STEM MODIFICATION AND CLUSTER TRANSFER IN MODERN HEBREW*

In the formation of Modern Hebrew denominative verbs, two structural properties are transferred from the base to the derived form: the consonantal root and the consonant cluster. While the model of Root-to-Template Association (McCarthy 1981) is largely based on root transfer, it fails to account for cluster transfer. In this paper I argue that the model which can actually account for cluster transfer as well as root transfer is what I will term here Stem Modification (Steriade 1988). Within this model, segmental and prosodic adjustments are made on the base itself and not on some designated material extracted from the base. This approach to stem formation also eliminates the notion of the consonantal root from the grammar of Modern Hebrew.

0. Introduction

It has been generally accepted that semantic relations among stems in languages such as Arabic and Hebrew are encoded in a consonantal root. For example, the Modern Hebrew words *gidel* 'to raise'[1], *gadal* 'to grow', *higdil* 'to enlarge', and *gadol* 'big' are semantically related because they share a morphological unit, the consonantal root, {*g*, *d*, *l*}, and a corresponding semantic unit, 'pertaining to a large size'. The vocalic patterns (and prefixes, if any) are selected independently, on the basis of morphological categories.

The view that the consonantal root is a morphological unit in Semitic languages is structurally expressed by the multi-tiered representation proposed in McCarthy (1979, 1981), where the consonantal root appears on a distinct segmental tier. In a representation of this type, semantically related stems are morphologically related if their consonantal tier is identical.[2] Other properties of the stem, such as the vocalic pattern and the array of vowel and consonant positions (the CV template), do not play a role in determining the semantic relations. The multi-tiered representation, which affords an attractive explanation for the wide range of morphologically conditioned alternations attested in several Semitic languages, is constructed according to the principles of Melody-to-Template Associ-

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[1] Unless otherwise specified, stress is final and the citation form of verbs is the 3rd person masculine past.

[2] Tiers must be identifed at an early stage of the derivation because on the surface they can be obscured by processes such as spirantization, as in *katav* 'to write' – *hixtiv* 'to dictate'.

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ation, whereby each morphological unit is independently associated with the template. (When the root is the main concern I refer to Root-to-Template Association.)[3]

Bat-El (1986) adopts this model in her analysis of Modern Hebrew denominatives. Given a fully specified base form, the derivation involves two stages: (i) Extraction: the consonants are extracted from the base, preserving precedence relations; *télegraf* 'telegraph' –Extraction→$\{t, l, g, r, f\}$, and (ii) Root-to-Template Association: the extracted consonants are associated with a given template plus vocalic pattern; $\{t, l, g, r, f\}$ + *CiCCCeC* –Association→*tilgref* 'to telegraph'. This method of derivation implies that the only structural information transferred from the base to the derived form is an ordered string of consonants.

It appears, however, that the information transferred from the base to the derived form is not only the order of the consonants, but also which consonants occupy adjacent positions in the base, i.e., whether they form a cluster. For instance, from the base *praklit* 'lawyer' we get *priklet* 'to practice law' (**pirklet*), but from the base *sandlar* 'shoemaker' we get *sindler* 'to make shoes' (**snidler*). This clearly shows that adjacent consonants in the base remain adjacent in the derived form. The problem is to find a formal way to account for what intuitively appears to be a general tendency. Extraction plus Root-to-Template Association cannot account for this phenomenon as it is not equipped to transfer information about clusters, because the moment the consonants are extracted, access to the base is lost. The choice between the templates CCVCCVC (*priklet*) and CVCCCVC (*sindler*) would therefore need to be lexically marked. This marking, however, is unnecessary if the template of the derived form is dictated by the base template.

Stem Modification is an alternative theoretical model which can account for generalizations about morphologically conditioned alternations since it allows for internal stem adjustments. It is introduced in Steriade (1988) as the appropriate analysis of reduplication and in McCarthy and Prince (1990) as a strategy to account for some types of transfer in Arabic broken plurals and diminutives. The advantage of Stem Modification is that it allows direct access to the base throughout the derivation. Thus, when this model is adopted for the formation of Modern Hebrew denominatives,

[3] In pretheoretical terms the structural relation of *gadal – gidel – godel* is not very different from that of *sing – sang – song*, as both cases involve morphologically conditioned vocalic alternation. It seems that what the Indo-Europeanists call Ablaut is what the Semitists call Melody-to-Template Association. It should be noted that Heath (1987) uses the term Ablaut in his account of a Moroccan Arabic dialect, but in a somewhat different sense, as he himself indicates.

the template is imposed on the base and then the relevant adjustments are made, rather than the base consonants carried over to the template, as in Extraction plus Root-to-Template Association. Since the consonants remain intact, it is a natural consequence that information about clusters and the array of vowel and consonant positions is transferred to the output.

When Stem Modification is adopted as the appropriate analysis of Modern Hebrew stem formation, the peculiar notion of "consonantal root" is eliminated from the grammar. It is claimed here that there is no such formative as a consonantal root because there is no stage in the derivation where it can be referred to as a unit.

This paper is organized as follows: Section 1 provides a brief overview of Root-to-Template Association (McCarthy 1981) and then introduces the analysis of Modern Hebrew denominatives as presented in Bat-El (1986).

Section 2 deals with the problem of transfer: The problem of cluster transfer is examined using a wide range of forms, demonstrating the shortcomings of Extraction plus Root-to-Template Association (section 2.1). Then the claim that direct access to the base must be available in the course of the derivation is supported by a phenomenon of vowel transfer and some results of experimental studies (section 2.2).

Section 3 develops the model of Stem Modification as the correct analysis of Modern Hebrew verb stems: The morphological categories of Modern Hebrew verbs are introduced to provide a background (section 3.1). The analysis of Stem Modification then begins with the simple cases, where the base is polysyllabic (section 3.2.1). Derivations from monosyllabic bases, which yield three shapes of verb stems, are shown to involve competing prosodic principles (section 3.2.2). Finally, the status of the consonantal root is discussed in relation to the approach developed here (section 3.3).

1. Extraction and Melody-to-Template Association

It is generally accepted that verbal stems in many Semitic languages consist of two identifiable formatives, a vocalic pattern and a consonantal root. Verbs which consist of the same root often share some basic meaning, as shown in (1a). Verbs which share the same vocalic pattern (and prefix) belong to the same derivational category, termed *binyan* (1b). A common binyan implies an identical pattern of inflection (1c), while a common root has no impact on subsequent morphological processes.

(1)a. Common consonantal root
{*g*, *d*, *l*}: *gadal* 'to grow', *higdil* 'to enlarge', *gidel* 'to raise'
{*k*, *n*, *s*}: *nixnas* 'to enter', *hixnis* 'to bring in', *kines* 'to assemble (transitive)'

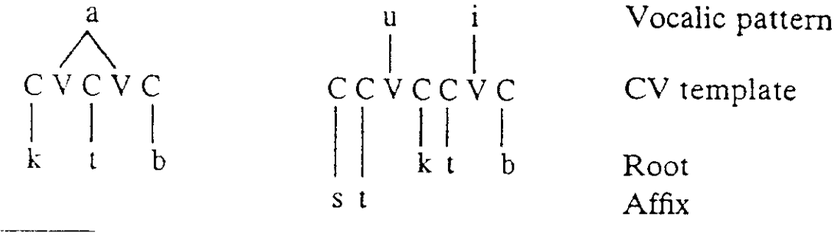
b. Common binyan
piʔel: *gidel* 'to raise', *dileg* 'to skip', *xipes* 'to search'
hifʔil: *higdil* 'to enlarge', *hitxil* 'to start', *hirgiš* 'to feel'

c. Common tense (future)
piʔel: *yegadel* 'will raise', *yedaleg* 'will skip', *yexapes* 'will search'.
hifʔil: *yagdil* 'will enlarge', *yatxil* 'will start', *yargiš* 'will feel'.

