Chapter 6

Word-based Items-and-processes (WoBIP): Evidence from Hebrew morphology

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In his seminal book *A-Morphous Morphology,* Anderson provides ample evidence supporting the item-and-process approach to morphology, whereby relations between words, and thus the derivation of one word from another is expressed in terms of processes. Although Anderson excluded Semitic languages from the paradigm, I argue in this paper for the advantage of item-and-process in the analysis of Modern Hebrew word relations. Under this approach, the word/stem is the base, and the putative consonant root is just a residue of phonological elements, which are lexically prominent as are consonants in non-Semitic languages. The empirical basis of the arguments is drawn from natural and experimental data of adult Hebrew as well as child Hebrew.

1 Introduction

"Items vs. processes in morphology" is the title of §3.4 in Anderson's (1992) seminal book *A-Morphous Morphology*. In this section, Anderson compares two models of morphology – item-and-arrangement and item-and-process (attributed to Hockett 1954) – and argues in favor of the latter. Taking apophony (or ablaut; e.g. *sing* – *sang*) as one of the many problems encountered with the item-and-arrangement model, Anderson claims that "what presents {PAST} in *sang* is … the *relation* between *sang* and *sing*, expressed as the **process** by which one is formed from the other" (Anderson 1992: 62; emphasis original). The process in this case is replacement (or stem modification); "the PAST form of *sing* is formed by replacing /ɪ/ with /æ/." Crucially, /æ/ is not the morpheme designating PAST, and *sang* is not derived by combining bound morphemes, i.e. *s-ŋ* and *-æ-*.

The section which immediately follows in Anderson's book (§3.5) is titled "Word-based vs. morpheme-based morphology". The issues addressed in these two sections are always considered together, since one is contingent upon the other. A root-based morphology is usually analyzed within the item-and-arrangement model. However, if

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morphology is word-based, the debate between item-and-arrangement and item-and-process still holds (see §2). This debate is particularly heated in the study of Semitic morphology, where a consonantal root has been claimed to be the core morphological unit in the word.

Paradigms like *sing – sang* are relatively rare in English, but abundant in Semitic languages, such as Hebrew, where the relation between words is often expressed with apophony; e.g. *χam – χom* 'hot – heat', *limed – limud* 'to teach – learning', *ʃuman – ʃémen* 'fat – oil', *gadol –gódel* 'big – size' (stress is final unless otherwise specified). Since item-and-arrangement has been the traditional approach to Semitic morphology, and has been supported by traditional Semiticists (see, however, §6) and generative linguists, Anderson contemplates whether *sing – sang* can be analyzed as a root *s-ŋ* plus the markers /ɪ/ 'PRESENT' and /æ/ 'PAST'. He, however, rejects this analysis due to the absence of "substantive evidence in its favor" (Anderson 1992: 62), and adds in parentheses "as there clearly is … for something like McCarthy's analysis of Arabic and other Semitic languages" (ibid). That is, Anderson accepts the common view that item-and-arrangement is the appropriate model for Semitic morphology.

While I support Anderson's approach to morphology, I do not agree with the exclusion of Semitic languages from the paradigm. On the basis of data from Modern Hebrew, I provide in this paper evidence supporting the word-based item-and-process (WoBIP) model for Semitic morphology. That is, English is not like Hebrew, but rather Hebrew is like English.

In the context of Semitic morphology, I outline in the following §2 the possible morphological models that can be derived from the four different approaches: word-based, morpheme-based, item-and-process, and item-and-arrangement. Then, in §§3–5 I provide supporting evidence for the word-based item-and-process model, but due to space limitation, I do not dwell on arguments against competing models. Each piece of evidence supports only part of the model, but together we get a well-motivated model of morphology. Given Anderson's commitment to the history of linguistics (see, in particular, Anderson 1985), I devote §6 to two principal Semiticists from the 19th century, whose grammar books support the word-based item-and-process model. Concluding remarks are given in §7.

2 Models of morphology

Research in morphology often concentrates on two questions: What is listed in the lexicon and how are words derived? Each of these questions is associated with competing approaches. The *what*-question is related to the root-based vs. word-based debate, which is of particular interest in the study of Semitic morphology, where the root is always bound. The *how*-question is related to the item-and-process vs. item-and-arrangement debate. Together, they give rise to three models of morphology, shown in Figure 1: root-based item-and-arrangement, word-based item-and-arrangement, and word-based item-and-process.

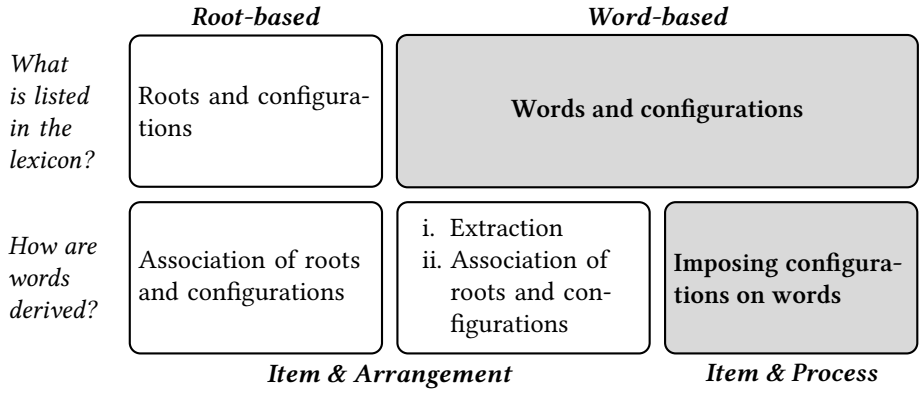


Figure 1: Models of morphology.

