

The Emergence of UG in the Periphery: Vowel Harmony in Hebrew Loanwords

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1. Introduction

This paper addresses the issue of the application of universal grammatical principles in adult grammars. Specifically, I show that the application of vowel harmony in Modern Hebrew (MH), which is not part of the native phonological system, is universally motivated in certain areas of the MH lexicon.

Grammatical principles applied in languages may come from one of two sources. First, they may be language specific principles of the native (L1) grammar acquired by the speakers. Such principles may vary among languages. Second, the grammatical principles may be universally motivated, overriding native grammatical principles in certain circumstances, usually in the lexicon's periphery.

In this paper, I assume that lexicons are divided into strata (Itô and Mester 1999) or that they have a core-periphery structure (Paradis & LaCharité 1997). Such subdivisions allow for differences in the grammars applying in various parts of the lexicon. For example, there may be productive principles in the language's periphery (e.g. loanwords) which do not apply systematically to the general native lexicon. This may be evidence that we can access UG when the effects of the L1 grammar are weakened (The Emergence of the Unmarked, TETU, McCarthy and Prince 1994).

The goals of this paper are twofold. First, I demonstrate that vowel harmony, a non-native process in MH, nevertheless applies to certain areas of the lexicon. This supports an approach that vowel harmony is universally motivated, part of UG. Secondly, I show that UG may apply in a (seemingly) sporadic manner even in what appear to be stable grammatical systems.

The paper is structured as follows. In §2, I review cases of alleged vowel harmony in the native lexicon. I follow this with a brief recap of vowel adaptation in MH loanwords in §3. In the subsequent section §4, I propose an Optimal Domains Theory (ODT) analysis of the phenomenon, followed by concluding remarks in §5.

2. Vowel harmony in the native MH lexicon?

Various phenomena in the native MH lexicon have been attributed to vowel harmony. These would imply that MH does have a productive vowel harmony system, something which would then be unsurprising to find in loanwords. However, I show in this section, that the "vowel harmony" observed is neither vowel harmony nor productive. Furthermore, even if one were to insist that the phenomena discussed are

vowel harmony, the type of harmony observed here differs from that found in loanwords.

2.1. Segholates

Segholates (Bat-El 1989:180, Bolozky 1995) are different from other noun templates in Biblical Hebrew in that they are diachronically analysed as being monosyllabic stems with word final clusters (CVCC). Biblical Hebrew disallows word final clusters.¹ Therefore, these word-final clusters are simplified via epenthesis. The epenthetic vowel and the underlying stem vowel harmonise with one another, as shown in the following (1):

(1) *Segholate harmony (a diachronic analysis)*

Underlying form	Surface form	Gloss
digl	de <u>g</u> el	'flag'
malk	me <u>e</u> x	'king'

Note, this analysis is by no means unproblematic. Usually, epenthetic vowels are the targets of vowel harmony rather than its sponsors, however, here the situation seems to be different.

There are segholate nouns in MH, many of which are inherited from the Biblical Hebrew lexicon. However, they may be more simply analysed as vocalic patterns restricted to certain templates, rather than cases of productive vowel harmony

2.2. Cross-guttural harmony

The distribution of the gutturals in Biblical Hebrew is restricted in coda position. Word-medial coda gutturals are often resyllabified as onsets of epenthetic vowels. The quality of the epenthetic vowels is determined by the quality of the previous vowel in the word, as shown in the following (2):

(2) *Cross-guttural epenthetic vowel harmony in Biblical Hebrew*

With guttural		cf. without guttural	
Word	Gloss	Word	Gloss
/maħʕiʃ/→[maħaʕiʃ]	'(he) remains silent'	/makʕib/→[maxʕiv]	'(it) is painful'
/hiħʕim/→[heħeħim] ²	'(he) executed'	/hiħʕiʃ/→[hiħʕiʃa]	'(he) defeated'

¹ There are two noteworthy exceptions (Cohen 2010): (a) The second person feminine past suffix is *-t*. Consonant final stems form clusters (e.g. *ħalax+t* 'walk' → *ħalaxt*); (b) A small group of nouns have stem final clusters (e.g. *neʕd* 'nard (type of spice)').

