Chapter 2

Semitic verb structure within a universal perspective*

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The distinctive character of a Semitic stem is usually identified by the *root-and-pattern* structure, whereby a stem consists of two interdigitated segmental units, a *consonantal root* and a *vocalic pattern*.[1] Interdigitation is governed by a *prosodic template* which determines the syllabic structure of the stem, i.e. the number of syllables, vowel length, and gemination. The vocalic pattern and the prosodic template together form a *binyan*, which may be accompanied by an affix. This type of word structure appears quite different from the more familiar structure involving morpheme concatenation.

Is Semitic morphology indeed so different? Within this volume, which highlights the distinctive aspects of Semitic morphology, I reconsider this question, claiming that the Semitic stem structure is not so peculiar, at least not to the extent that is usually believed. I will show that phonological phenomena constituting evidence for the consonantal root, the vocalic pattern, and the prosodic template in Semitic languages can also be found in non-Semitic languages. I will argue that the difference between Semitic and non-Semitic languages is not a matter of type but rather a matter of degree and combination. The phenomena characterizing Semitic-type morphology, i.e. those which constitute evidence for the consonantal root, the vocalic pattern, and the prosodic template, can be found in other languages but often to a lesser degree. In addition, while each phenomenon can be found in other languages individually, their combination within the same language is not found outside the Semitic family.

The discussion is divided into two parts, one concerned with the consonantal root (Section 1) and the other with the binyan (Section 2). Section 1.1 offers a brief review of McCarthy's (1981) structural interpretation of the classical view of the Semitic stem, based primarily on root cooccurrence restrictions. Cooccurrence restrictions in other languages are presented in 1.2 as evidence that in this respect Semitic languages are not unique. Section 1.3 discusses a universal approach to cooccurrence restrictions within the theoretical guidelines of Feature Geometry. Section 2.1 presents the phonological properties identifying a verb in Modern Hebrew, which include the vocalic pattern, the prosodic structure, and prefixes.

Section 2.2 shows that these properties can also be found in non-Semitic languages. Section 2.3 proposes an account of structural relations within the verb system that does not appeal to a consonantal root. Section 3 concludes that Semitic stem structure is not unique, but also details what does characterize Semitic morphology.

1. Cooccurrence restrictions

"[T]he basic unit of morphological analysis is the root (÷*asÚl* 'root'), a consonantal skeleton" says Owen (1997:46) in his review of the Arabic grammatical tradition. A similar view is presented in Goldenberg (1994), who claims that the root should "be conceived as the primary lexical representative in a paradigm" (p.30). Owen and Goldenberg express the widely-held view among Semiticists as well as general linguists (see review and references in Goldenberg 1994). One of the supporting arguments for the existence of the consonantal root as an independent morphological unit is based, in McCarthy (1981), on the cooccurrence restrictions on consonants within a Semitic stem. This section challenges this approach.

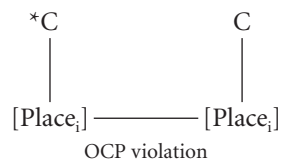
1.1 Evidence for the consonantal root

Greenberg (1950) conducted a survey of 3,775 tri-consonantal roots in Arabic and arrived at the following cooccurrence restrictions (the restriction regarding C_1 and C_3 will be mentioned in 1.2):[2]

(1) a. C_1 & C_2: The first two consonants in a root cannot be identical nor homorganic (i.e. roots such as *m.m.t* and *t.d.k* are impossible).
b. C_2 & C_3: The last two consonants in a root can be identical but not homorganic (i.e. roots such as *t.k.k* are possible, but roots such as *t.k.g* are not).

McCarthy (1981) attributes the restriction in (1a) to the Obligatory Contour Principle (OCP), a constraint which prohibits identical adjacent phonological elements.[3] Assuming that segments are composed of hierarchically organized features (see (6) below) where features of place of articulation form an independent constituent, the OCP can be viewed as referring to the place constituent. Identical as well as homorganic consonants have identical place of articulation and are therefore excluded by the OCP.

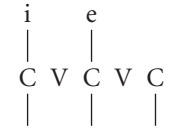
(2)



The definition of the OCP includes two arguments, identity and adjacency; the latter is most relevant for the present discussion. In a common Semitic stem such as CVCVC consonants are usually not adjacent (although in Hebrew, for example, C_1 and C_2 are adjacent in binyan hifʿil, as in *higdil* 'to enlarge', and C_2 and C_3 are adjacent when the stem-final vowel is deleted due to the addition of a vowel-initial suffix, as in *gadal-a* > *gadla* 'she grew'). The fact that surface non-adjacent consonants seem to be controlled by the OCP may constitute an argument that they are adjacent at some level in the grammar. This is the level where the consonants of the stem form an independent unit, known as the consonantal root. Therefore the cooccurrence restriction in (1a) provides an argument for the independent existence of a consonantal root in Semitic languages.

The non-linear representation in (3) below reflects, in phonological terms, the morphological independence of the consonantal root, as well as of the vocalic pattern. In such representation, first proposed in McCarthy (1979), the vocalic pattern and the consonantal root appear on distinct tiers. The segmental units are linked to a prosodic template expressed here in terms of CV-slots. A subsequent process, termed Tier Conflation in McCarthy (1986), folds the two tiers into one linear segmental tier where vowels and consonants are linearly ordered.

(3)



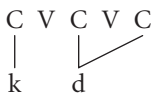
(*gidel* 'to raise' in Modern Hebrew)

This non-linear representation reflects the well-known morphological distinction between the consonantal root and the vocalic pattern. This representation without the consonants *g.d.l* is actually a non-linear representation of the traditional binyan, which includes positions for vowels and consonants as well as the vocalic pattern (often given as ʔ aʔ aʔ in grammar books).

Since the OCP excludes identical adjacent consonants at the left edge of the root (1a), it is expected to do so at the right edge of the root as well. This is, however, not the case. According to the cooccurrence restriction in (1b) identical but not homorganic consonants can appear at the right edge of the root. To account for this discrepancy McCarthy makes the following assumptions: (i) a $C_1C_2C_2$ root, where the last two consonants are identical, is underlyingly a C_1C_2 root; (ii) association of the root consonants with the prosodic template proceeds from left-to-right. When the root does not have enough consonants to fill all the C-slots in the template, the rightmost consonant spreads to the empty C-slot, as in (4a) (spreading is indicated by a broken line). Since association goes from left-to-right it would always be the last C-slot that remains empty, therefore (4b) is ill-formed (as indicated by the asterisk). Since association lines must not cross it

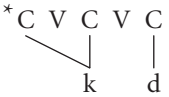
would always be the rightmost root consonant that spreads to the empty C-slot, therefore (4c) is ill-formed.

(4) a. Left-to-right association and speading



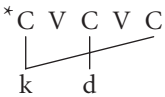
kdd

b. Violation of left-to-right association



**kdd*

c. Violation of prohibition on crossing association lines

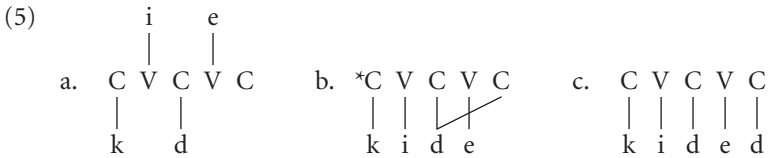


**kdk*

Notice that the representation in (4a) respects the OCP since what on the surface appear as two identical segments (e.g. two *d*s in *kided*) are at this stage one segment only (*d*).

A structure such as in (4a) is possible only if we assume a non-linear representation where vowels and consonants do not interact, i.e. they are located on distinct tiers (5a). A linear representation where vowels and consonants interact and in which one consonantal element is linked to two C-slots is inadmissible since it violates the representational constraint prohibiting the crossing of association lines (5b). A linear representation with two identical elements is well-formed but it does not give rise to the OCP since the two identical elements are not adjacent (5c). Within the spreading view of consonant doubling the latter representation cannot explain why two identical (or homorganic) consonants are not allowed in stem-initial position.

(5)



The OCP thus accounts for the cooccurrence restrictions on surface non-adjacent consonants in a Semitic stem. Since the OCP requires adjacency, its effect can arise only within a non-linear representation where vowels and consonants appear

on distinct tiers. This representation supports the view that vowels and consonants are distinct morphological units, where tier segregation is actually the nonconcatenative version of the morpheme boundary.