In this paper I support the word-based item-and-process (WoBIP) model. Before displaying the supporting arguments, a short review of the three models is given in the three ensuing subsections.[1]

2.1 Root-based item-and-arrangement

In the context of Semitic morphology, the root-based morphology teams up with item-and-arrangement. According to the traditional approach, the root in Hebrew and other Semitic languages consists of 2–4 consonants (3 in most cases) and is combined with a configuration (Bat-El 2011), where the latter, traditionally termed *mishkal* for nouns and *binyan* for verbs, is a shorthand for the grouping of prosodic structure, vocalic pattern, and affixes (if any).[2] In a configuration like *miCCéCet*, for example, the C-slots host the root consonants, the specified consonants (*m* and *t*) are affixes, and the vowels are part of the vocalic pattern (e.g. *mivʁéʃet* 'brush', *mizχélet* 'sleigh', *miʃméʁet* 'guard'). Table 1 shows examples of words sharing a root and examples of words sharing a configuration.

The classical studies seem to suggest a lexical representation consisting of morphemes, as can be inferred from Moscati's (1980: 71) account of the Semitic morphological system:

[1] I do not consider here the pluralistic approaches, whereby some words are derived from roots and others from words (McCarthy 1979; Arad 2005; Berman 2012), because all phenomena can be accounted for within the WoBIP model reviewed in §2.2.

[2] Each of these elements (i.e. the prosodic structure, the vocalic pattern, and the affix) is independent (McCarthy 1979; 1981), but here reference to the configuration suffices. In this context, we should note that the term "Semitic morphology" refers to morphology that employs configurations consisting of at least a vocalic pattern and prosodic structure. Of course, Hebrew and other Semitic languages employ the more conventional affixal morphology, but this type of morphology does not concern us here.

[3] Some words get additional, idiomatic meaning. For example, *sidux* carries the general meaning 'arrangement' and the more specific one referring to 'a prayer book'. Similarly, *sédeʁ* carries the general meaning 'order' and the more specific one referring to 'Passover ceremony' (*sédeʁ pésaχ*).

[4] As in other studies, the exponent of the 3rd person masculine past serves as the citation form because it is structurally neutral, i.e. it has no affixes. The gloss is still in the infinitive, implying reference to the lexeme.

Table 1: Roots and configurations.

Words sharing the root *√sdʁ*			
CiCeC	√sdʁ	sideʁ	'to arrange'
CaCiC		sadiʁ	'regular'
CiCuC		siduʁ	'arrangement'[3]
CeCeC		sédeʁ	'order'
meCuCaC		mesudaʁ	'arranged'
miCCaC		misdaʁ	'military parade'
miCCeCon		misdeʁon	'corridor'
CaCCan		sadʁan	'usher'
CiCCa		sidʁa	'series'
Words sharing a configuration[4]			
CaCCan	√sdʁ	sadʁan	'usher'
	√ʁkd	ʁakdan	'dancer'
	√btl	batlan	'lazy'
CeCeC	√bgd	béged	'garment'
	√jld	jéled	'boy'
	√dgl	dégel	'flag'
CiCeC	√χps	χipes	'to search'
	√btl	bitel	'to cancel'
	√χbʁ	χibeʁ	'to connect'

"The Semitic languages present a system of consonantal roots (mostly triconsonantal), each of which is associated with a basic meaning range common to all members of that root: e.g. *ktb* 'to write', *qbr* 'to bury', *qrb* 'to approach', etc. These roots (root morphemes) constitute a fundamental category of lexical morphemes." If roots are listed, so are the configurations, and word formation thus consists of associating roots and configurations, i.e. item-and-arrangement.

As Hoberman (2006: 139) notes, "students of Semitic languages find the concept of the root so convenient and useful that one finds it hard to think about Semitic morphology without it." However, researchers vary with respect to the definition of the term "root". Lipiński (1997: 202), for example, assumes that "Semitic roots are *continuous* morphemes which are instrumental in derivation but subject to vocalic and consonantal change … based on continuous or discontinuous 'pattern morphemes"' (emphasis original). The "continuous morphemes", which Lipiński calls roots, are not the traditional consonantal roots, but rather stems consisting of vowels and consonants; the "pattern morphemes" are what I call configurations. Aronoff (2007) drains the original morphological (structural and semantic) properties from the root, claiming that it does not have to be linked to meaning and its phonology can be vague. Yet another use of the term "root" is found

in Frost, Forster & Deutsch (1997) with reference to an orthographic root, which as the results of their experiments suggest, has no semantic properties.

