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LOCALITY CONSTRAINTS ON THE INTERPRETATION OF ROOTS: THE CASE OF HEBREW DENOMINAL VERBS ⋆

ABSTRACT. This paper argues for a distinction between word formation from roots and word formation from existing words. Focusing on Hebrew, it is shown that roots – and only roots – may be assigned multiple interpretations in different environments. When the basis for the derivation is a word, this word forces its semantic and phonological properties on any element derived from it. To account for this difference, a locality constraint on the interpretation of roots is postulated: the first nominal or verbal head that merges with the root serves as the immediate environment for determining its interpretation. This head forms a closed domain: any further derivation takes as its input not the root itself, but an element whose semantic and phonological properties have been cashed out. Word-derived words thus have access only to the words they are derived from, not to the root. While the ability of Hebrew roots to acquire multiple interpretations is language specific, the distinction between word formation from roots and word formation from words is shown to be universal. This is illustrated here with English zero-related pairs, which are shown to exhibit the same contrasts as Hebrew between word formation from roots and from words. Showing the effect of roots in word formation in both Hebrew and English further motivates the root hypothesis, namely, that in all languages the lexical kernel, or the root, is distinct from 'words' – complex entities – even if this distinction is not always morphologically manifested.

1. INTRODUCTION: ROOTS AND WORD FORMATION

One of the main reasons why word formation is often taken to be distinct from syntactic computation is its 'double nature': while some aspects of word formation are morphologically productive and semantically transparent, others exhibit paradigmatic gaps and non-compositional meaning. To account for this double nature, many theories postulate 'two places' for word formation: one for the regular, productive processes, another for the non-productive ones. Whether they take word formation to occur in two

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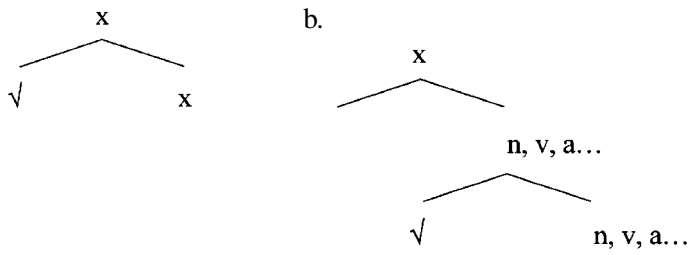
grammatical components (lexical vs. syntactic) or at two different levels of the same component (derivational vs. inflectional, level one vs. level two), all theories share the following intuition: 'lower' (lexical, derivational, level one) word formation is associated with idiosyncrasies (gaps, non-compositional meanings), while 'higher' (syntactic, inflectional, level two) word formation is productive and regular.

Recent developments challenge the two-place approach to word formation both empirically and theoretically. First, many word formation processes were shown to be syntactic in nature. Three very influential cases are Baker's (1988) work on incorporation as head movement, Pesetsky's (1995) work on zero morphemes, and Hale and Keyser's (1998 and subsequent work) on the syntactic nature of 'lexical items'. In addition, current minimalist theory, most specifically the view of it taken by Distributed Morphology (cf. Chomsky 1998; Halle and Marantz 1993, and subsequent work), adopts a 'single engine hypothesis', according to which all computation, whether of small (words) or large elements (phrases and sentences), is syntactic, performed by the computational system.[1] Seeking to reconcile the single engine hypothesis with the evidence in favor of two places for word formation, Marantz (2000) proposes to reconstruct the two places for building words *within* the syntax. The crucial distinction holds between creating words from *roots* (atomic elements, devoid of all functional material) and creating words from existing words, that is, from roots that are already merged with some word-creating head.[2] A category head x may thus merge either with a root, or with an existing word (a noun, a verb, or an adjective):

(1)a. b.



word formation from roots word formation from words

[1] See Marantz (1997) for background and discussion of the morphology-as-syntax view and for arguments against the Lexicalist Hypothesis.

[2] Note that the divide between roots and non-roots does not correspond precisely to the other levels of locality postulated. Specifically, as one reviewer notes, traditional derivational affixes attach to both root-derived and word-derived elements (e.g., *curious*, *health*, vs. *realiz-ation*, *realization-al*). See Marantz (2000) for discussion of productivity facts and identification of English roots.

The root is not an actual 'word'. It becomes a noun, a verb, or an adjective once it is merged with a head bearing a category feature, n, v or a (1a). When another head merges with this noun or verb, as in (1b), this head can only 'see' the head below it, not the root. In other words, while in (1a) the head x serves as the immediate environment for assigning an interpretation to the root, in (1b) this head merges with an element whose interpretation has already been fixed. Marantz further argues that the contrasts that have been attributed to the distinction between lexical (derivational) vs. syntactic (inflectional) word formation follow, in fact, from the distinction between roots and non-roots. 'Lower' word formation from roots may exhibit idiosyncrasies – this is the domain where the specific meaning of the root is fixed. Further, word formation from roots may also be non-productive: roots may select for their category forming heads arbitrarily, e.g., $\sqrt{}$clums takes *-y* as its adjectival head while $\sqrt{}$malic takes *-ious*. Word formation from words, on the other hand, consists of merging an affix with a word whose interpretation is already fixed in a given environment. It is therefore semantically transparent and productive (to the extent that the language allows creating an abstract noun from a concrete noun as with *-ness* affixation, or an adjective from a noun as with *-al*, etc.).