1.2 Cooccurrence restrictions in non-Semitic languages

Cooccurrence restrictions are one of the prominent issues in current phonological research and numerous examples of such restrictions are found in a variety of languages. Cooccurrences restrictions on vowels are well attested in languages which exhibit vowel harmony. Turkish, for example, requires vowels in suffixes to agree in terms of the feature [back] with the preceding, but not necessarily adjacent vowel (Lees 1961). For example, *ip-**i**n* 'rope Genitive', *el-**i**n* 'hand Genitive', *pul-**u**n* 'stamp Genitive', *son-**u**n* 'end Genitive'.

In Chumash, a Native American language of California, coronal sibilants agree in anteriority with the rightmost sibilant within a word (see Shaw 1991 and references therein). For example, *k-**s** **s**unon-u**s*** 'I obey him'–*k-ʃunon-ʃ* 'I am obedient', *uʃla* 'with the hand'–*usla-**s**iq* 'to press firmly by hand', *uqsti* 'of throwing'–*ʃ-uxʃti-ʃ* 'throw over to'. Notice that in Chumash neither intervening vowels nor intervening consonants block spreading. Analyses of Chumash sibilant harmony attribute this cooccurrence restriction to an OCP effect on coronal sibilants which forces spreading of the feature [anterior].

Cooccurrence restrictions involving labial segments can be found in Tashlhiyt Berber, an Afroasiatic language spoken in Morocco, where a labial nasal prefix becomes coronal when the stem contains a labial consonant (see Elmedlaoui 1995 and references therein). Compare, for example, ***m**-xazar* 'scowl Reciprocal' vs. ***n**-xalaf* 'place crosswise Reciprocal' and *a**m**-las* 'sharer' vs. *a**n**-lr**m**l* 'tired person' (a similar case can be found in Palauan; Josephs 1975). The alternation in the prefix reflects a more general restriction in the language which prohibits two labials within a derived form. Notice again that the two labials need not be adjacent, and the intervening segments can be vowels as well as consonants (see Selkirk 1993 for an analysis of such phenomena).

The cases above exhibit cooccurrence restrictions within morphologically complex words. Cooccurrence restrictions within a simple stem, as in Semitic languages, are also attested. Padgett (1991) has shown that Russian does not allow identical or homorganic consonants in monosyllabic roots of the form C(L)V(L)C (where L is a liquid and C is a consonant). That is, while *greb-* 'dig', *koz-* 'goat' and *tolk-* 'explain' are possible stems, **greg-*, **gok-*, and **told-* are not. Padgett's account for this restriction relies primarily on the OCP, as does McCarthy's for Semitic cooccurrence restrictions.

A blocking effect of the OCP can be seen in the Yamato stock of Japanese, where a restriction known as Lyman's Law prohibits the cooccurrence of two

voiced obstruents within a stem. This restriction blocks the application of Rendaku, which voices the initial obstruent in the second element of a compound (Lyman 1894 and McCawley 1968; see also Itô and Mester 1986 for an analysis within a more recent phonological framework). Rendaku freely applies in *ori **k**ami* → *ori **g**ami* 'folding paper', *yama **t**era* → *yama **d**era* 'mountain temple', and *onna **k**okoro* → *onna **g**okoro* 'feminine feelings'. However, when the second element in the compound contains a voiced obstruent anywhere in the stem Rendaku is blocked, as in *kami **k**aze* 'divine wind' (**kami **g**aze*), *onna **k**otoba* 'feminine speech' (**onna **g**otoba*), and *doku **t**okage* 'poisonous lizard' (**doku **d**okage*). Notice that the two relevant obstruents are not adjacent, and there is no reason to assume that they are adjacent at some earlier stage in the derivation. Regardless of adjacency, the restriction against voicing identity holds in Yamato Japanese as much as the restriction against place identity in Semitic languages.

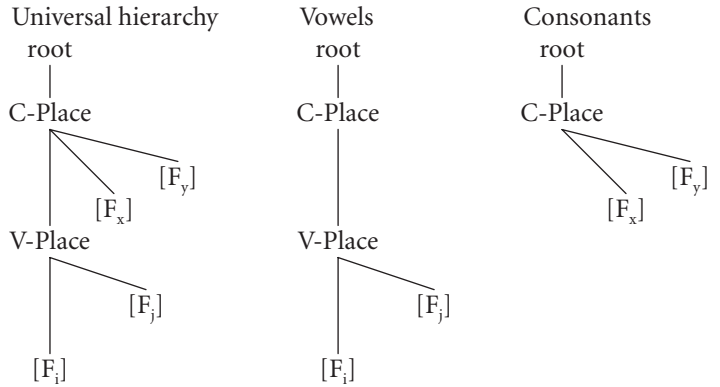
A restriction known as Grassman's Law (found in Indo-European languages), prohibits two aspirated segments within a simple stem. The synchronic reflection of Grassman's Law in Attic is the deaspiration of the first of two (not necessarily adjacent) aspirated segments within a simple stem (Steriade 1982), as in *t^{h}ak^h-us* → *tak^{h}us* 'fast' and *t^{h}rep^h-ō* → *trephō* 'to feed'. In related words where the second aspirated consonant loses its aspiration due to an independent rule, aspiration in the first consonant is preserved; cf. *tak^{h}us* 'fast' vs. *t^{h}attōn* (from *t^{h}ak^h-yōn*) 'faster' and *trephō* 'to feed' vs. *tet^{h}rammai* (from *te-t^{h}rap^h-mai*) 'I have fed'. Notice that the cooccurrence restriction on aspirated segments holds only within a simple stem; two aspirated consonants across morphemes, as in *p^{h}aethō* (from *p^{h}ae-t^h-ō*) 'to shine' and *grap^{h}et^{h}i* (from *grap^{h}e-t^{h}i*)' to be written', are permissible, as much as the two *m*s in the Hebrew word *me-maher* 'he is rushing' are not excluded. The prohibition against two aspirated consonants within a simple stem (but not across morphemes) is also found in Emakhuwa, a Bantu language spoken in Mozambique (Charles Kisseberth p.c.).

The examples above reveal that cooccurrence restrictions on surface non-adjacent segments are not specific to Semitic languages. An analysis of cooccurrence restrictions should thus account for all the attested instances, regardless of the language where such a phenomenon is found or its prominence within a particular language.[4] The prominence of a phenomenon within a language is irrelevant as long as the phenomenon reflects knowledge of native speakers (i.e. the forms which exhibit the phenomenon are not listed and learnt individually). Any analysis which attributes the cooccurrence restrictions in Semitic languages to the morphological independence of the consonantal root fails to account for cooccurrence restrictions in non-Semitic languages. Such a language-(family) specific account is theoretically erroneous because it is blind to the similarity between languages and thus misses the universal aspect of grammar.

1.3 Adjacency without morphological segregation: feature geometry

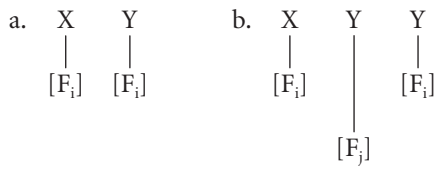
The theory of Feature Geometry represents segments as hierarchically organized sets of features (as opposed to earlier theories, where features are grouped into bundles), and thus allows for adjacency between surface non-adjacent segments. Most versions of the feature hierarchy encode the distinction between vowels and consonants by devoting to each a distinct type of constituent. Each segment thus forms a subset of a universal hierarchy.[5]

(6)



The hierarchical representation of features recognizes constituency, dominance, and independence. Distinct features or nodes appear on independent tiers and are thus not adjacent. Adjacency between two identical features (or nodes) is obtained when the two are dominated by adjacent segments as in (7a) below. More crucial is that adjacency can also be obtained when the identical features (or nodes) are not dominated by adjacent segments. In (7b) below $[F_i]$ dominated by X is adjacent to $[F_i]$ dominated by Z, even though there is an intervening Y between X and Z; Y in (7b) does not impede the adjacency of the two $[F_i]$ features because it does not dominate $[F_i]$.

(7)

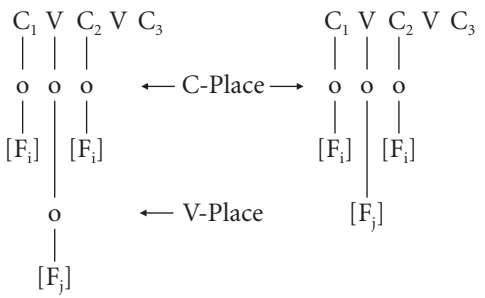


As argued in Bat-El (1989), the representational enrichment provided by the theory of Feature Geometry removes the necessity to isolate a consonantal root in order to account for the cooccurrence restrictions on consonants within a Semitic stem. Cooccurrence restrictions in a Semitic stem can be accounted for within the

same theoretical framework as cooccurrence restrictions in non-Semitic stems.