Similar morphological relations in Classical Arabic establish the empirical basis for McCarthy's (1979, 1981) prosodic theory of nonconcatenative morphology. To repeat the well-known example from Classical Arabic, in the forms *katab* 'wrote', *kattab* 'caused to write' and *kaatab* 'corresponded', the vocalic pattern and the consonantal root are distinct formatives; the vocalic pattern indicates the inflectional category (cf. the respective passive forms *kutib*, *kuttib*, and *kuutib*), and the consonantal root provides the basic meaning. What distinguishes the three forms is the array of vowel and consonant positions: CVCVC, CVCCVC, and CVVCVC respectively.

To account for this morphological phenomenon, McCarthy replaces the morpheme boundaries (or brackets) with morphologically motivated tier segregation. The distinction between material belonging to different formatives is structurally encoded by a multi-tiered representation, in which each formative appears on a separate tier. That is, the vocalic pattern, the consonantal root, and the affixes appear on distinct segmental tiers.[4] The segmental tiers are all linked to a prosodic template, represented originally by the CV skeleton, and by a syllabic template in McCarthy and Prince (1986).

(2) *katab* 'to write' *stuktib* 'should be written'



[4] McCarthy (1989) argues that tier segregation can also be phonologically motivated. But with respect to Semitic languages, McCarthy maintains his morphological motivation, i.e., that vowels and consonants appear on distinct tiers because they belong to different formatives.

The multi-tiered representation has to be eliminated at a later stage, where phonological rules refer to a single segmental tier. This is done by Tier Conflation which linearizes the multi-tiered representation into a single segmental tier (see McCarthy 1986).[5]

It is relevant to the present discussion that the model of Melody-to-Template Association assumes that (i) the consonantal root is an independent morphological unit, and (ii) the array of vowel and consonant positions is determined by a pre-selected prosodic template. Conversely, I will argue in this paper that (i) the consonantal root does not exist as an independent unit in Modern Hebrew, and (ii) the array of vowel and consonant positions is dictated by the base.

The model of Root-to-Template Association is adapted in Bat-El (1986) to account for the derivation of denominative verbs in Modern Hebrew. Given a fully specified base form consisting of consonants and vowels, a new verb can be derived by extracting the consonants from the base and associating them with a given template (plus a vocalic pattern):

(3)

Binyan	Derived verb	Base
hifʔil	hivrid 'to become pink'	varod 'pink'
	hidrim 'to go south'	darom 'south'
piʔel	kixev 'to star'	koxav 'star'
	mimen 'to finance'	mamon 'money'
	kifter 'to button'	kaftor 'button'
	tilgref 'to telegraph'	télegraf 'telegraph'
hitpaʔel	hityaded 'to befriend'	yadid 'friend'
	hitxašmel 'to be electrocuted'	xašmal 'electricity'

Bat-El (1986, 1989) emphasizes that Extraction does not refer to some underlying consonantal root but rather to the base consonants. This is clear from the examples in (4) below, where the consonants of the affixes are extracted along with the stem consonants.

(4)

Derived verb	Base
hitkamcen 'to be stingy'	kamc + an 'stingy person' (cf. hitkamec 'to be stingy')
hikcin 'to bring to extremity'	kic + on + i 'extreme' (cf. kace 'edge')

[5] In Bat-El (1989) Modern Hebrew verbs are derived by syllabification. This approach abandons the CV template and the multi-tiered representation but still refers to the consonants of the base as a unit at some stage of the derivation.

timcet 'to summarize'	ta + mc + it 'summary' (cf. mica 'to exhaust')
tixzek 'to maintain'	ta + xzuk + a 'maintenance' (cf. hixzik 'to hold')
misper 'to enumerate'	mi + spar 'number' (cf. safar 'to count')
himxiz 'to dramatize'	ma + xaze 'play, view' (cf. xaza 'to observe')

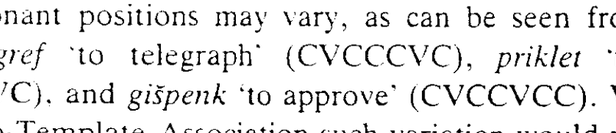
Extraction plus Root-to-Template Association is illustrated in (5) below:

(5) *maxaze → himxiz* *télefon → tilfen*

a. Extraction

maxaze → {*m*, *x*, *z*} telefon → {*t*, *l*, *f*, *n*}

b. Root-to-Template Association



Notice that while the derivation in (5) is consistent with Aronoff's (1976) view that a word is derived from a word and not from some abstract formative, it also includes a stage where the consonants are referred to as a unit. Section 2 demonstrates why this is a problem.

2. The Problem of Transfer

Some of the problems of transfer are raised in Clements (1985b), McCarthy and Prince (1986, 1990), Hammond (1988), and Steriade (1988), but these studies are concerned mainly with vowel length and syllabicity. This section presents the problem of cluster and vowel transfer, showing that the approach viewed in section 1 above fails to account for it.

2.1. *Cluster Transfer*

When the verb stem consists of five or more consonants the array of vowel and consonant positions may vary, as can be seen from the following verbs: *tilgref* 'to telegraph' (CVCCCVC), *priklet* 'to practice law' (CCVCCVC), and *gišpenk* 'to approve' (CVCCVCC). Within the model of Root-to-Template Association such variation would require each verb stem to be lexically specified for its CV template, as indeed suggested in McCarthy (1984).

It appears, however, that the array of consonant and vowel positions in the derived verb is not arbitrarily chosen but rather transferred from the base. As noted in Bolozky (1978), there is a strong tendency in Modern Hebrew to preserve the source clusters in the derived form.[6]

The problem, then, with Root-to-Template Association is that it treats the template as an arbitrary property of the verb stem, ignoring the undeniable correlation between the shape of the base and the shape of the derived verb. It fails to explain why a verb derived from a CVCCCVC base can never be lexically specified for the template CCVCCVC or CVCCVCC. The syllabic/moraic template, whose superiority is demonstrated in McCarthy and Prince (1986, 1990), also fails to provide a satisfactory solution since it does not specify segmental position and therefore would not be able to make the distinction between the syllables CVC and CCVC or CVC and CVCC. There is thus a regular and direct relationship between the base and the derived verb.