2.2 Word-based item-and-process (WoBIP)

Within this approach, the word or the stem is the core element to which all the required processes apply (Aronoff 1976). As a core element, it does not have an internal morphological structure. The processes are *operations* (Anderson 1992: 72) that *modify* the basic form (Matthews 1974: 97). Indeed, the most common process in languages is the one deriving *bats* from *bat*, i.e. affixation, but there are other processes, such as apophony, which derives *teeth* from *tooth*.

Also in the context of Semitic morphology, the input is a word/stem to which several processes apply (see §3.1.2 for word vs. stem as the base). The processes vary according to the goal, and the goal is that the output fits into a configuration. Such a goal- or output-oriented phenomenon, called *stem modification* (Steriade 1988; McCarthy & Prince 1990), is best analyzed within the framework of Optimality Theory (Prince & Smolensky 1993/2004), as shown in analyses of Semitic morphology, such as McCarthy & Prince (1993); Ussishkin (1999; 2000); Gafos (2003); Bat-El (2003).

The details of the required modification depend on the structural similarity between the base and the output; the more similar they are, the fewer the required adjustments. Any element in the configuration can be modified – the vocalic pattern, the prosodic structure, and/or the affix. The modification, however, is contingent upon the configuration of the output.

Table 2: Stem modification – modifying elements in the configuration.

Base form			Derived form		Modified elements
sabon	'soap'	→	siben	'to soap'	vocalic pattern
tipel	'to take care of'	→	me-tapel	'caretaker'	vocalic pattern, affix
matok	'sweet'	→	ma-mtak	'candy'	vocalic pattern, affix, prosodic structure

Within this approach, there is no morphological element consisting solely of three consonants, and the emphasis here is on a "morphological element". Of course, related words share consonants, but these are *stem consonants*, where the stem is a morphological unit (e.g. *tapél* in *me-tapel* 'caretaker'), but the consonants are phonological elements.

2.3 Word-based item-and-arrangement

Item-and-arrangement can also be applied within the word-based approach, but only if a root is extracted from the base word (Ornan 1983; Bolozky 1978). That is, the base is the word but the root is an intermediate morphological element in the derivation. The

derivation proceeds in two stages – extraction and association (Bat-El 1986; 1989). For example, the word *sabón* 'soap' serves as the base for the verb *sibén* 'to soap', which is derived in two stages: (i) extraction of the consonants *s,b,n*, which automatically become the root √*sbn* (traditionally called a secondary root), and (ii) association of this newly formed root with the verb configuration *CiCeC*. The assumption is that the extracted consonants carry the semantic properties of their base, which are, in turn, carried over to the derived form.

However, root extraction is necessary only when one is limited to the root-based approach, and thus to item-and-arrangement. In this model, all words are derived via association of a root with a configuration, regardless of whether the base is a word or a root. Not only is there no independent reason to prefer root extraction to stem modification (§2.2), but also there is empirical evidence refuting root extraction. These are cases of phonological transfer (§3.1), whereby properties that cannot be carried over by the consonants are transferred from the base to the derived form.

3 Phonological and morphological relations

3.1 Transfer of phonological structure

The most striking evidence for a direct relation between words, without an intermediate stage that derives a root, is provided by cases exhibiting phonological transfer (Clements 1985; Hammond 1988; McCarthy & Prince 1990). As shown below, there are cases where structural information, which cannot be encoded in the consonantal root, is transferred from the base to the derived form. In the case of Hebrew, the structural information is both prosodic and segmental (Bat-El 1994).

3.1.1 Prosodic transfer

Prosodic transfer includes transfer of the entire configuration or of a consonant cluster.

Configurations are often assigned a grammatical function (Doron 2003), but the question is whether this grammatical function is a property of the configuration or just a property shared by many (but not all) words within a morphological class. In general, words that share meaning are often structurally similar, but it does not necessarily mean that this shared meaning is a property of a morphological unit. One striking example is displayed by the nouns in Table 3 below, most of which are creative innovations (drawn from http://www.dorbanot.com). These nouns share the configuration *CoCCa* and the meaning 'related to a computer program'.

Since these nouns share a configuration and meaning, the traditional Semitic morphology would assign the meaning to the configuration. This is, of course, erroneous because there are other nouns with the configuration *CoCCa* that do not carry this meaning; e.g. *joʃʁa* 'dignity' (cf. *jaʃaʁ* 'honest'), *χoχma* 'wisdom' (cf. *χaχam* 'smart'), *oʧ͡sma* 'strength' (cf. *aʧ͡sum* 'huge'), *jozma* 'enterprise' (cf. *jazam* 'to initiate'). In addition, this meaning is too specific to function as a morpho-semantic feature.

Table 3: Nouns sharing a configuration.

CoCCa noun		Related word	
toχna	'computer program'	toχnit	'program'
gonva	'stolen computer program'	ganav	'to steal'
poʁna	'computer program with porno pop-ups'	poʁna	'pornography'
t͡soʁva	'illegally burned computer program'	t͡saʁav	'to burn'
gomla	'old computer program'	gimlaot	'pension'

What we actually have here is a Semitic-type blending. The last four words in the first column of Table 3 use the first word *toχna* as a base form, from which the configuration is drawn, along with the basic meaning. That is, *toχna* provides the configuration *CoCCa* and the meaning 'relating to a computer program'. The stem consonants are drawn from the related words in the third column of Table 3, along with some specific meaning denoted by this word. Crucially, such a derivation must be word-based, and the fact that these words are creative innovations suggests that this model is active in the Hebrew speakers' grammar.

