Padgett 1994).

(15) Minimal violation of ALIGNCODA

a.	/CCC/	ALIGNCODA
1. ☞	C[a].C[a]C]PrWd	
2.	C[a]C.C[a]]PrWd	*

b.	/CCCCC/	ALIGNCODA
1. ☞	C[a].C[a]C.C[a]C]PrWd	*
2.	C[a]C.C[a].C[a]C]PrWd	**
3.	C[a]C.C[a]C.C[a]]PrWd	***

Violation of ALIGNCODA can be avoided by not having a coda in word medial position, that is, /CCCCC/ (15b) would appear as C[a].C[a].C[a].C[a]C, but this would be at the cost of increasing MSEG violations. As demonstrated in (11) above, MSEG is ranked higher than NOCODA and therefore this candidate is ruled out. Although ALIGNCODA does not interact directly with MSEG, but rather via NOCODA, I assume that it is located at the bottom of the hierarchy, next to NOCODA.

To summarize, the last two sections account for three out of the four properties of Hebrew AWs mentioned in (7) above and repeated below:

a. Syllabic inventory (only CV and CVC) - undominated ONSET and *COMPLEX
b. Minimality (minimal number of syllables) - MSEG
c. Distribution of syllables (CVC is as close to the right edge as possible) - ALIGNCODA

The following section accounts for the fact that the epenthetic vowel is *a* and not any other vowel.

2.3. The Epenthetic Vowel: Hebrew has two epenthetic vowels, *a*, inserted to form AWs, and *e*, inserted to rescue violations of the Sonority Hierarchy Generalization and the Obligatory Contour Principle. Examples of the latter type are given below (the epenthetic vowel is underlined):[6]

(16) a. Obligatory Contour Principle

rakad+ti	--->	rakádgti	'I danced'	(cf. katav+ti	--->	katavti	'I wrote')
kilel+a	--->	kilgla	'she cursed'	(cf. bikeš+a	--->	bikša	'she asked for')

b. Sonority Sequencing Generalization

lavan+a	--->	lgvana	'white fm.'	(cf. katan+a	--->	ktana	'little fm.')
gamal+im	--->	ngmalim	'ports'	(cf. gamal+im	--->	gmalim	'camels')

I propose that it is necessary to draw the distinction between morphological and phonological epenthesis. The morphological epenthetic vowel participates in

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[6] The vowel *a* has the same function as *e* when inserted in a tautosyllabic cluster that includes a glottal, as in *ʔaduma* 'red fm.'; cf. *lgvana* and *ktana* in (16b).

word formation and therefore would be the most harmonic vowel. The phonological epenthetic vowel does not want to interrupt the shape of a word and therefore would be the least intrusive vowel. In Hebrew the morphological epenthetic vowel is *a* and the phonological is *e*.

Similar distinctions can be found, for example, in Mohawk and Kikuyu. In Mohawk (Michelson 1989) insertion of *i* and *e* is conditioned by phonological environment, while insertion of *a* ("the joiner") is morphologically motivated; *a* in Mohawk is inserted between any two consonants at a boundary within a verb base, even when the two consonants form a permissible cluster. Similarly, in Kikuyu (Peng 1992), the vowel *i* is inserted in loan words to break impermissible clusters, while *a* is inserted to form the "canonical stem".[7]

The distinction between morphological and phonological epenthetic vowels is based on the existence of two different scales (rounded vowels are not considered here as the marked feature [round] renders them a lower priority than epenthetic vowels, thus overriding their other properties).

(17) a. Peak Harmony - Morphological: based on sonority
P/a > P/e > P/i > ...

b. Peak Harmony - Phonological: based on place of articulation
P/ə > P/i > P/e > P/a ...