² The initial vowel here is lowered before the guttural.

This process is non-productive in MH. The historical gutturals have all been replaced by velar, uvular and glottal consonants. Normative and often hypercorrective forms in MH, in which there is cross-guttural harmony, are residues of the process in Biblical Hebrew.

2.3. Plural suffixes

An additional case of apparent vowel harmony is the plural suffix selection. Hebrew (both MH and Biblical Hebrew) has two plural suffixes: *-im* (masc.) and *-ot* (fem.). There are some irregular masculine nouns pluralised with *-ot*. Becker's (2009:109) corpus analysis finds that the *-ot* suffix is more frequent with irregular masculine noun stems containing *o*, examples of which are shown in (3):

(3) Plural suffix harmony

Harmonizing suffixes			cf.		
Singular	Plural	Gloss	Singular	Plural	Gloss
xal o n	xal o not	'window/s'	bal o n	bal o nim	'balloon/s'
ol o m	ol o mot	'world/s'	ʃov o ʔ	ʃov o ʔim	'coupon/s'

Becker shows the irregular *-ot* pluralisation of masculine stems to be statistically significant. However, this pluralisation pattern is completely non-productive in MH. There are no new irregularly pluralising nouns in new native MH words.³

This being said, Becker conducted production experiments, which showed that speakers (marginally) prefer the morpheme *-ot* when given nonce words. This may, in fact, be evidence for the application of UG in the adult plural suffixation in MH.

2.4. Cross-glottal harmony

An additional case of apparent vowel harmony in MH is cross-glottal harmony. The normative forms, a residue from Biblical Hebrew, are more often than not colloquially modified, undergoing harmony. This is demonstrated in the following table (4):

(4) Cross-glottal harmony

Normative	Colloquial	Gloss
lehan o t	le(h) o not	'to enjoy'
leʔas o t	la(?) o sot	'to massage'

³ The only exception is the acronym word [dox]/[doxot] 'report/s', whose story is a little more complicated. This could be analysed as some sort of analogy to other monosyllabic stems with a *CoC* structure, many of which pluralise with *-ot*.

Glottals are phonetically (and possibly phonologically) null in MH. The cross-guttural harmony presented in (4) may, in fact, be vowel spreading to resolve a hiatus rather than true vowel harmony.

2.5. Discussion

Residual effects of vowel harmony from Biblical Hebrew are evident in MH. Segholate templates are productively used in MH, and cross-guttural harmony does occur, but only in normative forms. In addition to these residual effects, it appears that there may be some vowel harmony in plural suffix selection. This, however, is once again not productive in the MH lexicon, and is only statistically significant due to residual effects. Finally, cross-glottal harmony may, in fact, not be harmony at all, if we assume (as we should) that the glottals are phonetically null in MH.

Observing the above, it appears that there is indeed no productive vowel harmony in native MH words, the operative word being *native*. This is because loanwords seems to behave differently. I briefly outline the various sources of vowels in loanwords in the following §3, followed by an analysis of the observed vowel harmony in MH loanwords in §4.

3. Vowel adaptation in MH loanwords

Cohen's (2010) analysis of a 1383-word corpus attributes ~95% of all vowel adaptations to perception and orthography. In perceptual adaptation (e.g. Best et al. 2001), speakers categorise incoming phones to the closest category in their language (e.g. English [tɔk] 'talk' → MH [tɔk]). Orthographically based adaptations (e.g. Vendelin and Peperkamp 2006) rely on the written forms to determine the quality of the vowel in L1 (e.g. English [fɪʌnt] 'front' → MH [fɪʌnt]).

There are some cases in which the adaptation of the source vowel may be attributed to vowel harmony.