The rest of this section introduces data crucial for the present discussion. Consider first the forms in (6) below:

(6)	Base	Derived verb
a.	xan**t**ariš 'nonsense'	xin**tr**eš 'to talk nonsense'
	té**l**egraf 'telegraph'	til**gr**ef 'to telegraph'
	sa**ndl**ar 'shoemaker'	sin**dl**er 'to make shoes'
	sinx**r**óni 'synchronic'	sinx**r**en 'to synchronize'
b.	**šl**úmper 'sloppy person'	**šl**imper 'to make sloppy'
	šnórkel 'snorkel'	**šn**irkel 'to snorkel'
	psanter 'piano'	**ps**inter 'to play the piano'
	ksilofon 'xylophone'	**ks**ilfen 'to play the xylophone'

The derived verbs in (6a) are of the shape CVCCCVC, and those in (6b) are of the shape CCVCCVC. It might be argued that the Sonority Sequencing Generalization (Selkirk 1984) does not allow the verbs in (6b) to select the same shape as those in (6a); the medial sonorant in **sil.**m**.per*, **šin.**r**.kel*, **pis.**n**.ter* and **kis.**l**.fen* (a dot indicates a syllable boundary) cannot join either the coda of the preceding syllable or the onset of the following syllable. (In Modern Hebrew two sonorants of any type are disfavored in coda or onset). It is thus possible that all the verbs in (6) select the shape CVCCCVC, and when the Sonority Sequencing Generalization is violated some type of metathesis takes place.

[6] This observation is based on a list of verbs, most of them with five or more consonants, presented in Yannai (1973–74). Yannai uses written material (literature and newspapers) as well as nonstandard speech in collecting these forms, though he notes that some of the forms are probably never in use beyond these particular sources.

The forms in (7), however, cannot be accounted for in this way (the parenthesized bases below do not exist as words):

(7)	Base	Derived verb
a.	**praklit** 'lawyer'	**priklet** 'to practice law'
	traklin 'salon, parlour'	**triklen** 'to make something neat'
	(**progres** 'progress')	**prigres** 'to progress'
	šravrav 'plumber'	**šrivrev** 'to plumb'
b.	(**kompleks** 'complex')	**kimpleks** 'to make something complex'
	ʔabstrákti 'abstract'	**ʔibstrekt** 'to abstract'
	gušpánka 'approval, seal'	**gišpenk** 'to approve, seal'
	nostálgia 'nostalgia'	**nistelg** 'to be nostalgic'
c.	**transfer** 'transfer'	**trinsfer** 'to transfer'
	stenograf 'stenographer'	**stingref** 'to take shorthand'
	streptiz 'striptease'	**striptez** 'to perform a striptease'
	pravoslávi 'Orthodox Christian'	**hitpravslev** 'to perform a striptease'

The forms in (7a) are of the shape CCVCCVC, although the expected shape CVCCCVC would respect the Sonority Sequencing Generalization. It should be noted that in Modern Hebrew a complex onset is admissible at the beginning of a word (e.g., *klum* 'nothing', *tlut* 'dependency', *gruš* 'penny', *vrid* 'vain', *pnina* 'pearl', *ptuxa* 'open'), as well as in the middle of a word (e.g., *til.gref* 'to telegraph', *kim.pleks* 'to make something complex', *hiš.pric* 'to squirt', *sén.dvič* 'sandwich', *ʔin.flác.ya* 'inflation', *ʔas.tro.lóg.ya* 'astrology'),[7] and therefore it is not a phonological restriction that prevents the formation of **pir.klet*, **tir.klen*, **pir.gres* and **šir.vrev* in (7a). Nonetheless the shape of the derived verbs is CCVCCVC, consistent with the shape of their base. Any theory which attempts to account for this phenomenon must thus assume that the derivation is local, i.e. the base is directly involved in determining the shape of the derived verb.

In the forms in (7b) there is a final consonant cluster, a rather unusual position for a cluster in Hebrew. The first two forms could be explained by the Sonority Sequencing Generalization, but this is not true for the last two forms, *giš.penk* and *nis.telg*, since **giš.pnek* and **nis.tleg* are properly syllabified.

The same is true for the verbs in (7c), which consist of six consonants.

[7] Complex onsets in a medial position are found only in borrowed nouns and in verbs derived from borrowed nouns and therefore are not common.

The first two forms can be accounted for by the Sonority Sequencing Generalization, but the last two could just as well be **stir.ptez* and **hitparv.slev*, respectively. Once again these forms raise the question of why the array of vowel and consonant positions is the way it is.

Different sets of forms are presented in (8) below. These are distinguished from those in (6) and (7) in that the bases are monosyllabic (assuming that a final vowel is extraprosodic; see section 3.2.1).

(8)	Base	Derived verb
a.	**flik** 'slap'	**hiflik** 'to slap'
	špric 'squirt'	**hišpric** 'to squirt'
b.	**flirt** 'flirt'	**flirtet** 'to flirt'
	boks 'box (blow)'	**hitbokses** 'to box (fight)'
	faks 'facsimile'	**fikses** 'to send a fax'
c.	**xrop** 'nap'	**xarap** 'to take a nap'
	truma 'contribution'	**taram** 'to contribute'
	blof 'bluff'	**bilef** 'to bluff'

In (8a) the clusters are preserved by selecting a binyan which forces a cluster (cf. *hidrix – yadrix – madrix* 'to guide' related to the native noun *dérex* 'way'). In (8b) the cluster is preserved by reduplication.

The verbs in (8c), however, do not preserve the base cluster, and if cluster preservation were accepted as a grammatical principle, they are certainly exceptions. These forms can be properly derived by Extraction plus Root-to-Template Association, and therefore one could claim that this strategy exists in the grammar along with Stem Modification (see a similar argument in Heath 1987 for stem formation in Moroccan Arabic and McCarthy and Prince 1990 for broken plurals in Arabic). However, I suspect that the fact that these apparent exceptions are derived from monosyllabic bases is not accidental. In section 3.2.2 I show that these derived verbs are not exceptional in any sense since cluster preservation is not a principle in the grammar but rather a consequence of Stem Modification.

I believe that the data presented in this section establishes the fact that clusters tend to be transferred from the base to the derived verb, yet, as can be seen from the forms in (8c), this is not a law. It is also clear from the discussion above that the model of Semitic verb formation suggested so far cannot account for cluster transfer without some ad hoc lexical marking. Section 3 below provides a different approach to Modern Hebrew verb formation, which accounts for cluster transfer and at the same time explains the cases where the cluster is not transferred. First, however, another type of transfer will be examined.

2.2. *Vowel Transfer*

The problem of transfer also arises with vowels, though to a much lesser extent. The binyanim pi?el and hitpa?el have a marginal vocalic pattern, {*o*, *e*}. This pattern appears in a handful of verbs, in particular in reduplicated forms which historically contained a medial back glide; e.g., *hitkomem* 'to rebel', *komem* 'to raise against' (historical root {*k*, *w*, *m*}), and *hitbonen* 'to look at' (historical root {*b*, *w*, *n*}). Although the pattern {*o*, *e*} is marginal and is thus expected to be unproductive, it is sometimes selected in deriving new verbs. For example, *boks* 'box (blow)' → *hitbokses* 'to box (fight)' (**hitbakses*), *xok* 'law' → *xokek* 'to make a law' (**xikek*), and *?ot* 'sign' → *?otet* 'to signal' (but also *?itet*).

The significant point is that the selection of the marginal pattern is contingent upon the base vowel. When there is *o* in the base it is possible for the regular {*i*, *e*} pattern to be selected, as in *kod* 'code' → *kided* 'to codify'. However, forms such as *?ot* 'sign' → *?otet* 'to signal' and *xok* 'law' → *xokek* 'to create a law' indicate that it is also possible, when there is *o* in the base, for the marginal {*o*, *e*} pattern to be selected. Essentially, however, the {*o*, *e*} pattern is never selected when there is no *o* in the base.