The morphological Peak Harmony (17a) is considered for the purpose of word formation, where the most sonorous vowel is selected as the best peak. Sonority is determined by oral stricture (openness), and therefore schwa, which lacks segmental material, does not have a fixed position in the scale. The phonological Peak Harmony (17b) is relevant when it is necessary to break impermissible clusters, and thus evaluates the vowel without place features as the least intrusive one. I assume that schwa is not specified for place (Anderson 1982 and many others), and that vowels are specified for consonantal features (Clements 1991), where coronal is the unmarked place (Paradis and Prunet 1991). Intrusion is determined by the place of articulation of the epenthetic vowel, where the least intrusive epenthetic vowel is the one that does not contain any oral features, that is ə (ʔ among the consonants). The next vowel up is the one with the unmarked place of articulation, that is *i* (*t* among the consonants).[8]

Nevertheless, not all languages select schwa as their epenthetic phonological vowel.[9] Some languages simply do not have schwa in their phonemic inventory and they are reluctant to introduce one by the phonology (of casual speech, since

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[7] In the light of this proposal it would probably be worthwhile to reconsider the notion of "empty morph" already discussed in Bloomfield (1933) and Hockett (1947). I suspect that at least some of the empty morphs are actually morphological epenthetic segments.

[8] It is not necessary to assume that unmarked features are not present and therefore are not intrusive, as the proponents of radical underspecification would suggest. Rather, unmarked place of articulation is recoverable by the redundancy statement 'If Place then Coronal' and therefore hasty pronunciation, which would minimize the intrusion, would not result in unrecoverable loss of information.

[9] My study of morphological epenthesis is not as yet sufficiently developed to conclude that all languages select the vowel *a* as the morphological epenthetic vowel, or to introduce any type of varieties attested among languages.

fast speech is characterized by massive vowel reduction even in languages that do not have a phonemic schwa). As pointed out in Steriade (1994:29), such languages demonstrate the attempt "to identify the schwa-sound with a vowel quality that is phonemically present in the language".

The alternative to schwa is, however, not uniform. Some languages select an unrounded high vowel, *i* (Yoruba) or *ɨ* (Chaha), and others select an unrounded mid vowel *e* (Hebrew and Spanish; phonetically *ɛ*). Steriade continues her explanation, noting that "Schwa is the vocalic neutral vowel and will therefore be identified with sounds that are in one respect or another closest to the neutral position" (ibid). While Steriade refers to the neutral vowel in phonetic terms, I suggest that it may be often the case that phonological considerations are required. Both *e* and *i* in Hebrew are lax, and therefore probably equally distant from the position of schwa. What determines the selection of *e* as the phonological epenthetic vowel in Hebrew is probably the phonological (not phonetic) markedness of its competitor *i*. The two unrounded vowels *e* and *a* often alternate and are deleted, while *i* is hardly ever affected by the phonology.

To summarize, the epenthetic *a* in Hebrew AWs is the most harmonic vowel in the morphological peak hierarchy, which is based on sonority. The epenthetic *e*, which breaks impermissible clusters is the language's choice of a schwa-like vowel, where schwa is the least intrusive vowel in the phonological peak hierarchy, which is based on place of articulation.

3. Weak Acronym Words

This section is concerned with AWs that include glides or glottals. Glides and glottals surface as vowels in some environments, and therefore affect the phonological shape of the AW. First, it is necessary to introduce more information regarding Hebrew phonology and the writing system.

The glide letters in the writing system stand for either vowels or consonants: י stands for *y* and *i*, and ו stands for *o*, *u*, and *v* (there is no back glide in Hebrew; see Bat-El (in progress) for the selection of *o* and *u*).

(18) י (Y):	*y*	יד	yad	'hand';	בנינו	banay	'my sons'
	i	קיר	kir	'wall';	בני	bni	'my son'
ו (W):	*v*	ורד	véred	'rose';	בניו	banav	'his sons'
	o	קול	kol	'voice';	בנו	bno	'his son'
	u	צוק	cuk	'cliff';	בנו	banu	'they built'

The letters referring to glottals do not always correspond to a segment in the surface representation of non-AWs (19a). In medial position the glottals are often deleted in casual speech, and *h*, when it is not deleted, may surface as *ʔ*. There is never a glottal in final position nor in any other coda position.[10] In addition, the glottals often attract the vowel *a* (19b).