In a stem such as $C_1VC_2VC_3$ the place features of C_1 and C_2 are adjacent since the place features of the intervening vowel are on a different tier. Thus, the OCP rules out a stem where the place features of C_1 and C_2 are identical (8a). As Greenberg (1950) further observes, C_1 and C_3 are rarely identical or homorganic. Given the feature representation sketched above, where every place feature is on a different tier, the identical place features of C_1 and C_3 are adjacent when C_2 has a distinct place feature (8b). Following (1a), represented in (8a) below, the features of C_1 and C_2 are distinct and thus allowing adjacency between C_1 and C_3.[6]

(8) a. C_1 & C_2 (*k VkVC) b. C_1 & C_3 (*k VbVC)



It should be noted, however, that this account fails to explain why violations of the cooccurrence restrictions are found in C_1 and C_3 more often than in C_1 and C_2 (see Frisch *et al.* 1997 for an alternative account).[7]

It thus appears that the phonological tier segregation offered by the feature hierarchy renders redundant the morphological tier segregation specific for Semitic languages. That is, it is not necessary to assume that vowels and consonants appear on distinct tiers because they belong to distinct morphemes. Therefore the cooccurrence restrictions on consonants within a Semitic stem are no longer an argument for the existence of the consonantal root. As evidenced by a large number of linguistic studies, the theory of Feature Geometry accounts for many phonological phenomena in natural languages, including the various types of cooccurrence restrictions. The inclusion of the cooccurrence restrictions found in Semitic languages within the general account is thus not surprising as long as we are not biased towards the peculiarity of Semitic stem structure.

The account given above predicts that the OCP would also rule out stems where C_2 and C_3 are identical or homorganic. This is, however, only partially correct. According to the restriction in (1b) C_2 and C_3 cannot be homorganic but they are very often identical. This exception to the general prohibition against identical consonants in a stem must be explained.

With McCarthy (1981) I assume that stems with identical C_2 and C_3 are cases of consonant doubling, hereafter reduplication (which should not be confused with reduplication involving the addition of a prosodic affix). Taking Modern Hebrew as an example we see that there are quite a few reduplicated words which have a related unreduplicated form. For example, *ḥagag* 'to celebrate'–*ḥag* 'holiday', *ṣided* 'to side with'–*ṣad* 'side', *šadad* 'to rob'–*šod* 'robbery', *dagig* 'little fish'–*dag* 'fish', *'išrer*–'to reconfirm'–*'išer* 'to confirm', and *katnuni* 'petty'–*katan* 'small'. A relatively large number of such structural and semantic relations in the language allow the native speaker to construct a grammar of reduplication. This grammar may expand to forms which look reduplicated but do not have an obvious unreduplicated related word. For example, *xilel* 'to play the flute' is related to *xalil* 'flute', but it has no related word with only one occurrence of *l*. There are also a few reduplicated forms which lack a related unreduplicated counterpart but have a related fully reduplicated form (e.g. *clil* 'sound'–*cilcel* 'to ring', *blil* 'mixture'–*bilbel* 'to confuse').

As noted in 1.1, McCarthy (1981) accounts for $C_1VC_2VC_2$ stems by spreading. Within the view advocated here, where vowels and consonants are not morphologically separated, spreading is unattainable. In order to permit reduplication of the entire segment it is necessary to spread the root node, which dominates all features associated with that segment. However, as can be seen from (9) below, spreading of the root node would violate the prohibition against crossing association lines since the intervening vowel also has a root node.

(9) a. * C V C V C
o o ← root node

Thus I claim that reduplication is not manifested by spreading but rather by copying. This view has been put forward in Bat-El (1984, 1989) within a root-based approach and later in Bat-El (1994a) and Gafos (1998) within a stem-based approach.

If reduplication is copying then stems with identical C_2 and C_3 violate the OCP as much as stems with identical C_1 and C_2. As claimed in Everett and Berent (1997), this is indeed the case. Surface violation of grammatical constraints in natural languages cannot be ignored, and the recently developed grammatical theory known as Optimality Theory has the formal tools to account for constraint violation in a systematic way.[8] According to Optimality Theory universal constraints are ranked on a language specific basis, and competition between two constraints with respect to one or more output forms enforces the violation of the lower-ranked constraint. For example, when the input is CCVC there is a competition between faithfulness constraints which require input-output identity and a constraint which prohibits a complex onset. In languages where the constraint

against complex onset outranks the faithfulness constraints the output would be CVCVC (or VCCVC or less likely CVC), depending on the particular faithfulness constraint and the interaction with other constraints. In languages where faithfulness outranks the constraint against complex onset the output would be identical to the input, i.e. CCVC. That is, the higher-ranked constraint forces the violation of the competing lower-ranked constraint. The question is then which constraints enforce OCP violation in Semitic reduplication?

It must be assumed that there is an anti-insertion faithfulness constraint which prohibits addition of a new consonant. This constraint disfavors relating a C_1VC_2 stem to a $C_1VC_2VC_3$ or $C_1VC_3VC_2$ stem, where C_3 is a non-affixal consonant; i.e. *kod* 'code' cannot be related to **kidel* or **kiled*, although neither of them violate the OCP.[9] There is also a prosodic markedness (surface structure) constraint which requires a minimum of two syllables in a word (see Section 2.1 for the notion of 'minimal word'). This constraint blocks relating $C_1V_iC_2$ to $C_1V_jC_2$, so that the noun *kod* 'code', for example, cannot have a related verb **kad*. These two constraints outrank the OCP and so force its violation. Therefore the forms that violated these two constraints (**kidel* and **kad*) are ruled out, leaving the form that violates the OCP (*kided*) to survive as the surface form.

The above discussion accounts for OCP violation in reduplicated forms, but it does not explain why the OCP can be violated only at the right edge of the stem, i.e. why reduplication always occurs at the end of the stem. Gafos (1998) as well as Everett and Berent (1997) account for the preferred right-edge reduplication by positing constraints which refer to the copied consonant. I believe, on the basis of word recognition models, that the cardinal element is the base rather than the copied material. The constraint which rescues the left edge of the stem from OCP violation is one which requires alignment of the base with the left edge of the output. It is often the case that the base stem can be identified within a reduplicated form (regardless of whether one or more of its segments, especially the vowels, have been altered). In $[C_1VC_2]VC_2$ the base stem (enclosed in brackets) is aligned with the left edge of the reduplicated form, and in $C_1V[C_1VC_2]$ it is aligned with the right edge. In order to account for the fact that the latter form is ruled out in Semitic reduplication, an alignment constraint must be assumed. This constraint enforces a left-alignment of the base within the reduplicated output (i.e. the left edge of the base aligns with the left edge of the reduplicated form). Left-alignment of the stem is compatible with the cohort model of word recognition proposed by Marslen-Wilson and colleagues (see Marslen-Wilson 1987 and references therein). According to this model, the lexicon is activated by the first (i.e. the leftmost) one or two phonemes in the input word and proceeds from there until only one candidate consistent with the input remains. Left-alignment thus allows a faster processing of the reduplicated form in association with its unreduplicated counterpart.

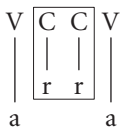
The highly-ranked left-alignment constraint ensures the absence of redupli-

cated $C_1VC_1VC_2$ forms. However, as pointed out in Schwarzwald (1974), Bat-El (1989), and Goldenberg (1994), among others, there are several consonantal roots in Modern Hebrew whose first and second consonants are identical (e.g. *mimeš* 'to materialize' and *sisgen* 'to variegate') or homorganic (e.g. *tidlek* 'to refuel'). Broselow (1984) raises the same point with regard to Amharic, which according to Mantel-Niecko (1964) has nineteen verbs where C_1 and C_2 are identical.

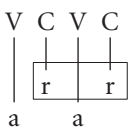
With Everett and Berent (1997) I claim that forms with identical C_1 and C_2 are not reduplicated; they arise due to various historical and synchronic effects, and they lack a counterpart with a single appearance of the consonant.[10] Hence, while many $C_1VC_2VC_2$ stems are related to C_1VC_2 stems, $C_1VC_1VC_2$ stems do not have a related C_1VC_2 stem. If a $C_1VC_1VC_2$ stem has a related stem, the latter must also be a $C_1VC_1VC_2$ stem, as in *mimen* 'to finance'–*mamon* 'money' and *sisgen* 'to variegate'–*sasgoni* 'variegated'. In such cases the constraint forcing left-alignment is not violated, but the OCP is. Violation of the OCP in this case is forced by an anti-deletion faithfulness constraint requiring to preserve all the consonants of the related stem (see Bat-El 1995). The anti-deletion and anti-insertion constraints reflect the segmental faithfulness between related forms. Segmental faithfulness ensures semantic transparency between related words, a view supported by Raffelsiefen's (1993) argument that semantic stability is contingent upon phonological transparency.