The fact that the {*o*, *e*} pattern is selected only when there is *o* in the base suggests, as does the fact of cluster transfer, that it is necessary to maintain direct access to the base in the course of the derivation. If Extraction plus Root-to-Template Association is applied, this information is lost after Extraction.

The fact that the derived form reflects properties of the base not determined by the consonantal root can also be observed in the experimental studies conducted by R. A. Berman and her research group (see report in Berman 1990). In the experiments, speakers of different age groups were given native nouns from which they had to form verbs. Relevant to the present discussion are the forms derived from bases of the shape CVC and CVCV; the crucial distinction between the two is the closed vs. the open final syllable. As expected, most of the derived verbs are bisyllabic and have a closed final syllable. There are, however, some instances where the final syllable is open. The distinction, however, is not arbitrary; there is a significant correlation between the final syllable of the base and the final syllable of the derived verb. The number of verbs with an open final syllable derived from CVCV nouns (e.g., *kise* 'chair' → me + *kase*) is significantly larger than those derived from CVC stems (e.g., *xum* 'brown' → me + *xame*); most verbs derived from a CVC base have a closed final syllable (e.g., *xum* 'brown' → me + *xamem*).

Such a correlation would not be expected under Extraction plus Root-to-Template Association; under that model, as there is no access to the base after Extraction, the preservation of the structure of the final syllable cannot be explained![8]

3. Stem Modification

As argued above, the only structural property which can be transferred by Extraction plus Root-to-Template Association is an ordered string of consonants. However, the derivation of Modern Hebrew denominatives requires the transfer of clusters, and this information is not carried by the ordered string of consonants. It is therefore necessary to abandon Extraction plus Root-to-Template Association and to consider Stem Modification as the appropriate approach.

In Stem Modification all the relevant changes are made on the base itself, as opposed to the consonants being extracted from the base and then associated with a selected pattern. The major advantage of Stem Modification is that anything in the base that is not affected by the pattern remains intact.

The term Stem Modification is adopted from Steriade's (1988) analysis of reduplication, though the analysis presented here is also compatible with McCarthy and Prince (1986, 1990). Steriade introduces reduplication as just one of the phenomena classified under Stem Modification, where nonreduplicative instances of Stem Modification are, for example, Madurese compounds, French hypocoristics, and Kaingang plurals. She does not mention Semitic verb formation as an instance of Stem Modification, though she points out that Ablaut is actually nonreduplicative Stem Modification. There is a great similarity between the derivations *mari-alis* 'Marie-Alice' → *malis* (French hypocoristic) and *télegraf* 'telegraph' → *tilgref* 'to telegraph' (Modern Hebrew denominative). In both cases, the prosodic structure of the output is adjusted and the selection of syllables is accomplished edge-in, while the rest of the segmental material, *ria* in *mari-alis* and the second *e* in *telegraf*, is truncated.[9]

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[8] It is possible, within the Extraction model, that speakers realize a base with an open final syllable as ending in a glottal stop, which never surfaces in the final position of the stem. That is, the consonants extracted from *kise* are {*k*, *s*, *?*}, and after association we get me + *kase?*, which is phonetically realized as me + *kase*. But as shown in Bat-El (1986), the base of Extraction is always the surface form, as evidenced by the inclusion of affixes (4) and the preservation of a spirantized consonant (e.g., *xaver* 'friend' → *hitxaver* 'to befriend'; cf. *hitxaber* 'to be connected', *xiber* 'to connect'; historical root {*ħ*, *b*, *r*}). Therefore, the restructuring of a final glottal stop at the end of a final open syllable seems less plausible and thus would be expected to be attained rarely.

[9] Steriade (1988) notes that template adjustment in French hypocoristics is either left-to-right, as in *dominik* → *domi*, or right-to-left, as in *dominik* → *mini*(*k*). The case of *mari-alis*

Reduplicative Stem Modification is classified by Steriade (1988) into three types: partial reduplication, prespecified full reduplication, and prespecified partial reduplication. Each type involves full reduplication accompanied by either prespecification, or syllabic adjustment, or both respectively. Prespecification involves substituting a selected segment for another segment in a designated position, and syllabic adjustment involves the implementation of prosodic constraints. Truncation of unsyllabified material is a direct consequence of syllabic adjustment; unsyllabified material is truncated by Stray Erasure due to Prosodic Licensing.

Steriade emphasises that these procedures are not peculiar to reduplication. The similarity between these procedures and those required for Modern Hebrew verb formation will indeed emerge. Before turning to the core of the analysis, it is necessary, however, to introduce the binyanim which are selected as the target patterns for denominatives.

3.1. *The Verb Stem in Modern Hebrew*

Modern Hebrew has five binyanim. To illustrate the phonological shape of verbs in the different binyanim, only tri- and quadriconsonantal stems are presented, since they are the most common in native verbs. Biconsonantal verbs are disappearing and verbs with more than four consonants are included in the crucial data.

(9)

	Perfective	Imperfective		
		Future[10]	Participle	
a.B1(pa?al)	CaCaC	CiCCo/aC	CoCeC	
	gadal	yigdal	godel	'to grow'
	šamar	yišmor	šomer	'to guard
B2 (nif?al)	niCCaC	CiCaCeC	niCCaC	
	nilxam	yilaxem	nilxam	'to fight'
b.B3 (hif?il)	hiCCiC	CaCCiC	maCCiC	
	hixnis	yaxnis	maxnis	'to put in'
B4 (pi?el)	Ci(C)CeC	CeCa(C)CeC	meCa(C)CeC	
	gidel	yegadel	megadel	'to raise'
	tirgem	yetargem	metargem	'to translate'
B5 (hitpa?el)	hitCa(C)CeC	CitCa(C)CeC	mitCa(C)CeC	
	hitkabel	yitkabel	mitkabel	'to be accepted'
	hitparsem	yitparsem	mitparsem	'to be published'

B1 and B2 are relatively unproductive as is evidenced by recent innovations (see sections 1 and 2.1 above).[11] B3, B4 and B5 are the binyanim usually selected for denominative verbs, with B4 being, by far, the favorite. We will therefore focus on the stems of the last three binyanim, presented below in square brackets.

(10)

	Perfective	Imperfective
B3:	h[igdil]	y[agdil]
B4:	[gidel]	ye [gadel]
B5	hit [gadel]	yit [gadel]

As can be seen from (10), a verb stem must consist of two syllables. In prosodic terms this is viewed as the imposition of a template on the segmental material (McCarthy and Prince 1986, 1990). The Modern Hebrew syllabic system seems to be quantity insensitive, and therefore the verb template is a bisyllabic foot.[12]

3.2. *A Formal Analysis of Stem Modification*

Stem Modification in Modern Hebrew involves several procedures, most of which are governed by the principle of Template Satisfaction (McCarthy and Prince 1990). The first procedure to take place is syllabification. Unlike Steriade (1988), but like other treatments of reduplication, I assume that the base provides segmental material only, without its prosodic structure (see Inkelas 1990 for a different view). The segmental material is then syllabified into the bisyllabic template. When there are too many vowels in the base to fit into the template, unsyllabified vowels are truncated, and when there are not enough segments to satisfy the template, reduplication is invoked to fill the empty position.

The non-prosodic procedure involved in Stem Modification is Melodic Overwriting (McCarthy and Prince 1990) (or Substitution in Steriade's 1988 terms), in which the base vowels are replaced by the appropriate

'Marie-Alice' → *malis* is explained by recoverability of the two parts of the base. The formal account is actually the third type of directionality, edge-in (Yip 1988).