3.1. Vowel harmony in MH loanwords

Logically, every case of two consecutive identical vowels *could* be a case of vowel harmony. However, in many such cases, vowel harmony is only *one* possible explanation for the quality of the epenthetic vowel, as other explanations (e.g. perception, orthography, standard epenthesis) are also possible. The data in the following table (5) are some cases in which harmony is one possible explanation:

(5) *Possible harmony in loanword adaptation*

	English	MH	Gloss	Possible source other than harmony
(a)	'vɪ.lɪdʒ	'vɪ.lɪdʒ	'village'	identical source vowels
(b)	dɪ.'lɪt	'dɪ.lɪt	'delete'	Identical MH categories
(c)	'spɒn.səɪ	'spon.sɔɪ	'sponsor'	English orthography
(d)	'su.mo	'so.mo	'Sumo'	MH orthography

In (5a), the English vowels are identical and the MH form is therefore not necessarily a case of harmony. In (5b), although the English vowels are different, the MH category closest to *both* English vowels is identical. Once again, this might not be a case of vowel harmony. In (5c), the English vowels are perceptually different, however, they are orthographically identical in English. Therefore, if the adapted form relies on the English orthography, this might not be a case of vowel harmony. Finally, in (5d), the MH orthographic representation of /u/ and /o/ is identical - <ʊ>. Therefore, this may be a case of misreading the MH orthographic form rather than vowel harmony.

However, there are cases (approximately 2% (33/1383) of the cases in Cohen's corpus in which vowel harmony is the *only* possible interpretation. The MH form cannot be attributed to any of the other factors mentioned above. The following table (6) presents cases in which the source of the MH vowel is necessarily vowel harmony:

(6) *Vowel harmony in MH loanwords*

	English	MH	Gloss
(a)	'dʒɔɪ.dɪ	'dʒɔɪ.dɔn	'(Michael) Jordan'
(b)	fɪlm	'fi.lim	'film'
(c)	'sɪ.nə.mə	'si.ni.ma	'cinema'
(d)	'sɪ.lə.bəs	'si.li.bus	'syllabus'
(e)	'di.zən.gɒf	'di.zin.gof	'Dizengoff (street name)'
(f)	'ɪ.mədʒ	'i.midʒ	'image'
(g)	'fɔɪ.wəɪd	'foɪ.woɪd	'forward'
(h)	'kæŋ.gə.ɹu	'keŋ.gu.ɹu	'kangaroo'

In all of the cases in (6), the MH vowel cannot be based on orthography. In (6a-b), the MH vowel is epenthetic and therefore cannot possibly rely on any English perceptual input. In (6c-h), the English vowel is reduced ([ə]). Rather than being adapted as the MH vowel closest perceptually to the English source ([e]) or being adapted via orthography, the MH vowel harmonises with a neighbouring vowel.

3.2. Vowel harmony in loanwords

Where does a non-native process in loanword adaptation come from?

The surfacing of universal grammar in loanword adaptation has been argued in several cases. Shinohara (2004) shows how universal processes (in her case, prosodically motivated epenthesis) may occur in loanwords even if the language has no evidence for such processes (The Emergence of the Unmarked – TETU – McCarthy&Prince 1994).

Berent et al. (2009) present evidence for UG in adult speech. Kenstowicz and Suchato (2006) claim that adaptation may set "a novel course that lacks a precedent in

the native grammar", and this novel course is universally motivated. Kenstowicz (2004) presents data from Fon (Niger-Congo: Benin), where epenthetic vowels in loanwords undergo harmony even though native words in Fon have neither epenthesis nor vowel harmony.

3.3. Remarks regarding schwa

The harmonising vowels in MH loanwords have two possible sources in the original L2 forms. The English correspondents of the MH vowels are either null (i.e. epenthetic in MH) or schwa.

Schwas are funny little things, and the fact that they behave differently from other English vowels during adaptation is not surprising (Anderson 1982, van Oostendorp 2003, Davidson 2007). It must be assumed that schwas are perceived and treated differently from other vowels, otherwise, it is impossible to explain why schwas behave differently in adaptation from other English vowels, and why schwas adapted from English behave similarly to epenthetic vowels in MH.

4. An ODT analysis of vowel harmony in MH loanwords

Vowel harmony is not native to MH grammar. However, harmony does occur in loanwords and generalisations regarding harmony in loanwords can be made. Whatever the grammar of harmony in MH is, it will have to account for these generalisations.

In this section, I present these generalisations, incorporating them into the grammar of vowel harmony within an Optimality Theory (Prince and Smolensky 1993/2004). My analysis is within an Optimal Domains Theoretical approach (ODT, Cole and Kisseberth 1994, Cassimjee and Kisseberth 1999).