While Modern Hebrew exhibits long-distance OCP violation (i.e. across one or more segments), there are no local OCP violations in natural speech. Schwarzwald (1974) and Bat-El (1989) point out that Modern Hebrew does not allow surface adjacent identical or homorganic consonants, as evidenced by the *e* between the identical consonants in *garera* 'she dragged' (cf. *gadla* 'she grew') and between the homorganic consonants in *tedirut* 'frequency' (cf. *txifut* 'frequency'). Similar examples can be drawn from truncated imperatives (Bolozky 1979; Bat-El 2001), where from *tesaper* 'you will tell' we get tsaper 'tell!' but from *teta'er* 'you will discribe' we get *ta'er* 'describe!' (**tta'er*). The OCP in Modern Hebrew thus makes direct reference to local adjacency, which is a subcase of general adjacency. As shown in (10) below, while in general adjacency reference is made to one tier only, in local adjacency two consecutive tiers (which form a plane) must be adjacent (the tier distinction between the vowels and consonants in (10) is phonologically motivated by the feature hierarchy and should not be taken as the morphologically motivated tier segregation advocated in McCarthy 1981).

(10) Local adjacency



General adjacency



Therefore we must assume two OCP constraints, one general and the other local (see Everett and Berent 1997). In order for a specific constraint to have an affect it must outrank the more general one (Pāṇini's theorem, the elsewhere condition), as is the case here, where Local-OCP outranks General-OCP. Local-OCP is never violated, and is thus assumed to be undominated by any other constraint in the language.[11]

The General-OCP is lower ranked as evidenced by the violations enforced by other constraints, in particular the faithfulness constraints which prohibit deletion or insertion of a consonant. The consequence of this ranking, as pointed out by Charles Kisseberth (p.c.), is that the general OCP has no effect. Within the framework of Optimality Theory there are no constraints on underlying representations, and therefore an input with two identical or homorganic consonants such as *mimen* or *tidlek* cannot be ruled out by the OCP. The general OCP functions in Semitic languages as a systematic control on contrast in the stem inventory; a language does not need all the stems resulting from all the possible combinations of the segments available to it. Languages tend to reduce contrast in a systematic way, as shown by cases of positional neutralization. Steriade (1995) in her discussion on positional neutralization shows that various languages tend to eliminate contrast in certain positions. For example, Chumash (a Native American language of California) uses only three of its six vowels in affixes, Bashkir (Turkic) permits round vowels in initial position only, and Maidu (another Native American language of California) allows laryngeally-specified consonants (i.e. ejectives and implosives) only in syllable onsets.

To conclude, it has been argued that within the theory of Feature Geometry which provides a phonological segregation between vowels and consonants, the morphological segregation imposed on Semitic stems is redundant. Surface violation of the OCP, exhibited by Modern Hebrew and other Semitic languages, can be well accounted for within the framework of Optimality Theory. Within such approach there is no place for the consonantal root.

While reference to the consonantal root as a morphological unit is widely accepted, there are opponents of this approach. The most well-known critical view is expressed by Brockelmann (1908) who claims, according to Troupeau (1984), that the root is nothing but an abstraction that has the benefit of making the ordering of vocabulary easier. In Brockelmann's view, the concept of root is unserviceable for morphology, which should start off with forms of words that had, or still have their own existence. Lipiński (1997:202) claims that "the morphological analysis of basic Semitic words and forms . . . reveal a relative stability of radical vowels, which should therefore be regarded as forming part of the root. . . . Semitic roots are continuous morphemes . . . subject to vocalic and consonantal change. . .". Owen's (1997) view that early Arab grammarians such as Sîbawayhi (d. 794) and al-Khalîl (d. 792)referred to a consonantal root suffers

from misinterpretation of their writings. They used the word *'aṣl* not with reference to a root but rather to a 'base' or 'foundation', which for them meant the original state of a word, prior to the phonetic and morphological changes that it may undergo (Troupeau 1984). Although arguments against the consonantal root are rarely made explicit (see, however, Heath 1987; Bat-El 1994a; Ussishkin to appear) several proponents of the root seem to ignore it in their formal analyses of Semitic word structure (see a review in Ephratt 1997). McCarthy and Prince (1990:219) claim that Arabic broken plurals "cannot be obtained with the ordinary resources of root-and-pattern morphology. The category root is also morphologically inappropriate as the basis of broken-plural formation, since some derivational affixes are transferred intact". Guerssel and Lowenstamm (1993), like Lipiński (1997), assume bases with consonants and one vowel in their analysis of Semitic apophony (ablaut; see Dor 1995 for a similar view). To conclude, the consonantal root is a traditional notion; tradition should be respected by all means, but not at the cost of masking scientific inquiry.

2. The binyan

From a phonological perspective, the binyan determines the phonological shape of the verb, i.e. its vowels and prosodic structure. As pointed out in Bat-El (1989) and Aronoff (1994), recognition of a binyan in a verb is essential for inflection; a verb that does not conform to one of the existing binyanim cannot be properly conjugated and thus cannot enter the verbal system. Therefore, "every new verb entering the language must conform to one of the existing vocalic patterns" (Bat-El 1989:16).

A Semitic binyan has two obligatory phonological properties, one segmental and another prosodic. The segmental property is the vocalic pattern, which provides information regarding the quality of the vowels in the verb stem. The prosodic structure assigns the verb its syllabic structure. In addition, some of the binyanim are characterized by an affix.

With McCarthy (1981) I view each structural property of the binyan as a separate entity, which can be captured in terms of constraints on surface representation; this view is justified in 2.1. A prosodic assignment in a non-Semitic languages is presented in 2.2, and an assignment of a vocalic pattern in non-Semitic languages is given in 2.3. Section 2.4 outlines a unified theoretical analysis of Semitic stem structure which eliminates all structural peculiarities of Semitic languages and thus reduces the distinctive characteristics of Semitic languages to natural differences among languages. The discussion centers around Modern Hebrew verb structure but the arguments should be viewed as referring to Semitic languages in general.

2.1 The phonological properties of a binyan

Given the great semantic idiosyncrasy of verbs, I assume that all verbs in Modern Hebrew are lexically listed (other Semitic languages suffer from a similar idiosyncrasy). However, not every phonologically well-formed sequence of segments constitutes a well-formed verb (only non-defective verbs are considered here). For example, (i) there is no verb with four syllables (suffixes excluded), (ii) there is no verb whose vowels are {u. e}, and (iii) there is no verb with a prefix whose vowels are {a. a}. These facts illustrate that the phonological shape of a verb is restricted by (i) a prosodic structure, (ii) a vocalic pattern, and (iii) the conjunction of a vocalic pattern with a prefix. These restrictions collectively form a binyan, which can be defined as a set of phonological constraints which delimit the shape of a verb. The following discussion elaborates on what constitutes knowledge of a binyan and its inflectional relations.

Below is the phonological shape of the five binyanim in Modern Hebrew in their past tense and future tense forms. I assume that the vocalic pattern (in bold) consists of two vowels and the stem is thus disyllabic (a dot indicates a syllable boundary). Prefixes identifying the binyan are overtly specified and the Future tense prefixes are indicated by F. Prefix consonants occupy in some cases the onset position of the first syllable of the stem (as in B3), and in others they form an independent syllable (as in B5).

(11)

	Binyan	*Past*	*Future*
B1:	pa^{c}al	C**a**.C**a**C	F**i**C.C**o**/**a**C
B2:	nif^{c}al	n**i**C.C**a**C	F**i**.C**a**.C**e**C
B3:	hif^{c}il	h**i**C.C**i**C	F**a**C.C**i**C
B4:	pi^{c}el	C**i**(C).C**e**C	F**e**.C**a**(C).C**e**C
B5:	hitpa^{c}el	hit.C**a**(C).C**e**C	Fit.C**a**(C).C**e**C

Following (11) above, the generalizations regarding the phonological shape of Modern Hebrew verbs are as follows:

(12) a. Prosodic Restrictions (see Bat-El 1989):[12]
   i. All verb stems are disyllabic;
   ii. A stem final syllable must have a coda (i.e. *gidel* is better than **gidle*; see McCarthy 1993 and Bat-El 1994b);

   b. Vocalic Patterns:
   A verb stem consists of one of the following vocalic patterns:
   {a. a}, {i. a}, {i. i}, {i. e}, {a. e}, {i. o}, {a. i}.

   c. Prefixes and their dependence on the vocalic patterns:
   i. A prefix identifies some verbs in the Past:
   n appears in a stem with a vocalic pattern {i. a}
   h appears in a stem with a vocalic pattern {i. i}

h and *t* (where *h* precedes *t*) appear in a stem with a vocalic pattern {a. e}.

ii. A prefix identifies all verbs in the Future:
' 1st pr. sg.; *n*: 1st pr. pl.; *y*: 3rd pr. sg. and pl.; *t*: elsewhere.[13]

iii. A prefix forms a separate syllable when the vocalic pattern is {a. e}; otherwise it occupies the first onset of the stem.

iv. When the prefix occupies a separate syllable, it is followed by *i* when the syllable is closed (B5) and by *e* when it is open (B4); the prefix of B2 exceptionally takes *i* in an open syllable.[14]

I view the properties in (12) as restrictions on the shape of the verb, where a verb is fully listed in the lexicon. These restrictions allow us to identify a form as verbal as well as to form new verbs. They also allow distinguishing between the binyanim, which are argued to be specified for semantic features (see the semantic system of the binyanim proposed in Doron 1999).