[10] The first C position in the future forms is occupied by a gender-number prefix, which also indicates the future. The forms of the prefix are *y* – 3rd m., *n* – 1st pl., ?(~*y* ~ ∅) – 1st sg., and *t* – elsewhere.

[11] The fact that the B1 and B2 are less productive is probably due to the complex phonology of their inflectional system: they do not preserve their syllabic structure throughout the inflectional paradigm (cf. *gadal* vs. *yigdal*), and B1 also requires some type of lexical specification for the vowel stem in the future form (cf. *yigdal* vs. *yišmor*) due to the historical distinction between transitive and intransitive verbs (Gesenius 1910).

[12] A reviewer noted that the fact that a verb stem in Modern Hebrew must end in a consonant and that there are no long vowels in the language (i.e., the only candidate for the second mora is a consonant), may suggest that the foot is actually iambic, $\sigma[\mu\mu]_\sigma$ (see Inkelas 1990). This conjunction of properties might well be accidental. In Arabic long vowels are admissable, yet a stem must end in a consonant (McCarthy 1993 f.n. 6). Therefore, until further evidence in favor of an iambic foot is brought out, I will maintain the quantity insensitive bisyllabic foot as the template imposed on Modern Hebrew verbs.

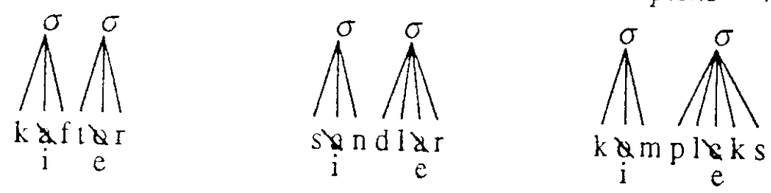
vocalic pattern of the verbal stem. In Anderson's (1992) terms, this process characterizes the relations between the verb and its base. Where the base consists of only one vowel, Melodic Overwriting functions as epenthesis, replacing a vowel in one syllable but adding a vowel in the other.

The ensuing discussion develops details of the analysis with respect to the two types of bases, polysyllabic and monosyllabic, while exploring which representation or principle triggers a particular process.

3.2.1. *Polysyllabic Bases*

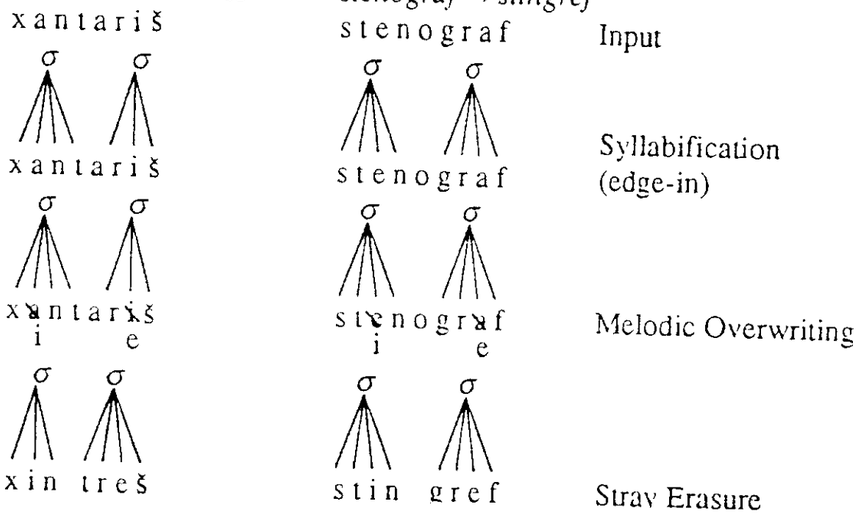
The only process that can be actually observed in derivations from bisyllabic bases is Melodic Overwriting. (I assume vacuous application where the substituting and the substituted vowels are identical).

(11) *kaftor → kifter*, *sandlar → sindler*, *kompleks → kimpleks*



Derivation from trisyllabic bases indicates that syllabification actually takes place and that it proceeds edge-in (Yip 1988). Since there are too many vowels in the base to fit into the two vocalic positions of the bisyllabic template, one vowel is truncated. The fact that the vowel in the middle is truncated suggests that syllabification proceeds edge-in: left to right (right to left) syllabification predicts that the rightmost (leftmost) vowel would be eliminated. Truncation is accomplished by Stray Erasure, which, as shown in Itô (1986, 1989), is a direct consequence of Prosodic Licensing. A sample derivation is given below:

(12)



Note that in the derivation of *xintreš*, Stray Erasure is followed by resyllabification of *t* into the onset to achieve a less marked syllable contact. Notice also that Melodic Overwriting is prosodically dependent since only syllabified vowels are subject to Melodic Overwriting.

The derivation in (12) predicts that only one array of vowel and consonant positions would be possible for each derived verb, the one that appears in the base. It therefore explains, unlike earlier models, why the array of vowel and consonant positions is not identical in all verbs consisting of more than four consonants.

Syllabification is consistent, to a certain degree, with McCarthy and Prince's (1986) Maximization of Association, which requires syllabification of as many segments as possible. In Modern Hebrew, however, all consonants must be syllabified, not just as many as possible, otherwise the derivation is blocked. A base such as *súpermarket* 'supermarket' is unlikely to be used as a source for verb formation, since syllabification of all consonants would result in violation of the Sonority Sequencing Generalization. In order to form a verb from such a base, it is necessary either to delete a consonant as in some broken plurals in Arabic (Hammond 1988) or to add a syllable as in Yawelmani (Archangeli 1991). Neither of these options are likely in Modern Hebrew verb formation, and the derivation is therefore blocked. (See Bat-El 1994) for parameterized principles which account for the available options.)[13] A similar situation is found in Kinande full reduplication where the derivation is blocked when a trisyllabic base cannot fit into a bisyllabic reduplicative affix (Mutaka and Hyman 1990).

Although syllabification proceeds edge-in, if the base ends in an open syllable, the final vowel is ignored.

(13)

Base	Derived verb
cenzúra 'censorship'	cinzer 'to censor'
citáta 'quotation'	citet 'to quote'
torpédo 'torpedo'	tirped 'to damage'
simpáti 'sympathetic'	simpet 'to sympathize'

It seems that the vowel at the edge of a base is ignored to facilitate a derivation which utilizes all the consonants in the base or, as suggested

[13] It is possible, however, to eliminate a glottal stop when there are too many consonants in the base; e.g., *ʔalaxson* 'diagonal' → *lixsen* 'to do something diagonally'. The vowel left at the beginning of the base after the deletion of the glottal stop is treated as being at the edge of the base and therefore ignored in the same way as any vowel at the edge of the base (see below). In *ʔorganizácya* 'organization' → *ʔirgen* 'to organize' it seems that the last three syllables have been eliminated. It is possible that *izacya* has been eliminated because it is identified as a (foreign) suffix.

by one of the reviewers, because it is unstressed. But the fact that in *bama* → *biyem* and *xuga* → *xiyeg* (see section 3.2.2 below) the final vowel is also ignored although it is stressed and there are only two consonants in the base requires a stipulation that the vowel at the edge of the base be extraprosodic. Eventually this vowel is subject to Stray Erasure, as it is prosodically unlicensed.[14]

To summarize thus far, verbal stem formation in Modern Hebrew involves the following procedures:

(14)a. Syllabification (edge-in): Impose a bisyllabic template over the segmental material

b. Melodic Overwriting: Substitute the syllabified vowels with the designated vocalic pattern

c. Stray Erasure: Eliminate unsyllabified segments

3.2.2. *Monosyllabic Bases*

As can be seen from the data below, monosyllabic bases have three possible outputs. The parenthesized numbers on the right side of some verbs indicate (near) minimal pairs.