Other creative examples are found in a children's story written by Meir Shalev (*ʁoni venomi vehadov jaakov* 'Roni and Nomi and the bear Jacob'). Each invented word in the first column of Table 4 has two bases, one providing the configuration and another the consonants.

Table 4: Meir Shalev's invented words.

Invented word		Source of configuration		Source of consonants	
koféfet	'she wears gloves'	lovéʃet	'she wears'	kfafot	'gloves'
mogéfet	'she puts on boots'	noélet	'she puts on shoes'	magaf	'boot'
lehitmaheʁ	'to hurry/ rush'	lehizdaʁez	'to hurry'	lemaheʁ	'to rush'
laχut͡s	'to run out'	laʁut͡s	'to run'	haχut͡sa	'outside'

Given that the invented words draw semantic properties from the two base words, as is usually the case with blends, direct access to the base must be assumed. That is, the configuration of one of the base words is imposed on the other.

Cluster transfer is often found in denominative verbs like *tʁansfeʁ* → *tʁinsfeʁ* 'to transfer' and *faks* → *fikses* 'to fax' (Bolozky 1978; McCarthy 1984; Bat-El 1994). In such cases, the distribution of the sequential order of vowels and consonants, thus including the clusters, is preserved in the derived form. For example, *fíltеʁ* 'filter' is the base of the

verb *filtɐʁ* (preserved cluster – *lt*), while *fliʁt* 'flirt' is the base of *fliʁtet* (preserved clusters – *fl, ʁt*), and not **filʁet*. Note that the higher the structural similarity between the base and the derived form, the closer the semantic relation (Raffelsiefen 1993), and thus, the fewer the structural amendments required in the course of stem modification (§2.2), the greater the semantic similarity.

3.1.2 Segmental transfer

Segmental transfer includes vowel transfer as well as the transfer of an affix consonant to the stem (Bat-El 1994).

In *vowel transfer*, an exceptional configuration is selected because its vowel is identical to that of the base (e.g. *kod* 'code' → *koded* 'to codify', *ot* 'sign' → *otet* 'to signal'). It should be noted that in most cases, the regular configuration is also possible (e.g. *kided* 'to codify'). However, the exceptional configuration is used only when the base has an *o*. That is, there is output-output correspondence between the base noun *kod* and the derived form, and *koded* is segmentally more faithful to *kod* then *kided* (Bat-El 2003).

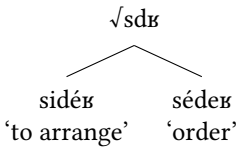
In *affix transfer*, the consonant that serves as an affix in the base becomes a stem consonant in the derived form. This is common with the suffix *-n*, as in *paʁʃan* 'commentator' → *piʁʃen* 'to commentate' (cf. *peʁeʃ* 'to interpret') and the prefix *m-*, as in *maχzoʁ* 'cycle' → *miχzeʁ* 'to recycle' (cf. *χazaʁ* 'to return'). Note that speakers' morphological knowledge allows them to strip the word of its affixes (more so in regular forms), and therefore the inclusion of an affix consonant in the derived words has its purpose, mostly to preserve a semantic contrast, as in *χizeʁ* 'to court' vs. *miχzeʁ* 'to recycle' (from *maχzoʁ* 'cycle'). But in the paradigm of *ʃamaʁ* 'to guard' – *miʃmaʁ* 'guard' there is no **miʃmeʁ* (though it is a potential verb).

3.2 Semantic distance

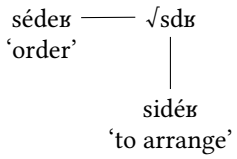
One crucial property distinguishing among the three approaches reviewed in §3 is the semantic "distance" between related words; among these, only the WoBIP model (1c) allows a direct relation between a base and its derived form.

(1) The distance factor

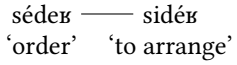
a. *Root-based item-and-process*



b. *Word-based item-and-process*



c. *Word-based item-and-arrangement*



The advantage of the direct relation (1c) is that information can be carried over from input to output, be it structural (§3.1) or semantic. It is often the case that within a group of words sharing stem consonants, there is 1st, 2nd or higher degree of separation between words, as illustrated in Figure 2.

Such a network can express different degrees of semantic relations, depending on how far one word is from another. Needless to say, such a network cannot be expressed if all words are derived from a single root. Of course, one can claim that the three words at the middle of the network (*takdím, kidómet,* and *mikdamá*), which are not directly related to one another, are derived from a root, while all other words are derived from words (McCarthy 1979; Arad 2005). However, this is an unsupported and unnecessary burden on the system. All words in the network are connected to one another, directly or indirectly, where some words are basic and others are derived. The fact that all the words in Figure 2 share the stem consonants is due to the important role of consonants in conveying lexical information and lexical relations (see §5.2).