4.1. Descriptive generalisations

Three characteristics of harmony in adaptation need to be accounted for: (a) Optionality ; (b) Vowel quality ; and (c) Directionality.

4.1.1. Optionality

Vowel harmony does not always occur in loanwords. All MH loanwords in which vowel harmony occurs also have alternate non-harmonising forms in which there is no vowel harmony.⁴ In the alternate forms, the vowels are adapted via perception, orthography, or by using the standard epenthetic [e].

⁴ The only MH loanword I am aware of which obligatorily harmonises is ['fɪlim] 'film', but this may also be due to the reanalysis of the adapted form as ending with the plural suffix *-im*.

4.1.2. Vowel quality

Only English schwas and nulls (epenthetic vowels in MH) tend to harmonise, whereas full vowels are adapted via perception or orthography. MH appears to treat both schwas and nulls as epenthetic elements.⁵

Any full vowel can be a potential sponsor of harmony, as in the following (7):

(7) Potential sponsors of harmony

English		MH
/a/	nə'.væ.də 'Nevada'	→ na.'va.da
/o/	'bɔɪ.dəɪ 'border (collie)'	→ 'bɔɪ.doɪ
/u/	'gu.gəl 'Google'	→ 'gu.gul
/i/	'ki.tɪ 'kitten'	→ 'ki.tin

4.1.3. Directionality

There is a preference for vowels to harmonise with sponsors on their left, as almost all harmony is rightward "spreading" in MH loanwords, unless there is no sponsor to the left (i.e. words in which the initial syllable harmonises), as shown in the following (8):

(8) Directionality – rightward spreading

English		MH	*MH
kɔʊl.'ɪɑ.bi 'kohlrabi'	→	kɔ.ɪɔ.'ɪɑ.bi	*kɔ.lɑ.'ɪɑ.bi

There are some exceptions with leftward "spreading", all showing the following preference: Higher vowels are more likely to sponsor harmony: /i/,/u/ >> /o/,/e/ >> /a/. In the following table (9), the righthand vowel is higher than the lefthand vowel and is, therefore, the sponsor of the harmony:

(9) Directionality - leftward spreading

English		MH	*MH
'kæŋ.gə.ɹu 'kangaroo'	→	'keŋ.gu.ɹu	*'keŋ.ge.ɹu
'sæ.mən 'salmon' ⁶	→	'sa.lo.mon	*'sa.la.mon

⁵ The only apparent cases in which full vowels appear to harmonise are a handful of words which involve the vowel *ɪ*, harmonising with Hebrew *e*. *ɪ* is perceptually equidistant (more or less) between the two Hebrew categories *e* and *i*, so this might not actually be a case of harmony per se.

⁶ Note, the vowels in Hebrew were probably adapted via orthography followed by harmony.

4.2. Constraint interaction

Harmony is a requirement for a feature F to be realised on all sponsors within a domain D. How harmony is (or is not) realised is a result of the interaction among constraints on the structure of domains and constraints on the realisation of F.

4.2.1. Forming the domain

For features to be realised, they have to be within a domain. This is achieved via alignment constraints, which designate the domain's edges.

- (10) *ALIGN(ANCHOR, L ; F-DOMAIN, L) ; ALIGN (ANCHOR, R ; F-DOMAIN, R)*
 The anchor of a feature is aligned with the domain's edges
 (Cole and Kisseberth 1994).

These two constraints set up the left and right edges of the domain. In a situation in which there is no harmony, where every feature is realised on "its" anchor, the left and right edges of the domain are aligned with the left and right edges of the segment.

However, if, for some reason, one of the edges "shifts" due to constraint interaction, then a feature may be realised over a larger span than a single segment. One type of constraint which could trigger the domain's expansion sets a lower limit on the domain's size.