Other structural constraints are drawn from universal grammar. In particular, priority is given to unmarked syllables (see Clements and Keyser 1983 for universal syllable markedness), and therefore *gidel* is better than **gdiel*, since in the latter the first syllable (*gdi*) has a complex onset and the second one (*el*) is onsetless. Marked syllables with complex onsets or codas can be found in denominative verbs derived from nouns with more than four consonants; since a verb consists of two syllables (12a–i), it can host, without complex onset or coda, a maximum of four consonants. The marked syllables with complex margins are enforced by the anti-deletion faithfulness constraint mentioned in 1.3 above which does not allow consonants to be deleted in the course of word formation.

Further knowledge is required to express inflectional relations within the verb paradigm, as summarized in (13).

(13)

	B1	B2	B3	B4	B5
Past		n	h		h, t
	{a. a}	{i. a}	{i. i}	{i. e}	{a. e}
Inflectional relations	↕	↕	↕	↕	↕
	{i. a/o}	{a. e}	{a. i}	{a. e}	{a. e}
Future	F	F	F	F	F, t

Inflectional relations can be expressed by the schema $[X]_{Future} \leftrightarrow [Y]_{Past}$. This schema states that 'the Future form of a verb with the phonological shape X has a Past form with the phonological shape Y, and vice versa'. For reasons of brevity only one direction of relation is considered here, $[X]_{Future} \rightarrow [Y]_{Past}$. I do not make any assumptions regarding the input (see Horvath 1981), I merely view the inflectional paradigm as relations between surface forms.

Structural relations within the inflectional paradigm (suffixes are ignored) are

usually expressed by affixation and apophony (ablaut), where apophony serves to arrive at a well-formed vocalic pattern. As indicated in (14) below, in B3, B4, and B5 the phonological shape of the Past form is minimally but still sufficiently different from that of the Future. The relations are expressed by the following permutations:

(14) a. B5: } Prefix: *h*
[yitCa(C)CeC]$_{\text{Future}}$ → [**hit**Ca(C)CeC]$_{\text{Past}}$

b. B3: } Apophony: *a* > *i*
[yaCCiC]$_{\text{Future}}$ → [**hi**(C)CiC]$_{\text{Past}}$

c. B4:
[yeCa(C)CeC]$_{\text{Future}}$ → [**Ci**(C)CeC]$_{\text{Past}}$

In B5 there is only prefixation, and in B4 only apophony. B3 involves both prefixation and apophony. Notice that the Future prefixes, recognized by speakers as limited to the Future tense, are eliminated in the Past. When the Past has a prefix, it takes the position of the Future prefix (B3 and B5); otherwise the Future prefix is ignored.

The phonological simplicity of the inflectional relations within these binyanim, in particular the absence of alternation in the prosodic structure, allows B3, B4, and B5 to be the most productive, where productivity here is measured on the basis of new coining (see Bolozky 1978 for the selection of a verb shape in denominative verbs).

The lack of prosodic alternation allows the stem consonants in B3, B4, and B5 to occupy the same syllabic position in both the Past and the Future forms. For example, in *gidel–yegadel* 'to raise B4 Past–Future' *g* remains in the onset of the penultimate syllable, *d* is in the onset of the ultimate syllable and *l* is in the final coda. Such preservation of prosodic position is not found in B1 and B2. In *gadal–yigdal* 'to grow B1 Past -Future' *g* shifts positions between the onset (Past) and the coda (Future) of the first syllable. Similarly, but in the reverse order, in *niklat–yikalet* 'to be absorbed B2 Past–Future' *k* shifts positions between the coda (Past) and the onset (Future) of the first syllable. This prosodic shifting is imposed by the restrictions in (12) above. Both *gadal* and *yigdal* must be disyllabic (12a–i), but *yigdal*, being a Future form, requires a prefix (12c-ii). Therefore there is no other shape available for these forms (recall that unmarked syllables are preferred and therefore **agdal* or **yigadl* are ruled out). In B2 the Future prefix must occupy a separate syllable since the vocalic pattern is {a. e} (12c-iii). In the Past form of B2 the prefix occupies the first onset of the stem and therefore prosodic shift between the two forms is inevitable. Again, the requirement that syllables be unmarked rules out **nikalt* (where *k* is in onset position as in *yikalet*) or **yikalaet* (where *k* is in the coda position as in *niklat*); **yiklate* suffers not only from prosodic shift (of *t*) but it also violates the restriction which requires a final consonant in the stem (12a-ii).

Limitation on the internal syllabic structure of the first syllable of the verb stem need not be independently specified in Modern Hebrew. The facts are that the first stem syllable in B1- Past and B2-Future is never closed while that of B4 and B5 (Past and Future) can be closed or open (e.g. B4 *kibel* 'to accept', *tirgem* 'to translate'). These facts should not be attributed to lexical specification of the prosodic structure of the binyanim (see Bat-El 1989 and Inkelas 1990) but rather to the relation between the Past and the Future forms. In B4 and B5, as noted above, the consonants do not change their prosodic position, while in B1 and B2 they do. Thus an initial closed syllable in a B1-Past stem will result in prosodic shifting which may, in some cases, enforce epenthesis to rescue violation of the Sonority Sequencing Principle. That is, had there been a B1-Past verb such as **talfan* its Future form would have been **yitlfan*, which would have to surface as **yitlefan* where the impermissible *lf* onset is avoided. Epenthesis, which obscures the syllabic shape of a verb, is strongly avoided (see also fn. 10). Thus, only verbs which preserve their prosodic structure in both tenses allow the first syllable to be closed (this includes B3). Further consequences are that only the binyanim whose prosodic structure is constant in both Past and Future allow denominative verbs with more than three consonants (see Bolozky 1978). Due to the additional phonological load expressed by prosodic shifting, B1 and B2 are not at all productive; B2 is never used for new coining while new verbs in B1 are relatively rare. It should be noted that without the phonological factor the poor productivity of B1 is surprising considering its high frequency in the language (reported in Berman 1997 and earlier studies).

All the phonological properties mentioned above, whether basic or consequential, can be compressed into one simple structure such as CaCaC for B1, Ci(C)CeC for B2, etc. Does this mean that all these properties form together a morphological unit? Not necessarily.

The structure consisting of the compressed properties is known as the binyan. Traditional studies in Semitic languages represent a binyan as one morphological unit, from which it can be understood that the phonological properties of this unit are inseparable (see also Aronoff 1994). There is no doubt that all phonological properties of the binyan are essential in defining a well-formed verb, but this does not necessarily entail that they form an inseparable unit. I argue that these phonological properties, although contingent upon each other, are independent.[15] First, the prosodic structure of Modern Hebrew verbs is a universally defined prosodic unit, the minimal word (McCarthy and Prince 1986). The minimal word, which can be disyllabic as in Modern Hebrew or bimoraic, has been shown to function in phonological systems of various languages and therefore its independence of the vocalic pattern in Modern Hebrew is not in doubt.[16] The independence of the vocalic pattern is manifested by the Hebrew passive pattern {u. a} which is not linked to a particular binyan. This pattern is usually associated with

B3 and B4, and some descriptions of Hebrew wrongly refer to this association as two additional binyanim, Huf^{c}al (passive of B3) and Pu^{c}al (passive of B4). The argument that {u. a} is free of prosodic structure is supported by a few forms where this vocalic pattern is used to passivize B5 verbs. The verbs *hitnadev* 'to volunteer' and *hitpater* 'to resign' can be passivized with {u. a} yielding *hitnudav* 'to be forced to volunteer' and *hitputar* 'to be forced to resign' respectively. Unlike Aronoff (1994), who follows Berman (1982), I do not see any justification for postulating an additional binyan Hitpu^{c}al for such cases. A verb with the vocalic pattern {u. a} is recognized as a passive verb regardless of its prosodic structure.[17]

To summarize this section, I have argued that a binyan is a shorthand for a collection of restrictions on the prosodic structure, vocalic pattern, prefixes and their association to each other. On the basis of these phonological restrictions a verb can be inflected. Inflection, based on relations between surface forms, is affected by altering the phonological shape of the verb in accordance with the constraints.