(15)a. $C_1VC_2(V) \rightarrow C_1VC_2VC_2$

kod 'code'	kided 'to codify'
ʔot 'sign'	ʔotet 'to signal' (1)
xok 'law'	xokek 'to create a law'
xam 'hot'	ximem 'to heat'
cad 'side'	cided 'to side with'
dal 'poor'	dilel 'to dilute' (2)
mar 'bitter'	mirer 'to embitter' (3)
mana 'portion'	minen 'to apportion' (4)

b. $C_1VC_2(V) \rightarrow C_1VyVC_2$

tov 'good'	tiyev 'to improve'
ʔot 'alphabetical symbol'	ʔiyet 'to spell' (1)
xov 'debt'	xiyev 'to debit'
kis 'pocket'	kiyes 'to pickpocket'
sid 'plaster'	siyed 'to plaster'
tik 'file'	tiyek 'to file'
bul 'stamp'	biyel 'to stamp'

[14] In *fantázya* 'fantasy' → *fintez* 'to fantasize' the final vowel is extraprosodic. The glide cannot be syllabified due to the Sonority Sequencing Generalization and thus is deleted by Stray Erasure as any other [-consonantal] segment would be.

kef 'fun'	kiyef 'to have fun'
xuga 'dial'	xiyeg 'to dial'
bama 'stage'	biyem 'to stage' (4)

c. $C_1VC_2(V) \rightarrow C_1VC_2C_1VC_2$

kav 'line'	kivkev 'to draw a dotted line'
dal 'poor'	dildel 'to impoverish (2)
mar 'bitter'	hitmarmer 'to complain' (3)
daf 'page'	difdef 'to turn pages'
mila 'word'	milmel 'to gabble'

The (near) minimal pairs marked above suggest that the selection of the shape of the derived verb is arbitrary (see, however, fn. 16). I claim that the difference between (15c) and (15a and b) is due to competing principles and that the difference between (15a) and (15b) is due to the direction of copying in the reduplication process.

The two competing principles are Maximality and Template Satisfaction.

(16)a. Maximality (Itô 1989)
Units are of maximal size, within the other constraints on their form.

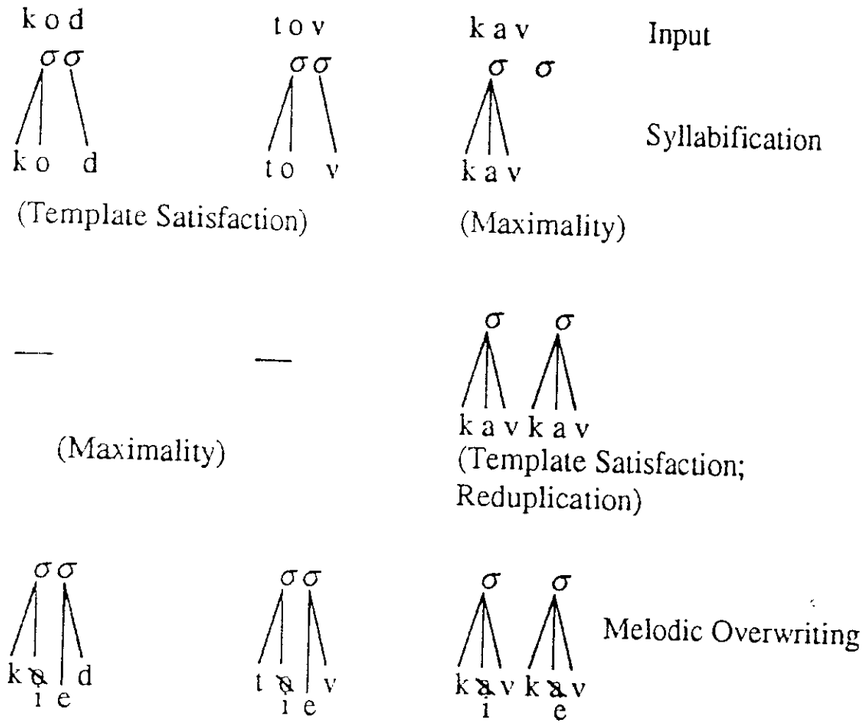
b. Template Satisfaction (McCarthy and Prince 1990)
Satisfaction of templatic constraints is obligatory and is determined by the principles of prosody, both universal and language specific.

The forms that select the shape $C_1VC_2C_1VC_2$ (15c) give priority to Maximality. As illustrated in (17c) below, the maximal CVC syllable is linked to one syllable of the template, leaving the other one empty; $[C_1VC_2\ _\sigma][\ _\sigma]$ (or $[\ _\sigma][C_1VC_2\ _\sigma]$). The empty syllable is then filled by copying the base (reduplication), and the vowels are then substituted by Melodic Overwriting.

The forms that select the shapes $C_1VC_2VC_2$ (15a) and C_1VyVC_2 (15b) give priority to Template Satisfaction, whose interpretation at this stage of the derivation is that both syllables of the template must be linked to at least one segment. Syllabification thus results in $[C_1V\ _\sigma][C_2\ _\sigma]$, where C_2 occupies the coda of the second syllable as expected from edge-in syllabification (17a and b). Derivations like *xok* → *xokek*, where the base vowel fails to be substituted (see section 2.2 above), show that the vowel is indeed linked to the first syllable. Melodic Overwriting then applies, functioning not only as a feature changing rule (substituting the vowel in

the first syllable with *i*) but also as a feature filling rule (inserting *e* to the second syllable).[15]

(17)a. *kod* → *kided* b. *tov* → *tiyev* c. *kav* → *kivkev*

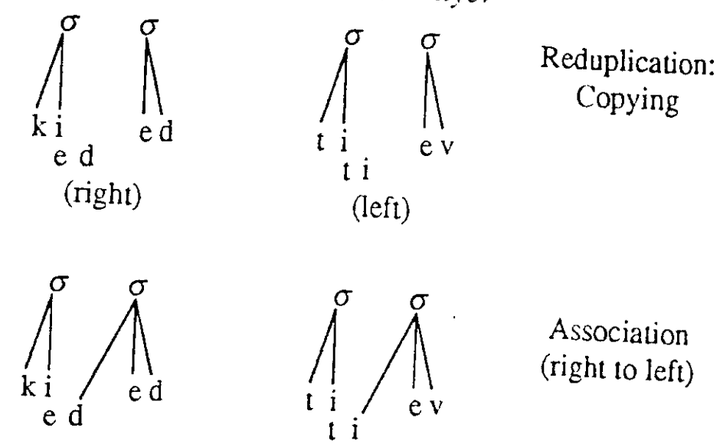


In the outputs in (17a and b) the template is not yet satisfied since the forms violate the Onset Principle (Itô 1989), which does not allow onsetless syllables. The onset is then filled by reduplication, where either the segmental material to the left or to the right of the onset can be copied. These two options yield the two possible outputs in (15a) and (15b). Copying the melody on the right of the empty onset, followed by right to left association, results in linking the rightmost consonant of the base to the onset (18a). Copying the melody on the left of the empty onset, followed by right to left association results in linking the *i* to the