3.3 Derivation without a configuration

A fundamental element of the traditional root-based item-and-arrangement model is that every word consists of a root and a configuration, where every configuration is a function. This is particularly essential in the verbal paradigms, where the configurations are claimed to carry grammatical categories, such as transitivity (Doron 2003; Arad 2005). Such a theory predicts that the transitivity relation must involve a change in the configuration. This is true for most cases (e.g. *katáv* ‘to write’ – *hitkatév* ‘to correspond’, *ʃalaχ* ‘to send’ – *niʃlaχ* ‘to be sent’, *laχaʦ͡s* ‘to press’ – *hilχiʦ͡s* ‘to cause to feel pressured’), but not all.

In an extensive study of labile alternations in Hebrew, Lev (2016: 114–115) lists 91 verbs where transitivity does not involve a change of the configuration; three of his examples are provided in Table 5. As Lev argues, a root-based morphology cannot accommodate labile verbs because under this approach the root has to associate with two different con-

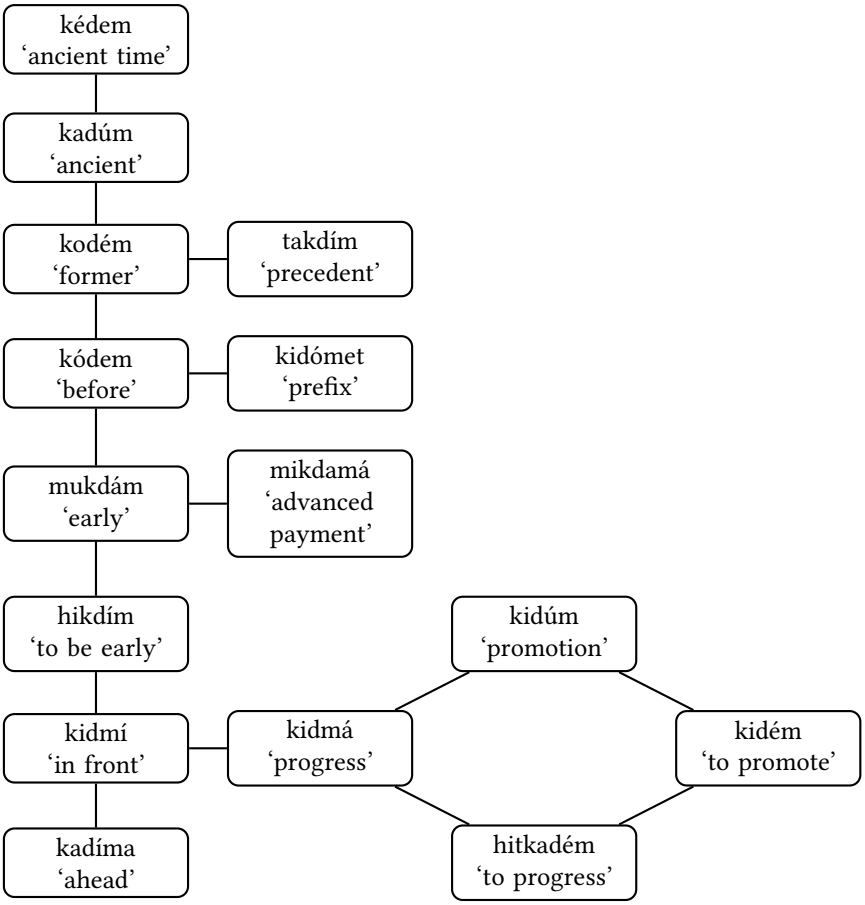


Figure 2: Degrees of separation.

figurations in order to derive verbs contrasting in transitivity. The word-based approach, on the other hand, can incorporate labile verbs, assuming that transitivity in such verbs is not lexically specified but rather derived from the syntactic context. That is, some verbs are specified for [± transitive] and others, i.e. the labile verbs, are [ø transitive]. Many of the examples in Lev's list are recent innovations, i.e. where verbs with transitivity specification become labile. For example, the verb *tijel* used to have one meaning only, 'to walk', but today it also means (at least for some speakers) 'to walk someone (usually a dog)'. This change can be viewed as a loss of transitivity specification, i.e. [–transitive] >[ø transitive]. Crucially, it is the verb that loses its specification for transitivity, not the configuration. That is, in historical change too, as shown in the ensuing §4, it is the word that changes, and not some putative consonantal root.

Table 5: Labile verbs (Lev 2016: 114–115).

Verb	Transitive	Intransitive
hiʃχiʁ	‘to make black’	‘to become black’
hivʁik	‘to polish’	‘to shine’
hivʁi	‘to cure’	‘to recuperate’

4 Historical change

4.1 Configuration change

Over the course of time, words may change their meaning or their structure. In his study of instrumental nouns in Hebrew, Laks (2015) shows that quite a few instrumental nouns undergo change in their configuration, in particular within a compound, as illustrated in Table 6. As Laks shows, the change always goes towards the participial configuration, and it never occurs when the instrumental noun does not have a verbal counterpart. That is, while both *maχded* ‘pencil sharpener’ and *mazleg* ‘fork’ have the same configuration, only the former adopts the participial configuration *meχaded*, given its verbal counterpart *χided* ‘to sharpen’; the latter cannot adopt a participial configuration because it does not have a verbal counterpart.