[10] The distinction between the three vowel-final verbs in (19) is identified within the inflectional paradigm, in particular within the Feminine Participle: *kana* - *kona* 'she buys'; *kara* - *koret* 'she reads'; *kara* - *korʔat* 'she tears' (notice that ה in stem final position never surfaces as a glottal; it has been suggested that in this position it stands for underlying *y*; cf. *kaniti* 'I bought' vs. *karati* 'I read/tore').

(19) a. ה = h ∅ / h / ʔ מהר maher / maʔer / maer 'fast'; קנה kana 'he bought'
א = ʔ ∅ / ʔ באר beʔer / beer 'well'; קרא kara 'he reads'
ע = ʔ ∅ / ʔ נעל naʔal / naal 'to lock'; קרע kara 'he tore'

b. גבוה *gavóha / gavóa* 'high ms.' cf. גדול *gadol* 'big ms.'
אדומה *ʔaduma* 'red fm.' cf. כתומה *ktuma* 'orange (color) fm.'
נעל *náʔal / náal* 'shoe' cf. ילד *yéled* 'boy'

It will appear that also in AWs glides surface as either vowels or consonants. Glottals in AWs, as in non-AWs, never surface in final position (or in any other coda position). However, while in non-AWs word final glottals are deleted, in AWs they surface as *a* since all underlying consonants must have a phonetic realization in AWs. Thus, while glottals in non-AWs attract *a*, in AWs they alternate with *a*.

3.1. Acronym Words with Glides: An initial glide in an acronym stands for a consonant in the corresponding AW (20a), while a final or medial glide in an acronym stands for a vowel in the corresponding AW (20b).

(20) a. WXK vaxak Vaadat XaKira 'commission of inquiry'
YXB yaxab YeXidat Binuy 'construction unit'
WLTM valtam Vaʔada LeTeum Miluʔim 'army reserves coordination committee'

b. RŠY ráši Rabi Šlomo Yicxáki 'a name of a rabbi'
CYM cim Ci Israeli Misxari 'Israeli commercial fleet'
BYLW bílu Beyt Israel Lexu Venelxa 'a name of a pioneer group'
YWS yoš Yehuda VeŠomron 'Judah and Samaria'

The realization of a glide letter as a consonant in initial position is due to the priority of ONSET (8), as illustrated in the tableaux below; ONSET is never violated, even at the cost of increasing the number of MSEG violations.

(21) ONSET >> MSEG

a. /WLTM/	ONSET	MSEG
1. ☞ v[a]lt[a]m		**
2. olt[am]	*!	*

b. /YXB/	ONSET	MSEG
1. ☞ y[a]x[a]b		**
2. ix[a]b	*!	*

Glides surface as vowels in medial and final position simply to reduce MSEG violations, because when a glide surfaces as a vowel the epenthetic vowel is not inserted. As shown in (22) below, it is better to have a glide in peak position than to increase violations of MSEG. When a glide is in a nuclear position it is realized as a vowel, nevertheless it counts as a *Peak/glide violation (this involves restructuring of feature geometry which I will not discuss here; see Bat-El 1994b).

(22) MSEG >> *P/glide

a.	/CYM/	MSEG	*P/glide
1. ☞	cim		*
2.	c[a]y[a]m	*!*	

b.	/RŠY/	MSEG	*P/glide
1. ☞	r[a]š[i]	*	*
2.	r[a]š[a]y	**!	