In the following section I will show that each of the properties characterizing the binyan can be found in non-Semitic languages as well. The goal of this brief review is to show that a wider spectrum of exploration reveals that Semitic languages are not unique, at least not to the extent that it is often believed.

2.2 Prosodic structure in non-Semitic languages

The prosodic characteristics of a binyan, i.e. the template, can be found outside the Semitic family. In the Yawelmani dialect of Yokuts, an American Indian language of California (Newman 1944; Kisseberth 1969; Archangeli 1984), there are two types of affixes, neutral affixes and template affixes. Neutral affixes do not affect the prosodic structure of the root (not to be confused with the Semitic consonantal root), while template affixes enforce a particular prosodic structure on the root, regardless of its inherent shape (which surfaces under neutral affixes).

In the table in (15), six roots are presented with neutral and template affixes. To see the affect of the affixes notice that the prosodic structure of each root remains constant when neutral affixes are added. However, when template affixes are added the root receives the prosodic structure assigned by the affix.

The template affixes in Yawelmani, like the binyanim in Semitic languages enforce a prosodic structure on the verb. The assigned prosodic structures in Yawelmani are limited to CVC(C), CVVC(C), or CVCVV(C). This can be compared with the binyanim in Classical Arabic, where the Perfective, for example, is limited to CVCVC in the first binyan, CVCCVC in the second, and CVVCVC in the third (similar distinctions can be found in Tiberian Hebrew, Akkadian, and other Semitic languages). Template affixes consist of segmental material (the affix) and prosodic structure. The same is true for binyanim, which consist of segmental material (vocalic pattern and in some cases affixes) and prosodic structure. In

(15) Yawelmani neutral and template affixes

	Neutral affixes		Template affixes	
Root	-al	-t	-(')inay CVC(C)	-'aa CVCVV(C)
	'dubitative'	'passive aorist'	'gerundial'	'durative'
caw 'shout'	caw-al	caw-t	caw-inay	cawaa-'aa-n
cuum 'destroy'	cuum-al	cuum-t	cum-inay	cumuu-'aa-n
hoyoo 'name'	hoyoo-al	hoyoo-t	hoy-inay	hoyoo-'aa-n
diiyl 'guard'	diiyl-al	diiyl-t	diyl-inay	diyiil-'aa-n
ilk 'sing	'ilk-al	'ilk-t	'ilk-inay	'iliik-<aa-n
hiwiit 'walk'	hiwiit-al	hiwiit-t	hiwt-inay	hiwiit-'aa-n

both languages there is evidence for the independent phonological existence of at least one of the two properties. It has been argued above, on the basis of the passive {u. a} pattern, that a vocalic pattern in Modern Hebrew exists independently of the prosodic structure. In Yawelmani these same prosodic structures function independently in limiting the prosodic structure of the roots.

Another example can be drawn from Temiar, an Austroasiatic language spoken mainland Malaysia. McCarthy (1983), based on data from Benjamin (1976), shows that Temiar's verbs exhibits a templatic system similar to that of Classical Arabic. For example, the template of the Causative Perfective is CCCV(:)C and that of the Simulfactive Perfactive is CCVCV(:)C (vowel length is drawn from the stem as in Arabic broken plurals; see McCarthy and Prince 1990). The second C-slot in both templates is filled by the causative marker *r* while the other C-slots are filled by the stem consonants. The first vowel in the Simulfactive Perfective template is filled by an *a*, while the other V-slot (in both templates) is filled by the stem vowel. Thus, the Causative Perfective of *slɔg* 'to lie down, marry Perfective' is *srlɔg* and its Simulfactive Perfactive is *sralɔg*. When there are no sufficient consonants to satisfy the template an epenthetic *t* is inserted as in *trkɔ:w* 'Causative Perfective' and *trakɔ:w* 'Simulfactive Perfactive', both related to *kɔ:w* 'to call Perfective'. Verbs which have too many consonants (e.g. *sindul* 'to float') cannot fit into the template and thus remain uninflected or subject to simple affixation.

As shown above, the prosodic aspect of the binyan is not peculiar to Semitic languages. In 2.3 below I show that the vocalic pattern is also be found in non-Semitic languages.

2.3 The vocalic pattern

As shown in (11) above, every binyan assigns a vocalic pattern for its Past and Future forms. The phonological alternations involved in the relations among the

binyanim is identical to that between the tenses in each binyan. This relation is expressed by *apophony* (also known as *ablaut* or *gradation*), which is defined as a morphologically conditioned alternation, in this case vocalic alternation.

Apophony is dominant in Semitic morphology but its presence in Indo-European languages cannot be ignored. In English the relation in Present–Past pairs such as *come–came*, *speak–spoke*, *meet–met*, *strike–struck*, *swim–swam*, etc. is expressed by apophony. A similar group of verbs in German includes Infinitive-Preteritum pairs such as *h*[*e:*]*ben–h*[*o:*]*b* 'to raise', *f*[*i*]*nden–f*[*a*]*nd* 'to find', *k*[*o*]*mmen–k*[*a:*]*m* 'to come', *r*[*u:*]*fen–r*[*i:*]*f* 'to call'. The stem vowel in the Perfect is in some cases identical to that of the Infinitive (e.g. *k*[*o*]*mmen–k*[*a:*]*m–gek*[*o*]*mmen* 'to come'), in others to the Preteritum (e.g. *bl*[*ei*]*ben–bl*[*i:*]*b–gebl*[*i:*]*ben* 'to stay'), and in some cases it is different from both (e.g. *f*[*i*]*nden–f*[*a*]*nd–gef*[*u*]*nden* 'to find').

The phonology employed throughout the verb system in Semitic languages is the *irregular* phonology of modern Indo-European languages, and indeed, these verbs are often called irregular verbs (Quirk *et al.* 1985). However, in ancient Indo-European languages apophony is much more common (see the grade system in Ancient Greek and Latin), and Meillet (1912), as well as other studies on Indo-European languages, does not fail to draw attention to this similarity between Semitic and Indo-European languages. McCarthy and Prince (1990) make a similar correlation between sound and broken plural in Arabic and irregular and regular verbs in English. They note that "The main difference is that the subregularities in English do not span much of the input space . . ., while broken plurals are formed on literally every canonical noun type in Arabic" (p.212). Apophony in English and German does not have a morphological function beyond expressing relations between the forms of these particular verbs. That is, it does not have a role in identifying morphological classes nor in determining the inflectional class. Phonologically, however, apophony in Semitic and Indo-European languages is identical; the stem vowels alternate on the basis of morphological information.

As shown in McCarthy (1983), meaningful apophony affecting two vowels, as in Semitic languages, can be found in echo words in Gta', a South Munda language spoken in India. For example, the pattern {a. a} conveys the meaning 'equivalent' as in *kitoŋ* 'god'–*kataŋ* 'being with powers equal to *kitoŋ*' and *kesu* 'wrapper worn against cold'–*kasa* 'cloth equivalent to *kesu* in size and texture'. Similarly, the pattern {u. a} conveys the meaning 'different' as in *kitoŋ* 'god'–*kutaŋ* 'being other than *kitoŋ* and *kesu* 'wrapper worn against cold'–*kusa* 'any other material usable against cold'. McCarthy (1983), based on data from Mahapatra (1976), provides an analysis of Gta"s echo words based on the same structure and principles underlying his analysis of Semitic verb structure.