- (11) **MONOD*
 Domains cannot be monosyllabic
 (Cassimjee&Kisseberth 1999)

On the one hand, features would like to align themselves with their sponsors. On the other hand, there is both articulatory and perceptual motivation for features to spread beyond the boundaries of their sponsors. If the constraint forcing domains to be larger than a single syllable outranks those setting up the domain edges, then harmony could occur. The (in)ability to spread onto neighbouring epenthetic vowels is controlled by the interaction between the alignment constraints and the constraint militating against monosyllabic domains. In a non-harmony language, *ALIGNL/ALIGNR* >> **MONOD*, and the standard epenthetic vowel surfaces. In a harmony language, **MONOD* is ranked above one (or both) alignment constraints, forcing the violation of the lowest ranked alignment constraint and the expansion of the domain.

4.2.2. Full vowels vs. schwa and epenthetic vowels

One observation in the harmony patterns in MH is that full vowels tend to trigger harmony, while adapted English schwas and epenthetic vowels tend to undergo harmony. Full vowels do not undergo harmony. This is achieved via a group of undominated constraints.

The first constraint is a faithfulness constraint, requiring identity between the MH output and the English input.

- (12) *IDENTV*
Vowels in the output are identical to their correspondents in the input

Vowels which have anchors cannot harmonise with other vowels and are anchors of their own domains. When the MH vowel has an English correspondent, it is identical to that correspondent (I do not address the perceptual mapping patterns and the orthography here). Full vowels in English, therefore, do not undergo harmony. However, epenthetic vowels in MH, which do not have correspondents in the English input, vacuously satisfy *IDENTV*, whether or not they undergo harmony. English schwas are treated similarly to epenthetic vowels (see §3.3 above).

An additional undominated constraint prevents adjacent domains from overlapping. In other words, there can only be one sponsor in each domain.

- (13) **OVERLAP*
Domains do not overlap

This constraint ensures that each domain will have one, and only one, sponsor.

Finally, it is not sufficient to construct the domains. It is necessary to realise the various features within the domains.

- (14) *REALISEF*
Underlying features must be realised

This constraint ensures that features are realised on all sponsors within a domain. All vowels within the same domain must harmonise. On the other hand, since consonants are not potential sponsors of the vowel features, they are not subject to *REALISEF*.

Since these three constraints are undominated, I will assume them in all the following analyses without explicitly mentioning them.

4.2.3. Directionality

An additional characteristic of vowel harmony is that it typically operates in a certain direction (leftward or rightward). However, as shown in the above data, the directional preference in MH (rightward "spreading") interacts with vowel quality in such a way that the higher the vowel, the more likely it is to trigger harmony.

The direction of the spreading is controlled by these two factors. First of all, the relative ranking of the two alignment constraints, *ALIGNL* and *ALIGNR*, determine the "default" directional preference. If *ALIGNL* >> *ALIGNR*, then domains will tend to

spread rightwards in order to satisfy *MONOD.⁷ This is the situation in MH as shown in the following tableau (15):

(15) *Directionality – rightward spreading*

	'diz ngof	*MONOD	ALIGNL	ALIGNR
☞	['dizin][gof]	*		*
	['di][zongof]	*	*!	
	['di]z_n[gof]	**!		

The square brackets designate the domain boundaries. The undominated IDENT_F, OVERLAP and REALISE_F ensure that the domains will be formed, will not overlap, and that the features will be realised within the domains. Only vowels without correspondents in the input do not violate these constraints regardless of whether they are inside a domain or not. *MONOD has to be violated at least once here, since there is only one possible expansion of the two domains (that of the /i/ and that of the /o/) which incorporates the second syllable. Then the question is which domain will indeed spread. The preference is ordinarily for the lefthand syllable to spread, which implies that ALIGNL >> ALIGNR.

However, we also have leftward "spreading" in MH in two cases: word initial epenthetic vowels and some word medial epenthetic vowels. How do we account for this?

Word-initial epenthetic vowels cannot be "filled" via rightward spreading, as they have nothing on their left. They can, however, be filled by expanding the domain of the vowel to their right, which would result in leftward spreading, as shown in the following tableau:

(16) *Directionality – word-initial epenthetic vowels*

	n 'vada	*MONOD	ALIGNL	ALIGNR
☞	[na'va][da]	*	*	
	n_['va][da]	**!		

The problem is with word-medial epenthetic vowels, as these have two potential sponsors, one to the left and one to the right. However, as ALIGNL >> ALIGNR, word-medial epenthetic vowels should prefer to harmonise with the vowel on the left rather than that on the right. How do we account for cases in which the harmony is with the vowel on the right?