[15] Cf. Kolami echo words (McCarthy and Prince 1990), where *g* is either substituted for the initial consonant (feature changing), or inserted where the base begins with a vowel (feature filling).

onset, which is then interpreted as *y* since it is not in a nuclear position (18b).[16]

(18)a. *kod* → *kided* b. *tov* → *tiyev*



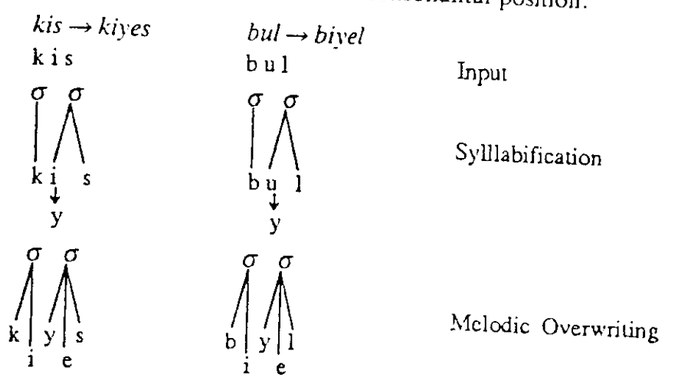
Some of the monosyllabic bases consist of more than two consonants, as can be seen from the data below:

(19)a. **faks** 'facsimile' **fikses** 'to fax'
flirt 'flirt' **flirtet** 'to flirt'
boks 'box (blow)' hit**bokses** 'to box (fight)'

b. **blof** 'bluff' **bilef** 'to bluff'
xrop 'nap' **xarap** 'to take a nap'
truma 'contribution' **taram** 'to contribute'

[16] Bases with a high vowel tend to select the shape C_1VyVC_2 for their derived verb, and this does not seem to be arbitrary. It is possible that the high vowel is linked to the second syllable where it is realized as an onset (assuming that both vowels and glides are specified for the same features). Since there is no back glide in Modern Hebrew, both back and front high vowels become a front glide when in a consonantal position.

(i) *kis* → *kiyes* *bul* → *biyel*

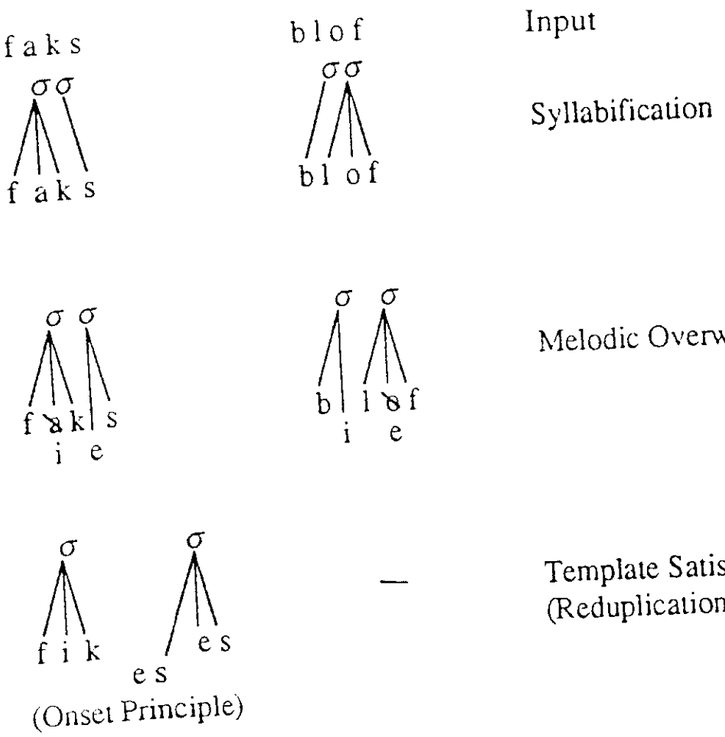


In this case the template is fully satisfied after Melodic Overwriting, and therefore no further processes are invoked.

On the surface it would appear that in this case there are also two possible options since a monosyllabic base with three (or four) consonants may select either a $C_1VC_2C_3VC_3$ shape (19a) or a $C_1VC_2VC_3$ (19b). But if we assume that Maximality (16a) is active at any stage of the derivation (unless overriden by other principles), then the two options are not arbitrarily chosen.

Edge-in syllabification links the two consonants at the edge to the onset and the coda of the first and second syllables of the template, respectively. The medial consonant is linked to a position where a maximal proper syllable, CVC, would result. Thus, in (20a) the medial consonant is linked to the first syllable, while in (20b) to the second. In both cases linking to the other syllable would result in a CC syllable.

(20)a. *faks* → *fikses* b. *blof* → *bilef*



In (20b) the template is satisfied after Melodic Overwriting, and therefore no further processes are invoked. In (20a) the Onset Principle is violated, and therefore reduplication is invoked. Although copying can be either from the left or from the right as in (18), in cases like (20a) only copying from the right surfaces, since copying from the left would result in a geminate, **fikkes*, and tautomorphemic geminates are inadmissible in Modern Hebrew.

While it seems that building a maximal proper syllable is a leading principle at any stage of the derivation, in some cases this principle is ignored: (i) In *fášla* 'failure' → *fišel* 'to fail' (the final vowel is extraprosodic) the medial consonant chooses the onset position of the second syllable, thus yielding [fa][šl] (and not [faš][l] → **fišlel*), where the first syllable is proper but not maximal. (ii) The base *blof* has another, less common, output (in addition to *bilef*), and this is *bilfef*. Here the initial edge-in syllabification results in [bl][of], where both syllables are improper. Melodic Overwriting and reduplication (from the right) then yield *bilfef*. (iii) A similar situation arises with bisyllabic bases. In *ʔišur* 'confirmation' → *ʔišrer* 'to reconfirm' and *caxak* 'to laugh' → *cixkek* 'to giggle' there is an option for the initial syllabification to form two proper syllables, [CV][CVC], but this would yield *ʔišer* 'to confirm' and *cixek* 'to laugh (a more standard form), respectively. In order to derive a different verb from the same base, the initial syllabification allows one improper syllable, yielding [ʔiš][ur] and [cax][ak]. Melodic Overwriting and reduplication (from the right) then derive [ʔiš][rer] and [cix][kek] respectively.

The examples in (19b), and also *fášla* → *fišel* and *blof* → *bilfef*, show that clusters may fail to be transferred when there are not enough vowels in the base to satisfy the bisyllabic template, i.e., when the base is monosyllabic. In this case the two consonants of a cluster may be split by the vowel inserted via Melodic Overwriting. When the base is polysyllabic there is no need to insert vowels: in most cases the base vowels are overwritten and therefore the clusters of the base remain intact.

3.3. *The Fate of the Consonantal Root*

The analysis of Modern Hebrew stem formation presented in this study does not refer to a consonantal root at any stage of its derivation, and therefore holds the view that such a morphological unit does not exist in the grammar.