Apophony is not the only morphologically conditioned phonological phenomenon found in natural languages. Rotuman, an Eastern Oceanic language of Melanesia, expresses its Complete–Incomplete relation by metathesis (Besnier

1987; Blevins 1994; and references therein; e.g. *mofa–moaf* 'rubbish, refuse, litter', *mure–muer* '(of wind) to blow gently', *tɔfi* → (*tɔif* →) *tæf* 'period of six lunar months as the usual length of reign of a Rotuman king'). Alabama and Choctaw, as well as other languages of the Muskogean family spoken in the southeastern part of America, form their Plural and Repetitive forms by subtracting the final rhyme of the root (Martin 1988 and Broadwell 1993; e.g. Alabama: *bal**aa**-ka* 'lie down sg.'–*bal-ka* 'lie down pl.', *kol**of**-li* 'cut once'–*kol-li* 'cut repeatedly'; Choctaw: *bon**ot**-li* 'roll up sg. Object'–*bon-li* 'roll up pl. Object', *bak**aaf**-li* 'split sg. Object'–*bak-li* 'split pl. Object'). Cf. subtraction in French *blā:ʃ–blā* 'white fm.–ms.'. Rendille, a Cushitic language spoken in Kenya, expresses gender relations in some polysyllabic animate nouns by accentual alternation (Oomen 1981; e.g. *ínam* 'boy'–*inám* 'girl', *áram* 'husband'–*arám* 'wife', *sibéen* 'young male goat/sheep'–*sibeén* 'young female goat/sheep'). Cf. stress alternation in English *cónvict–convíct*. More examples of this sort, accompanied by a detailed discussion, are provided in Matthews (1974) and Anderson (1992).

Morphological relations expressed by phonological alternation are less common than those expressed by affixation, nevertheless they should not be ignored by grammatical theory. Apophony is a type of morphologically conditioned alternation and since it is also found in non-Semitic languages it should receive a unified account, assuming that it is part of the native speaker's knowledge of grammar. Within the Generative Theory, apophony in Indo-European languages has not given rise to morphological distinctions between consonantal roots and vocalic patterns (although the structuralists' approach could be interpreted as such). The relation between *meet* and *met* is not expressed by a root {m.t} accompanied by the morpheme {i} in the Present and morpheme {E} in the Past and thus there is no reason why apophony in Semitic languages should motivate such an analysis.

Morphological relations expressed by a phonological process cannot be accounted for by a simple concatenation of morphemes. Matthews (1974) and Anderson (1992) provide extensive discussions on this type of morphology and conclude that morphological relations should be expressed by operations (or processes). An operation can be an addition of phonological material, i.e. affixation, as well as an application of a phonological rule, e.g. vocalic alternation (apophony), metathesis, or deletion (truncation). This view is also adopted in the following analysis of morphological relations in Semitic languages.

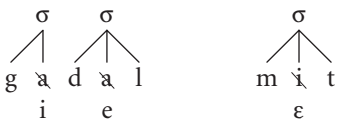
2.4 A stem modification analysis

"One way of handling a phonologically conditioned alternation is to set up a basic form which undergoes a *modification*where necessary" (Matthews 1974:97). The same is true for morphologically conditioned alternations like English *man–men* (ibid. p. 128). In this section I propose a structural interpretation of stem modifi-

cation which expresses the morphological relations between stems in Semitic languages. The analysis takes a fully specified surface stem as the base of the operation rather than root and binyan. In many cases the phonological operations involved do not provide the clue for selecting the base and, for our purposes, it is actually not at all relevant. Lexical-semantic considerations, like those in Berman (1978), are often responsible for selecting the base. The task of the morphological operation is to express the structural relations among words.

The structural relation between *gadal* 'grew' and *gidel* 'raised', for example, is expressed by apophony where the vowels in *gadal* are substituted by {i. e} (or the vowels of *gidel* are substituted by {a. a}). This relation is identical to that in English where "the Past form of *sing* is formed by replacing /I/ with /æ/" (Anderson 1992: 62). As can be seen from (16) below Modern Hebrew *gadal–gidel* and English *mit–mɛt* are alike; the fact that Modern Hebrew involves two vowels and English only one is insignificant (see Section 2.3 for two-vowel apophony in Gtaʔ).

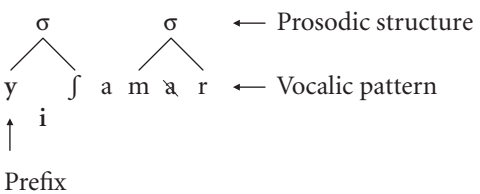
(16) *gadal* → *gidel* *mit* → *mɛt*



Notice that apophony does not involve reference to a consonantal root as it operates directly on the stem. Thus, not only can the cooccurrence restrictions on consonants be accounted for without isolating a consonantal root (see 1.2, 1.3), but apophony also does not support the existence of such a unit.[18]

The relation between *gadal* and *gidel* exhibits only apophony; the prosodic structure in both forms is identical and thus vacuously assigned. There are, however, relations in Modern Hebrew where the prosodic structure alters as well, as in the derivational relations *gadal* 'to grow' B1–*higdil* 'to enlarge' B3, and the inflectional relations *ʃamar* 'he guarded'–*yiʃmor* 'he will guard'. Cases of this sort provide evidence that the segments are conveyed from the base to the output without the prosodic structure. The prosodic structure is assigned independently as proposed in 2.1 above.

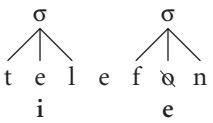
(17) *famar* → *yiʃmor*



The association of the segmental material with the prosodic template proceeds edge-in, leaving the *a* (of the first syllable of the base) without a prosodic position and it is thus deleted (see Steriade 1982 and Itô 1986 for prosodic licensing and stray erasure).

As can be seen in (18) below, exactly the same operation is involved in the formation of denominative verbs (see further details in Bat-El 1994a, 1995). In this particular example there is prosodic assignment and apophony, and due to the edge-in mapping of the prosodic structure the medial *e* is deleted.

(18) *telefon* → *tilfen*



Whether presented in procedural terms, or within a constraint-based approach (see Sharvit 1994 and Ussishkin to appear), apophony as well as alternation in the prosodic structure takes as a base a segmental string of vowels and consonants, i.e. the entire stem. In Bat-El (1994a, 1995) it is shown that a stem-based approach is not only a possible alternative to the root-based approach but for some data it is the only possible approach. It accounts for cluster transfer in denominative verbs as in *flirt* 'flirt'–*flirtet* 'to flirt' (**filret*) as well as in *faks* 'facsimile'–*fikses* 'to send a fax' (**fikes*). It also explains the fact that denominative verbs whose vocalic pattern is the marked {o. e} such as *xokek* 'to make a law' can be derived only from nouns whose base contains an *o*, in this case *xok* 'law'.

Errors of binyan transfer found in child language and aphasic speech can as well be accounted for within the stem modification approach. Berman (1986 and other studies) reports on many cases where children use, for example, *zarak* 'he threw B1' instead of *nizrak* 'it got thrown B2' and **nifrak* 'B2' instead of *hitparek* 'it came apart B5'. Similarly, Barkai (1980) reports on a Hebrew speaking aphasic patient who said, for example, *gadlu* 'they grew up B1' instead of *higdilu* 'they enlarged B3' and **mitnavélet* 'B5' instead of *niv*(*h*)*élet* 'she is shocked'. Such errors do not provide any evidence for the existence of a consonantal root; they are due to binyan transfer by which the binyan of the target verb is exchanged with another 'existing' binyan via stem modification. Evidence for the existence of the consonantal root should be based on errors of root transfer, whereby the binyan of the target word is preserved but the root is exchanged by another root, where all roots in the produced errors 'exist' in the language (as are the binyanim in binyan trasfer).[19]

The stem modification approach takes a fully specified stem as a base on which phonological modification operates. Its superiority is motivated on empirical and theoretical grounds and therefore the view that Semitic morphology

requires the dissection of the stem into morphemes should be abandoned in favor of a universally unified approach.

3. Conclusion: What then is special about Semitic morphology?

I have shown in this chapter that all properties characterizing Semitic stem structure can be found in non-Semitic languages as well. Thus, in terms of phonological phenomena, Semitic languages are not unique as they do not exhibit any property that cannot be found elsewhere.

What is special about Semitic morphology is the *combination* of these properties. To the best of my knowledge there is no language outside the Semitic family whose morphology combines prosodic enforcement, apophony, and cooccurrence restrictions on surface non-adjacent segments.

In addition, the degree of prominence of these properties in Semitic morphology is much greater than in other languages. All properties mentioned above are rather limited in non-Semitic languages, either lexically or phonologically. Russian cooccurrence restrictions are lexically limited as they are found only in C(L)V(L)C stems. The same is true of English and German where apophony is found only in a subclass of verbs, and of Gta' where apophony is limited to echo words. Furthermore, Yawelmani prosodic enforcement is a property of only some of the affixes and does not affect stems consisting of more than three consonants. Similarly, in Temiar only verbs that can fit into the template (i.e. verbs with two or three consonants) are subject to templatic morphology. Phonological limitation is found in vowel harmony which affects only one or two vowel features, as well as in Chumash cooccurrence restrictions which refer only to coronal sibilants. However, all these properties are part of native speakers' knowledge (i.e. not sporadically listed on particular lexical items) and therefore their prominence is irrelevant.