3.2. Acronym Words with Glottals: Like glides, glottals surface as consonants in initial position (23a) and as vowels in final position (23b). Unlike glides, however, glottals in medial position surface as consonants (23c).[11]

(23) a. ʔXM ʔaxam ʔanašim Xašuvim Meʔod 'VIP'
ʔBM ʔabam ʔécem Bilti Mezuhe 'UFO'
ʔKYM ʔakim ʔaguda leKimum Yeladim Mefagrim 'Association for mentally disabled children'

b. ʔSʔ ʔása ʔirgun Sport ʔakademáʔi 'the academic sport association'
HGʔ hága HitGonenut ʔezraxit 'civil defence'
XYBH xíba XaYalot Bešerut Hamištara 'police female soldiers'

c. ʔRHB ʔarhab ʔaRcot HaBrit 'USA'
LHDM lahadam Lo Hayu Dvarim Meʔolam 'it never happened'
TʔGD taʔagad Taxanat ʔisuf GDudit 'regimental gathering station'
MʔC máʔac Maxléket ʔavodot Ciburiyot 'department of public projects'
MʔM maʔam Mas ʔérex Musaf 'VAT'

The first two constraints actively involved in the representation of AWs with glottals are *P/glottal and *Margin^{cod} /glottal. *P/glot does not allow glottals in peak position, and *M^{cod}/glot (adopted from the Margin Hierarchy in Prince and Smolensky (1993:207) with a distinction between onset margin and coda margin) does not allow glottals in coda position. As demonstrated in (24) below, these two constraints are ranked higher than MSEG (a dotted line between constraints indicates that ranking has not been established, and *a* without brackets is the surface realization of a glottal).

(24) *M^{cod}/glot, *P/glot >> MSEG

a.	/LHDM/	*M^{cod}/glot	*P/glot	MSEG
1. ☞	l[a].h[a].d[a]m			***
2.	la.d[a]m		*!	*
3.	l[a]h.d[a]m	*!		**

[11] For space reasons I do not consider here the fate of two adjacent glides or glottals which are in syllable positions where they are both supposed to surface as vowels; see Bat-El (in progress). It should also be noted that in commonly used AWs with a medial glide it is possible for the glide to delete, as in non-AWs (19a). For example, the AW *bdhad* (BHD *Bsis HaDraxa*) 'instruction base' is often pronounced as *báad* or *bad*.

b.	/ʔRHB/	*M^{cod}/glot	*P/glot	MSEG
1. ☞	ʔ[a]r.h[a]b			*!
2.	ʔ[a].rab		*!	*

Notice that the fact that a medial glide surfaces as a vowel while a medial glottal surfaces as a consonant is accounted for by the different ranking of *P/glot and *P/glide with respect to MSEG: *P/glot >> MSEG >> *P/glide. That is, *P/glide, but not *P/glot, is violated when in conflict with MSEG. *P/glot is, however, violated when in conflict with the undominated constraint *M^{cod}/glot. This happens when the glottal is in word final position (23b). While languages often display a glide ~ vowel alternation, there is very little evidence for a glottal ~ vowel alternation. It seems, however, that in St'at'imcets (Lillooet Salish) *h* surfaces as *a* (Patrícia Shaw p.c.) and in Hebrew AWs *ʔ* surfaces as *a*. It is the stress pattern in Hebrew AWs that provides evidence that a final glottal surfaces as a vowel. Consonant final AWs usually bear ultimate stress (with the exception of segolates; see fn. 3), while vowel final AWs, i.e. AWs that correspond to acronyms with final glides or glottals, bear penultimate stress. That is, in final position glottals behave like glides, i.e. they surface as vowels. It should be noted that in non-AWs final glottals are deleted and stress is usually final (unless accent or extrametricality are involved; see Bat-El 1993).

It is thus proposed that while in most languages *P/glot is never violated, in Hebrew AWs it is violated due to the higher ranked constraint *M^{cod}/glot.[12] That is, it is better for a final glottal to surface as a vowel (251) than as a consonant in coda position (252).