Table 6: Change of configuration in instrumental nouns (Laks 2015).

Old configuration		New configuration – participle		
maχded	maCCeC	meχaded	meCaCeC	‘pencil sharpener’
nakdan	CaCCan	menaked (tekstim)	meCaCeC	‘text vocalizer’
masχeta	maCCeCa	soχet (mit͡sim)	CoCeC	‘juicer (juice squeezer)’

In order for this restriction to hold, an instrumental noun must be linked to its verb, from which it can draw its participial configuration. Otherwise, as Laks argues, the instrumental noun could adopt any of the five participial configurations, not necessarily the one associated with its verb. That is, we get the instrumental noun *meχaded* ‘pencil sharpener’ because *meCaCeC* is the participial configuration of *χided* ‘to sharpen’. Similarly, we get the instrumental nouns *soχet* (*mit͡sim*) ‘juicer’ because *CoCeC* is the participial configuration of *saχat* ‘to squeeze’. Such a change is possible only in a word-based lexicon; a root-based lexicon does not account for the restrictive generalization as it allows options that are not attested.

4.2 Semantic change

Over the course of time, the meaning of words also changes; crucially, the semantic change affects words and not putative roots. For example, the verbs *nimlat* and *himlit* used to differ in transitivity only, with the former meaning 'to escape' and the latter 'to help someone to escape'. Nowadays, these verbs are not related, since *himlit* means 'to give birth (for non-humans)'. Similarly, *kalat* and *hiklit* used to be related, with the former meaning 'to absorb' and the latter 'to cause to absorb'. However, the meaning of *hiklit* is now 'to record', and the two verbs are vaguely related, if at all. For the traditional root-based approach (§2.1), it would be rather strange that the change in meaning does not affect the element that carries it, i.e. the root. This inconsistency does not arise within the word-based approach.

It is quite feasible that the root does not undergo semantic change because its meaning is just "a basic meaning range", according to Moscati (1980) and other Semiticists, or underspecified, according to Arad's (2005) analysis within the theory of Distributed Morphology (Halle & Marantz 1993 and subsequent studies). That is, semantic specification of roots may have at least three degrees of specification: fully specified (e.g. *boy*), underspecified (e.g. Hebrew roots), and unspecified (e.g. the roots in *refer*, *remit*, and *resume*; Aronoff 1976).

The major problem is that the specific meaning of words is derived, according to Arad (2005), from the morpho-syntactic context, i.e. the configurations. This works nicely for some words but not for others. Consider, for example, the pairs *zaʁak* 'to throw' – *hizʁik* 'to inject' and *maʃaχ* 'to pull' – *himʃiχ* 'to continue'. It is not clear which semantic property can be assigned to the configurations *CaCaC* and *hiCCiC* such that the relation within these pairs would be consistent.

4.3 Segmental change

Like semantic change, segmental change also affects words and not consonantal roots, even when the change is in the stem consonants. This is seen in the case of stop-fricative alternation, which due to its opacity, suffers from a great degree of change-oriented variation (Adam 2002).

As shown in Table 7, normative verb inflectional paradigms are changing under the force of paradigm uniformity. Although the change affects consonants, it certainly does not affect a consonantal root because derivationally related words are hardly ever affected; nonetheless they change, and sometimes they even undergo independent change. For example, while χ can change to *k* in *katav* – *jiktov* (normative *jiχtov*) 'to write PAST – FUTURE', it never changes to *k* in *miχtav* (**miktav*) 'letter'. Note also that while the direction of change in this paradigm is from a fricative to a stop (*jiχtov* → *jiktov*), the change in a related pair is towards a fricative, as in *ktav* → *χtav* 'handwriting'.

Table 7: Change of configuration in instrumental nouns (Adam 2002).

Old paradigm			New paradigm			
k–χ	kisa	jeχase	χ–χ	χisa	jeχase	'to cover PAST – FUTURE'
k–χ	katav	jiχtov	k–k	katav	jiktov	'to write PAST – FUTURE'
b–v	bitel	jevatel	v–v	vitel	jevatel	'to cancel PAST – FUTURE'

5 Other supporting sources

5.1 Children's words

During the early stages of acquisition, verbs in the production lexicon of children acquiring Hebrew are not derivationally related, i.e. they do not share stem consonants. Derivationally related verbs start appearing later on, where the new verbs "are learnt as versions of, and based upon, the verbs known from before" (Berman 1988: 62).

This direct derivation in children's speech is not surprising given Ravid et al.'s (2016) study on the distribution of verbs in spoken and written Hebrew corpora: child-directed speech (to toddlers age 1;8–2;2) and storybooks (for preschoolers and 1st–2nd grade). In both corpora, the average number of verbs per root was below two: 684 verbs for 521 root types in the spoken corpus (1.3) and 1,048 verbs for 744 roots in the written corpus (1.4). Only around 30% of the verb types in each corpus share a root with another verb, and most such verbs share a root with only one other verb.