⁷ Recall, that if ALIGNL/ALIGNR >> MONOD, then there is no harmony at all.

Descriptively, in MH, if the epenthetic vowel is flanked by two full vowels, the higher vowel will be the sponsor of the harmony, regardless of the direction. This can be achieved in two ways.

The first, suggested in Kitto and deLacy (1999), is that markedness constraints with respect to epenthetic vowels could explain this behavior: $*a \gg *e/o \gg *i/u$. The ranking, of course, could be language specific, which would account for different epenthetic vowels in different languages. However, in MH, the standard epenthetic vowel is [e], implying that $*e$ is the lowest ranked markedness constraint. But this contradicts the harmony data, as [i] and [u] are more likely to trigger harmony than [e]. Therefore, Kitto and deLacy's (1999) proposal appears less favourable.

My proposal is that alignment constraints of lower vowels outrank those of higher vowels in MH, in such a way that the ALIGNR of lower vowels is ranked higher than the ALIGNL of higher vowels. For example, $\text{ALIGNR}_{[e]} \gg \text{ALIGNL}_{[u]}$. This would result in the higher righthand vowel spreading, rather than the lower lefthand vowels, as shown in the following tableau:

(17) *Directionality - leftward spreading*

	'keŋg_ɮu	*MONOD	ALIGNL _[e]	ALIGNR _[e]	ALIGNL _[u]
☞	['keŋ][g <u>u</u> ɮu]				*
	['keŋge][ɮu]			*!	
	['keŋ]g_ [ɮu]	*!			

4.2.4. *Variation*

The ranking of *MONOD in relation to the alignment constraints determines whether we get harmony or not. In native MH words, $\text{ALIGNL}/\text{ALIGNR} \gg *MONOD$. We never get harmony and epenthetic vowels are invariably /e/.

But this is not the situation in loanwords. As we have seen, many loanwords *may* undergo harmony. In order for the optional harmony to occur in loanwords, a grammar allowing variation in loanwords (as opposed to no variation in native words) is necessary.

Such a grammar simply requires the fluctuation in the ranking of a single constraint - *MONOD. In native words, *MONOD is ranked below alignment constraints. In loanwords, the ranking of *MONOD varies in any given evaluation. This could be achieved via Stochastic OT (Boersma 1997), a noisy harmonic grammar (Boersma and Pater 2008) or suchlike. I will not concern myself with the exact mechanism of variation.

In loanwords which do harmonise, *MONOD >> *ALIGNR, as in the following tableau:

(18) *Harmonising form*

	'dʒoʊd_n	*MONOD	ALIGNR
☞	['dʒoʊdon]		*
	['dʒoʊ]d_n	*!	

In loanwords which do not harmonise, *ALIGNR >> *MONOD, as in the following tableau:

(19) *Non-harmonising form (standard epenthesis instead)*

	'dʒoʊd_n	ALIGNR	*MONOD
☞	['dʒoʊ]d_n		*
	['dʒoʊdon]	*!	

5. Concluding remarks

As MH does not have synchronic vowel harmony in native vocabulary, what happens in loanwords reflects the universality of vowel harmony. Vowel harmony potentially exists in grammars without vowel harmony, something evidenced in loanword adaptation and acquisition alike. Because lexical contrast is a major force militating against vowel harmony, full vowels are less likely to be affected, and non-lexical vowels (epenthetic vowels and schwas) are more susceptible to undergoing harmony.

The vowel harmony in MH loanwords is a product of universal default settings as it is not part of the native grammar. This may imply that the following is the *universal* default setting with respect to vowel harmony:

(20) *Directionality: ALIGNL >> ALIGNR*

(21) *Quality: High vowels are better harmony triggers than other vowels.*

During acquisition, core grammars start off as flexible grammars, and as the evidence flows in, the grammars settle down into fixed systems (Boersma and Hayes 2001). There are exceptions, but these are mainly high frequency words (Bybee

2001). This, however, is what happens in the core. In the periphery, grammars differ from that core, displaying more variability and less stability.

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