I claim that the combination of properties unique to Semitic languages, as well as the dominance of these properties in the language, do not justify a distinct morphological structure for Semitic languages. Each property should receive a unified account regardless of its status in a particular language or language family, as long as it consists as part of native speakers' knowledge.

Notes

* I would like to thank Charles Kisseberth, Joseph Shimron, and an anonymous reviewer for their helpful comments.

1. The term 'stem' refers to a word without its affixes. I confine my attention to verbal stems although various types of nominal stems exhibit a similar structure. The data under

discussion consist mostly of unaffixed verbs. However, no claim is made regarding the underlying stem within a verbal paradigm. The discussion in this chapter abstracts away from semantic considerations but it should be noted that I view the stem as the unit carrying the semantic content which can be enhanced by grammatical properties assigned by the affixes and the vocalic pattern (i.e. the binyan).

2. Further study on this issue within current theoretical frameworks can be found in McCarthy (1988), Padgett (1991), Frisch *et al.* (1997), and Everett and Berent (1997). It should be noted that the generalizations given in (1) are usually attributed to Greenberg (1950), but credit should also be given to earlier grammarians. From Allony (1969), an edited version of *Ha'egron* written in 902 by Rav Seʿadya Ga'on, it can be learnt that this issue had already been raised during that period. Grammarians discussed the division of consonants into groups (which correlate with current division on the basis of place of articulation) and the impossible sequences of consonants (which correlate with cooccurrence restrictions). It should be noted, however, that the discussion refers to written letters rather than to speech sounds, and due to the consonantal writing system it appears to make reference to root consonants.

3. The OCP was first introduced in Leben (1973) in the context of tone systems. See Goldsmith (1976) and McCarthy (1986) for further development, as well as Odden (1988) and Yip (1988) for critical views.

4. The reviewer suggested to account for the above mentioned restrictions in terms of Cairns' (1969) "universal ordered set of redundancy rules", which I believe can be translated into constraint base approach (Cairns considers universal restrictions on initial consonant clusters in terms of implicational relations and the SPE markedness theory). This is indeed an interesting program that unfortunately falls beyond the scope of this chapter.

5. The theory of Feature Geometry was first introduced in Clements (1985) and Sagey (1986). Further discussion can be found in McCarthy (1988), Padgett (1991), Clements and Hume (1995), and references therein. While phonologists agree that features are hierarchically organized, they often debate the precise organization. Here I abstract away from this dispute and hence the hierarchy in (6) provides only those nodes relevant to the present discussion. The 'root' is an organizing node dominating all features (not to be confused with the consonantal root); the 'C-Place' node dominates the consonant features, and the 'V-Place' node dominates the vowel features; 'F' stands for a feature.

6. The relevant features for consonantal subgrouping are actually place and stricture ([sonorant] for sonorants/obstruents and [continuent] for stops/fricatives). For example, three groups of consonant are identified within Semitic coronals: coronal sonorants (*l r n*), coronal stops (*t d* and the emphatic stops), and coronal fricatives (θ ð s z ʔ and the emphatic fricatives). Padgett (1991) argues that stricture features are place-dependent and thus allows the OCP to refer to place and stricture as a unit.

7. The fact that the OCP is limited to the stem can be attributed to a language specific ordering within a rule-based approach (i.e. the OCP applies before the affixes are attached), or to a language specific domain restriction on the OCP (i.e. the domain of the OCP is the stem).

8. Optimality Theory was first introduced in Prince and Smolensky (1993) and its

application to prosodic morphology has been studied in McCarthy and Prince (1993). Since then quite a few studies within this theoretical framework have been conducted, some of which can be found in Archangeli and Langendoen (1997) and many others on the web (http://ruccs.rutgers.edu/roa.html). See, in particular, Rose (2000) for an account of OCP violation in Semitic)

9. In cases such as *kis* 'pocket'–*kiyes* 'to pickpocket' it is assumed that the *y* in the verb corresponds to some existing vowel in the input, either in the base or in the vocalic pattern (see Bat-El 1994a and Ussishkin to appear).

10. A common historical source for $C_1VC_1VC_2$ stems is full reduplication. For example, *kabkab* 'star' in Amorite changed in other Semitic languages into *kakkabu*(*m*) or *ko:kab* < *kawkab* (Lipiński 1997). Another source of identical or homorganic C_1 and C_2 is prefixed nouns, where the prefix is often synchronically opaque. For example, The noun *mamzer* 'bastard' is historically derived from the base *mazar* 'to be blemished' (Hurwitz 1913). Modern Hebrew speakers do not recognized the first *m* in *mamzer* as aprefix, and consequently C_1 and C_2 are identical in the denominative verb *mimzer* 'to bastardize'. Similarly, the Modern Hebrew noun *tadrix* 'briefing', where the first consonant is a prefix (cf. *derex* 'way'), has a related denominative verb *tidrex* 'to brief', where C_1 and C_2 are homorganic, but nevertheless they are both part of the stem. Denominative verbs derived from prefixed nouns are not uncommon in Modern Hebrew and consequently many of the verbs whose first two consonants are identical or homorganic have as the first consonant *m* or *t*, the most common prefixes in the language.

11. The power of the Local-OCP can be clearly seen in the verb derived from the noun *ḥaṣoṣra* 'trumpet'. Some speakers say *ḥiṣeṣer* 'to play the trumpet', where an *e* is inserted to rescue the Local-OCP violation. Other speakers are reluctant to violate the disyllabic structure of the verb (since the inserted vowel creates an additional syllable) and thus choose to rescue the violation by metathesis, as exhibited in *ḥiṣreṣ*. Similarly, in *hikḥil* 'to become blue' most speakers avoid Local-OCP violation (as in the normative *hiḥḥil*) by preserving the post-vocalic *k* unspirantized.

12. Due to the loss of weight distinctions the prosodic restrictions in Modern Hebrew are rather simple. Other Semitic languages require more elaborated restrictions. Akkadian, for example, requires tri-syllabic stems (with the exception of Preterite B-stems which are disyllabic). The final stem syllable must be heavy; the other two syllables are either both heavy or one of them is light. See also Hoberman (1992) for prosodic restrictions in Modern Aramaic.

13. Further person-number as well as gender distinctions are made by inflectional suffixes.

14. Notice that this exception must be lexically specified otherwise the distinction between the Future forms of B2 and B4 will be eliminated (cf. *yikanes* 'he will enter' B2 vs. *yekanes* 'he will gather' B4).

15. We may view this question in an analogical context of the elements and their derivatives. Although H_2O has its own properties it is not a basic element as it consists of the basic elements H and O (thanks to Joseph Shimron for pointing out this analogy).

16. The effect of the minimal word can be seen in English and Latin which do not allow

monomoraic (CV) words; the minimal size of the word is bimoraic, (C)VV or (C)VC. Similarly, deletion of a final vowel in Lardil (a Pama-Nyungan language spoken in the Gulf of Carpentario) is blocked in disyllabic words since the output would consist of less than two syllables (see Prince and Smolensky 1993).

17. Acquisition of the verbal paradigm may provide further support for the independence of the phonological properties of a verb (but should be carefully examined within a wider context). If all the properties of a binyan form one unit they are expected to be acquired simultaneously (assuming that there are no other blocking constraints such as the one prohibiting a complex onset). However, mixing of the properties of the binyan is not uncommon. Here are some examples (data provided by Galit Adam, p.c.): (i) *tidlik* 'you ms. sg. will light B3' (adult *tadlik*), where the vocalic pattern {i. i} of the Past (*hidlik*) appears with the Future prefix; (ii) *artíva* 'she made wet B3' (adult (*h*)*irtíva*/(*h*)*ertíva*), where the vocalic pattern {a. i} of the Infinitive (*le-hartiv*) appears with the prefix identifying the Past form; (iii) *tilefi* 'you fm. will peel B4' (adult *tekalfi*) where the vocalic pattern {i. e} of the Past (*kilef*) appears in the Future form.

18. The view that the vocalic pattern, but not the consonantal root is a morphological unit must abandon the classical approach that words are exhaustively composed of morphemes. Also the *-berry* words in English are not exhaustively composed of morphemes; while *berry* is a morpheme, *boysen* in *boysenberry* and *huckle* in *huckleberry* are not (see Anderson 1992: 49).

19. Evidence for the consonantal root based on experimental studies (Berent and Shimron 1997 and Ephratt 1997 among others) are problematic since the subjects where given written material which is primarily consonantal. Such experiments are appropriate for arguments regarding the processing involved in reading which is not necessarily identical to the process involved in natural speech.

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