These results mean, as the authors admit, that at least until the age of 7, the children have very little input supporting a root-based morphology. Nevertheless, the authors insist that the children must "eventually construe the root as a structural and semantic morphological core" (Ravid et al. 2016: 126). As argued in the current paper and elsewhere, starting with Bat-El (1994), Hebrew speakers are free from this burden since Hebrew morphology (and Semitic morphology in general) is not root-based, but rather word/stem-based.

Previous studies that attribute children and adults' innovations to root extraction (§2.3 – word-based item-and-arrangement) must now reconsider their conclusion at least for children below the age of 7. In an experimental study reported in Berman (2003), children at the age of 4–6 years old had a rather high success rate (84–88%) of morphological innovation (forming novel verbs from nouns or adjectives) with a very high percentage of well-formed innovations (91–99%). If children can form verbs from nouns/adjectives at the stage where they still do not have sufficient input that allows them to form a root-based morphology (Ravid et al. 2016), they probably use another strategy – the modification strategy employed within the WoBIP model (§2.3). And if they can use this model successfully until the age of 7, they have no reason whatsoever to shift to a root-based model later on. Of course, as I have argued here and elsewhere, they do not – Hebrew speakers employ WoBIP at all ages.

5.2 Experimental studies

There are quite a few experimental studies supporting the consonantal root in Hebrew. Most notable are Berent's studies with the acceptability rating paradigm (Berent & Shimron 1997; Berent, Everett & Shimron 2001, inter alia) and Frost's studies with the priming paradigm (Frost, Forster & Deutsch 1997; Frost et al. 2000, inter alia).[5] However, most experimental studies supporting the consonantal root in Hebrew morphology adopted a visual modality. As such, they cannot tease apart the effect of orthography, which is primarily consonantal (Bat-El 2002 and Berrebi 2017 for a critical view).

A fresh look on the matter is provided in Berrebi's (2017) auditory priming study, which controlled semantic relatedness and orthographic identity. Word pairs sharing phonological stem consonants were either semantically related (e.g. *kibel* 'to receive' – *hitkabel* 'to be accepted') or semantically unrelated (e.g. *ʁigel* 'to spy' – *hitʁagel* 'to get used to'); and when semantically unrelated, either orthographically identical with respect to the consonants (e.g. *ʁigel* 'to spy' – *hitʁagel* 'to get used to') or orthographically different (e.g. *ʃikeʁ* 'to lie' – *hiʃtakeʁ* 'to get drunk', where *k* is spelled differently). The results showed that all conditions had a priming effect, i.e. whether or not the prime and the target were orthographically identical or semantically related. As the property shared by the prime and the target in all conditions was phonological, i.e. stem consonants, the results suggest that there is a phonological priming effect among words sharing stem consonants. Crucially, the stem consonants are not a morphological unit since there was also a priming effect when the words were semantically unrelated and orthographically different (e.g. *ʃikeʁ – hiʃtakeʁ*).

If we assume that priming effects reflect the organization of the lexicon, then we can conclude that words are also phonologically organized according to the stem consonant. As emphasized in §2.2, the stem consonants are phonological elements (consonants) within a morphological unit (stem); they do not carry meaning and they do not constitute a morphological unit.

Stem consonants, and not vowels, serve to identify relations between words because consonants are lexically prominent, while vowels have syntactic functions (Nespor, Peña & Mehler 2003; Berent 2013); this is true not only for Hebrew but also for non-Semitic languages. In their experimental study, Cutler et al. (2000) asked the participants: "Is a *kebra* more like *cobra* or *zebra*?". They found that speakers identify similarity between a nonce word (*kebra*) and an existing word on the basis of shared consonants (*kebra – cobra*) rather than shared vowels (*kebra – zebra*). That is, the consonants serve as the core of similarity between words in English, French, Swedish, and Dutch as much as they do in Hebrew and other Semitic languages (see also Ooijen 1996; New, Araujo & Nazzi 2008; Carreiras & Molinaro 2009; Winskel & Perea 2013).

Consonants are lexically prominent from the very early stages of language development. This is reported in Nazzi & New's (Nazzi & New) study, where French 16–20 month old infants could learn in a single trial two new nonce words if they differed by one con-

[5] In an additional study, which was design to ask "is it a root or a stem?" (rather than "is it a root?"), Berent, Vaknin & Marcus (2007) note that although their results do not falsify the root-based account, they strongly suggest that the stem can account for the restrictions on identical consonants.

sonant (*pize – tize*), but not if they differed by one vowel (*pize – paze*). That is, although vowels are acoustically more prominent than consonants, when it comes to lexical contrast, consonants are employed. This is true for children and adults, regardless of the ambient language, whether it is Semitic or non-Semitic.

Consonants are prominent not only in speech perception and lexical relations but also in the association between sound and shape revealed by the *bouba-kiki* effect (Köhler 1929), whereby people pair labial consonants with round shapes and dorsal consonants with spiky shapes. One of the many subsequent studies of the *bouba-kiki* effect is Fort, Martin & Peperkamp (2015), which found that the sound–shape association remains constant regardless of the vowels. That is, *lomo* was associated with a round shape as much as *limi*, and *toko* with a spiky shape as much as *tiki*. Fort, Martin & Peperkamp (2015) conclude that consonants have a greater effect than vowels in sound – shape association.