(25) *M^{coda}/glot >> *P/glot

	/HGʔ/	*M^{cod}/glot	*P/glot	MSEG
1. ☞	h[a].ga		*	*
2.	h[a].g[a]ʔ	*!		**
3. ☹	h[a]g.<ʔ>			*
4. ☹	h[a].g[a].ʔ[a]			***

Notice, however, the last two candidates in (25). As the frown face indicates, these candidates were supposed to win out since they do not violate either *M^{cod}/glot nor *P/glot. In (253) the final glottal is not parsed (indicated by < >), and since PARSE in undominated in Hebrew AWs (see (13)), this candidate is ruled out (I do not consider here the violations of faithfulness constraints relating to features involved in parsing a glottal as a vowel). In (254), however,

[12] Similar emergence of the marked representation is found with sonority. Most languages make a clear phonological distinction between obstruents and sonorants, probably by the presence of another constraint between nasals and fricatives within the sonority scale vowels > liquids > nasals > fricatives > stops. A few languages, however, treat some fricatives as sonorants, in particular *v* (Russian) and *s* (Arusa).

the glottal is rescued by the following epenthetic vowel, in the same manner as it is rescued when it is to appear in medial coda (cf. *lahadam* in (24a)), nevertheless (254) is not the optimal candidate. In order to rule out this candidate it is necessary to introduce ALIGN MORPHEME (which rules out (253) as well), which states that the right edge of every prosodic word must coincide with the right edge of a morpheme, and thus disallows epenthesis at this edge of the morpheme.

(26) ALIGNMORPH: Align (PrWd, R, Morph, R)

The candidates in (25) are reevaluated in (27) below (| = edge of a morpheme):

(27) ALIGNMORPH >> *P/glot

/HG?I/	ALIGN MORPH	*M^{cod}/glot	*P/glot	MSEG
1. ☞ h[a].ga |]			*	*
2. h[a].g[a]? |]		*!		**
3. h[a]g.]<?> |	*!			*
4. h[a].g[a].? | [a]]	*!			**

The undominated *M^{cod}/glot and ALIGNMORPH force a glottal to surface as a vowel in word final position. Word medially, ALIGNMORPH is not relevant and therefore the epenthetic vowel is free to rescue a *M^{cod}/glot violation (24a).

4. Conclusion

This paper provided an analysis of Hebrew AWs, demonstrating that the grammar of AWs is a grammar of a natural language. Each one of the constraints in the hierarchy summarized below is justified, in one way or another, in OT literature.

(28) PARSE, *COMPLEX, ONSET, *M^{cod}/glot , ALIGNMORPH (undominated) >> *P/glot >> MSEG >> *P/glide , NOCODA, ALIGNCODA

AWs have some of the phonological and morphological characteristics of non-AWs. They have similar phonological shapes and they can equally host affixes. For example, the AWs *galac*, *samxat* (from (6) above), *cim*, and *yoš* (from (20b) above) are phonologically similar to the non-AWs *gamad* 'dwarf', *xalban* 'milkman', *gir* 'chalk' and *yom* 'day', and the AWs *samxát+it* 'general manager fm.' and *palmáx+nik* 'a member of the shock troops' host suffixes like the non-AWs *rakdan+it* 'dancer fm' and *kibúc+nik* 'a member of the kibbutz' (see Bat-El (in progress) for the stress).

AWs differ, however, from non-AWs in several respects. For example, in non-AWs complex onsets (and, to a lesser extent, codas) may surface, and word final glottals are deleted (and stress is final). Such distinctions should be captured, as proposed in McCarthy and Prince (1993a:24) by different constraint rankings, assuming that AWs are formed at a different level of the morphology

(in the sense of Itô and Mester 1994). In AWs *COMPLEX is undominated while in non-AWs it is placed at a lower position in the hierarchy, allowing complex onsets to surface when *COMPLEX is in conflict with a higher ranked constraint. Similarly, in non-AWs PARSE is ranked lower than *P/glot, and therefore it is better to delete the word final glottal than to parse it as a vowel.

References

Anderson, S.R. 1982. The analysis of French schwa; or, how to get something from nothing. *Language* 58:535-573.