This view, although on the periphery of traditional thought, is not entirely new. Horvath (1981) points out that cluster transfer poses a theoretical problem. One of her arguments against the existence of consonantal roots is simply that "the notion of a consonantal cluster cannot be maintained at the level of consonantal roots (unless a completely ad hoc device is employed)" (p. 237). A study of the phonological and phonotactic restrictions on consonant co-occurrence in Modern Hebrew (Schwarzwald 1973–74) shows that constraints, which can be interpreted as the Obligatory Contour Principle, hold between consonants which are adjacent on the surface (i.e., when the vocalic pattern is present) and not between root consonants which are never adjacent on the surface.

hitxamma* and **hiʔatda* are thus impossible, and therefore *hitxamema* 'she got warmed up' and *hiʔateda* 'she was intended to' are found instead (cf. *hitkabla* 'she was accepted'). ***mimen* 'to finance' and ***tidlek*** 'to fuel', on the other hand, are well formed, since the identical or homorganic consonants are not adjacent on the surface, though they are adjacent in the consonantal root level. Semantic considerations have led Oman (1971) to the conclusion that the basic semantic unit is the stem, which consists of vowels and consonants, and not the consonantal root.

Nonetheless, the consonants in a Hebrew stem have hitherto been treated as an identifiable unit carrying the basic meaning. The function of other structural properties of the stem is "to modify the meaning of the root" (Blau 1972:13). Berman (1985) indicates that "[T]here is evidence that from around age 4 children do begin to relate to some kind of consonantal 'skeleton' as representing a given core of meaning . . ." In the later preschool years, children manifest this knowledge by extracting the consonantal core of known words to coin innovative verbs and nouns." (p. 350). Berman obviously believes, like many others, that there is such a unit as a consonantal root, and Berman (1990), which is based on the experimental study mentioned in section 2.2, also points out the tendency to create forms with 3 or 4 consonants in the root.

The question is why 3 or 4 consonants and not, say, 2 or 3, or any other reasonable number. The answer arrived at in the present work is that what is crucial is the bisyllabic structure, rather than the consonant count. The unmarked bisyllabic stems are CVCVC, with 3 consonants, and CVCCVC, with 4 consonants (complex onsets or codas are marked). Not only does the approach developed here eliminate the need to stipulate the number of consonants, it also demonstrates that the number of consonants is actually irrelevant. I argue that there is no place for reference to the number of consonants since there is no such unit as a consonantal root whose elements can be counted.

It should be emphasized that the basic assumption of this argument is that forms are not necessarily exhaustively comprised of morphological components. In the spirit of Anderson's (1992) view of Ablaut, the relation between a verb and its base in Modern Hebrew is characterized by a replacement process (Melodic Overwriting). This is rather different from saying that the consonantal root and the vocalic pattern are the realization of some semantic or morphological entities.

The fact that children, as well as adults, manifest the ability to derive forms that have the same consonants as in the base can be accounted for by Stem Modification and therefore does not require the notion of consonantal root. Moreover, since at no stage in the process of Stem Modification is the consonantal root referred to as a unit, there is no reason to believe in the existence of such a unit.

The belief in the consonantal root as the basic unit of meaning is due to the stability of consonants in word formation; most of the morphophonemic alternations are vocalic. The stem consonants cannot be treated as an independent unit carrying meaning since, as in any language, the meaning is associated with the entire stem and not with the consonants. In the course of derivation some of the semantic properties of the base are transferred to the derived form, yet it does not follow that these properties are associated with the transferred consonants. In a chain of derivation such as *ʔamad* 'to stand' → *ʔamuda* 'column' → *ʔimed* 'to paginate', the semantic properties transferred from *ʔamad* to *ʔamud* are not the same as those transferred from *ʔamuda* to *ʔimed*; yet the same set of consonants appears in the two derived forms.

Within the model of Stem Modification it is completely unnecessary to isolate the semantic properties associated with the consonants from those of the base. The process of Stem Modification never requires a consonantal root, and therefore such a unit is not relevant to the grammar; it does not exist.

One of the *NLLT* reviewers noted that in the light of the study presented here, the question that should be raised is whether Modern Hebrew verbal morphology is typologically Semitic. Modern Hebrew verbal morphology is not apparently very different from that of Biblical Hebrew, and if Biblical Hebrew is Semitic, so is Modern Hebrew.[17] It seems that the two languages are very different phonologically, but not morphologically. Biblical Hebrew, unlike Modern Hebrew, does not allow complex onsets and codas, and therefore it cannot provide evidence in favor of Stem Modification.

What is left for future research is the role of the consonantal root in other Semitic languages, in particular Arabic, which provided the original evidence for nonconcatenative structure (McCarthy 1979, 1981). It should be mentioned that McCarthy (1993) claims that verbs in Arabic are derived from one basic stem, that of the first binyan, and not from a consonantal

[17] Wexler (1990) claims that Modern Hebrew is a Slavic language, whereas Biblical Hebrew is Semitic. One of the major weaknesses of his argument is his treatment of the verbal system. He claims that the reduced number of binyanim in Modern Hebrew in comparison to Arabic and the semantic opacity of the binyanim signify a tendency toward Slavic origin. However, he maintains that this reduction existed in Biblical Hebrew, and he acknowledges that Biblical Hebrew is a Semitic language. I believe that Modern Hebrew verbal morphology will cease to be Semitic-like at the moment the role of Melodic Overwriting and the template are reduced (and I do not say that this is unlikely to happen).

root, as claimed in his earlier work. Guerssel and Lowenstamm (1994), whose analysis of Arabic verbs differs from McCarthy's, propose that the base consists of consonants and one vowel, and not just a consonantal root. Similarly, in the analysis of the Arabic broken plurals by McCarthy and Prince (1990), the consonantal root does not have any role in the derivation. It is thus worthwhile to re-examine the arguments in favor of the consonantal root to see whether they can be reinterpreted without assuming the existence of the consonantal root. What seems like spreading across a vowel, for example, could be viewed as copying (see Bat-El 1984), and the cooccurrence restrictions on the consonants (which can be found in non-Semitic languages; see Mester 1988) could be explained within the theory of feature geometry, which allows vowels and consonants to appear on separate phonologically motivated tiers, as in Clements (1985a, 1985b) and subsequent studies.

4. Conclusion

I have proposed in this paper an analysis of Modern Hebrew verb structure that does not rely on the principles of Root-to-Template Association. In particular, it does not admit the morphological and phonological segregation between consonantal roots and vocalic patterns, nor that the prosodic template is specific to each binyan. It is argued that there is no consonantal root in the morphology, that the vocalic pattern is part of a morphological process, and that the template is common to all verbs, regardless of their binyan.

The analysis is based on verbs consisting of more than four consonants, which, although prosodically limited to a bisyllabic template, do not maintain a constant array of consonant and vowel positions. It has been shown that the array of consonant and vowel positions is not determined by the template but rather transfered from the base, where the base consists of a string of vowels and consonants. Stem Modification has been suggested as the appropriate model, as it allows direct access to the base in the course of derivation and therefore, unlike the model of Root-to-Pattern Association, can account for the transfer phenomenon.

All the participating principles and processes of Stem Modification are available within general prosodic theory and are active in languages which are not considered typologically Semitic. This, and the elimination of the consonantal root from the grammar, clearly raises the question whether Modern Hebrew verb morphology is Semitic-like. I have claimed that it is, calling for reconsideration of other Semitic languages. The notion of the Hebrew consonantal root was established during the 10th century.

It is my contention that in the light of recent theoretical developme reconsideration of that unit is certainly opportune.

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