6 19th century Semitic grammarians

The root-based item-and-arrangement model of Semitic morphology has been deeply entrenched for generations, thus presenting the advocates of the word-based item-and-process approach as revolutionary (see Horvath 1981; Lederman 1982; Heath 1987; Hammond 1988; McCarthy & Prince 1990; Bat-El 1994; 2002; 2003; Ratcliffe 1997; Ussishkin 1999; 2000; 2005; Laks 2011; 2015; Lev 2016).

However, WoBIP has its seeds in the studies of the orientalists Wilhelm Gesenius (1786–1842) and William Wright (1830–1889), who wrote the seminal grammar books of Hebrew and Arabic respectively. It is important to note that both Gesenius and Wright were not native speakers of a Semitic language (Gesenius was German and Wright British), and thus not biased like the other Semitic grammarians by the consonantal script of Hebrew and Arabic.

Gesenius (1813) distinguishes between "primitive" verbs, which consist of a stem only and are not derived from any other form, and derived verbs, among which there are verbal derivatives and denominative verbs. Gesenius used the term "internal modification" when addressing the processes involved in the derivation. He indicates two types of "changes in the primitive form" (Gesenius 1813: 115): internal modification (cf. stem modification; §2.2) and repetition (i.e. reduplication) of one or two of the stem consonants. Within the internal modification, he includes vowel change like *gadal* 'to grow' – *gidel* 'to raise', and gemination as in Biblical Hebrew *ga:dal* 'to grow' – *giddel* 'to raise' (there is no gemination in Modern Hebrew). Crucially, Gesenius compares vowel modification in Hebrew to that in English *lie – lay* and *fall – fell*, and does not find them different. That is, Gesenius finds stem modification to be identical in both Hebrew and English, but unlike Anderson (1992) who contemplates whether English is like Hebrew, Gesenius actually claims that Hebrew is like English.

A similar approach is found in Wright's (1859) grammar book of Arabic, where he describes the relation between verbs within the WoBIP model. For example, "the third form … is formed from the first by lengthening the vowel sound after the first radical" (p. 32) or "[T]he second form … is formed from the first … by doubling the second radical"

(p. 31). This is the format of Wright's description of each and every binyan in Arabic, and it specifically says that (i) one form is derived from another, i.e. word-based derivation, and (ii) the derivation involves some process, doubling, lengthening, etc., i.e. item-and-process. Note that Wright uses the term "radical" to refer to a consonant in the stem, without reference to the stem consonants being an independent morphological unit.

That is, although it has always been said that the root-based approach is the one assumed by traditional Semiticists, it is important to emphasize that the two great 19th century Semiticists, Gesenius and Wright, were proponents of the WoBIP model of Semitic morphology.[6]

7 Concluding remarks

In §3.6, Anderson (1992: 71) concludes: "… the morphology of a language consists of a set of Word Formation Rules which operates on lexical stems to produce other lexical stems …" In this paper I extended the scope of this model to Semitic morphology. That is, in Semitic languages too, words are derived from words/stems via modification of the base.

The modification in Semitic morphology is output oriented, as the output has to fit into a configuration. The constraint-based framework of Optimality Theory (Prince & Smolensky 1993) allows for output-oriented grammar, where the constraints impose certain configurations (structural constraints) as well as output-output identity of consonants (faithfulness constraints). A configuration is imposed by several constraints, referring to syllabic structure (usually a foot), syllable structure, and vocalic patterns (where the latter ones are language specific). Identity among the stem consonants is imposed by the faithfulness constraints, where preservation of segmental identity ensures preservation of morphological relation among words.

That is, the stability of the stem consonants is due to phonological faithfulness constraints that require identity among stem consonants. Phonological faithfulness enhances morphological relations. "Any given *focal* word (that is, a specific word in which we are interested) is thus surrounded by a vaguely defined family of words which are more or less acoustically similar to it. The members of the family will in general have the widest variety of meaning, and yet it may often happen that some members of the family will resemble the focal word not only in acoustic shape, but also in meaning" (Hockett 1958: 297, 1987: 86). That is, within an acoustic family of words there is a morphological

[6] A reviewer suggested that Gesenius and Wright adopted the word-based approach, which was used for Latin grammar, because they worked prior to the introduction of the term morpheme. Kilbury (1976) and Anderson (1985) attribute the term morpheme to Baudouin de Courtenay's student H. Ułaszyn, in his articles from 1927 and 1931. However, it is possible to have a notion without a specific term. Sibawayhi (760–796), who wrote the first known Arabic grammar *Al-kitab*, used the term *kalima* 'word' in the sense of a morpheme (e.g. the suffix *-ta*) and referred to the radicals that make up the words (Levin 1986). Gesenius notes that the Jewish grammarians call the stem root and the stem consonants radical letters. That is, there was a reference to morphological units (stem, affixes), but the stem consonants did not constitute a morphological unit.

family, where the words are not only acoustically similar but also semantically related. For the purpose of membership in a morphological family, the consonants are more important than the vowels. This status does not grant the consonants morphological status, neither in English nor in Hebrew.

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