Adam, G. 1993. Stop - fricative alternation in Israeli Hebrew. M.A. thesis, Tel-Aviv Univ.

Bat-El, O. 1993. Parasitic Metrification in the Modern Hebrew Stress System. *The Linguistic Review* 10:189-210.

Bat-El, O. 1994a. Stem modification and cluster transfer in Modern Hebrew. To appear in *NLLT*.

Bat-El, O. 1994b. ONSET violation in Tiberian Hebrew. To appear in Merchant, Padgett, and Walker (eds.) *Phonology in Santa Cruz* v.3.

Bat-El, O. in progress. The segmental and prosodic structure of Hebrew acronym words.

Begemihl, B. 1987. *Alternate Phonologies and Morphologies*. Ph.D. dissertation, Univ. of British Columbia, Vancouver.

Bloomfield, L. 1933. *Language*. New York, Henry Holt.

Clements, N. 1991. Place of articulation in consonants and vowels: a unified theory. In Laks and Rialland (eds.) *L'Architecture et la Géométrie des Représentations Phonologiques* Paris: Editions du C.N.R.S.

Hockett, C.F. 1947. Problems of Morphemic Analysis. *Language* 23:321-343.

Itô, J. 1989. A Prosodic Theory of Epenthesis. *NLLT* 7:217-259.

Itô, J. and A. Mester. 1994. Japanese Phonology: Constraint Domains and Structure Preservation. In Goldsmith (ed.) *A Handbook of Phonological Theory*. Oxford, Basil Blackwell.

McCarthy, J. 1981. A Prosodic Theory of Nonconcatenative Morphology. *LI* 12:373-418.

McCarthy, J. 1993a. A Case of Surface Constraint Violation. *Canadian Journal of Linguistics* 38:169-195.

McCarthy, J. 1993b. The Parallel Advantage: Containment, Consistency, and Alignment. Handout from talk presented at Rutgers Optimality Workshop 1.

McCarthy, J. and A. Prince. 1993a. *Prosodic Morphology I: Constraint Interaction and Satisfaction* Ms., Univ. of Massachusetts, Amherst and Rutgers Univ.

McCarthy, J. and A. Prince. 1993b. Generalized Alignment. *Yearbook of Morphology 1993* pp. 79-154.

McCully, C.B. and M. Holmes. 1988. Some Notes on the Structure of Acronyms. *Lingua* 74:27-43.

Mester, A. and J. Padgett. 1994. Directional Syllabification in Generalized Alignment. To appear in Merchant, Padgett and Walker (eds.) *Phonology at Santa Cruz* v.3.

Michelson, K. 1989. Invisibility: Vowels without a Timing Slot in Mohawk. In Gerdts and Michelson (eds.) *Theoretical Perspectives on Native American Languages*. Albany, State Univ. of New York Press.

Paradis, C. and J.F. Prunet (eds.). 1991. *The Special Status of Coronals: Internal and External Evidence*. Phonetics and Phonology.v.2. New York, Academic Press.

Peng, L. 1992. Prosodic Preservation and Loss in Kikuyu Reduplication. Ms., Univ. of Arizona.

Prince, A. 1985. Improving Tree Theory. *Proceedings of BLS 11*. UC Berkeley pp.471-490.

Prince, A. and P. Smolensky. 1993. *Optimality Theory: Constraint Interaction in Generative Grammar*. Technical Report #2 of the Rutgers Center for Cognitive Science, Rutgers Univ.

Selkirk, E. 1981. Epenthesis and Degenerate Syllables in Cairene Arabic. In Borer and Aoun (eds.) *Theoretical Issues in the Grammar of Semitic Languages*. MIT Working Papers in Linguistics. pp. 209-232.

Steriade, D. 1994. Underspecification and Markedness. To appear in Goldsmith (ed.) *A Handbook of Phonological Theory*. Oxford, Basil Blackwell.

Yip, M. 1988. English Vowel Epenthesis. *NLLT* 5:463-484.