Word formation from roots and from non-roots in English is in some cases morphologically distinct. Specifically, truncation, a mechanism suggested by Aronoff (1976) to explain a certain puzzle of English word formation, is argued by Marantz to reflect word formation from *roots*. What seems like truncation, *-ous* truncated between *atrocious* and *atrocity* (**atroc-ious-ity*), is in fact the root $\sqrt{}$atroc creating *atrocious* in an adjectival environment (*-ous*) and *atrocity* in a nominal one (*-ity*). Viewed this way, the idiosyncratic properties associated with 'word formation' are derived from general structural principles: both *atrocious* and *atrocity* are formed by the same root; but no derivational relation holds between them, so the absence of *-ous* in *atrocity* is not surprising.

This paper provides a decisive argument (based on Hebrew data) supporting the distinction between word formation from roots and word formation from words. Note that the distinction itself is universal, but its manifestations may differ from one language to another. In English the main overt manifestation of word formation from roots is in cases of truncation. In Hebrew, due to the specific morphophonological making of the language, the distinction has both morphological and semantic manifestations. The following claims are defended:

1. Roots may be assigned a variety of interpretations in different morphophonological environments. These interpretations, though retaining some shared core meaning of the root, are often semantically far apart

from one another, and are by no means predictable from the combination of the root and the word-creating head. This property is language specific, occurring in some languages but not in others.

2. The ability to be assigned multiple interpretations is strictly reserved for roots. Once the root has merged with a category head and formed a word (n, v, etc.), its interpretation is fixed, and is carried along throughout the derivation. This locality constraint is universal and holds across all languages.

A prediction suggests itself immediately: root-derived and word-derived elements in Hebrew will differ in their range of interpretations. The latter will necessarily be tightly related in their meaning (in a sense to be made precise in section 3) to the word from which they are derived. As will be illustrated here, this prediction is indeed borne out. Noun-derived verbs are shown here to depend in their interpretation on the noun from which they are derived, while root-derived verbs may take on multiple, semantically various interpretations.

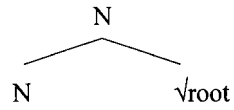
A further result of this paper is a distinction between two types of languages: English-type, where each root is normally assigned one interpretation in a verbal or nominal environment, and Hebrew-type, where a single root may form multiple nouns and verbs. While this difference has to do with the initial lexical inventory of the language, both language types are sensitive to the distinction between word formation from roots and word formation from words.

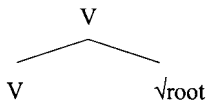
The argument is built as follows. Section 2 presents a characteristic property of Hebrew word formation: the multiple semantic interpretations that roots acquire in different environments. In section 3 the central claim is made that roots, but not words, may acquire multiple interpretations. Examining cases where morphological cues are available to distinguish root-derived from noun-derived verbs, the domain for assignment of interpretation is shown to be locally constrained by the first category head with which the root is merged. Sections 4 to 6 further extend and develop the claim made in section 3. Section 4 extends the analysis to cases where no morphological cues are available, especially English zero-related pairs. English verb formation is shown to be subject to the same locality constraint as Hebrew. Another group of word-derived elements, verb-derived nouns, is explored in section 5. As the theory predicts, these nouns are dependent in their interpretation on the verbs from which they are derived. Section 6 argues that Hebrew noun-derived verbs differ from root-derived verbs not only semantically but also phonologically; this provides important evidence both for the locality constraint postulated in section 3 and for the existence of the consonantal root in Hebrew. Finally, section 7 locates

the discussion of denominals in a cross-linguistic context, reducing 'lexical' differences among languages to specific choices made by languages with respect to their basic inventory and the possible combinations they employ in building verbs.

2. HEBREW WORD FORMATION: ROOTS AND PATTERNS

Following work in the framework of Distributed Morphology (Halle and Marantz 1993, and subsequent work), I take *roots* to be atomic lexical elements, devoid of any syntactic or functional material. When roots are embedded in a nominal or verbal environment, they become actual 'words' – nouns, verbs etc.:

(2)a. 

b. 

Noun and verb creating morphology in English may be null (as in pairs such as *file-file, shop-shop*) or overt (as in *employ-employ**ment***, *character-character**ize***). In other languages, such as Hebrew, word-creating morphology is mostly overt and is easily distinguishable from the root. Most Hebrew roots consist of segmental consonants, represented here as √CCC. Semantically, the root does not have a fixed interpretation (as will be illustrated below); phonologically, the three consonants are unpronounceable on their own. Hebrew employs pattern morphology to make the consonantal root into a word. The combination of roots with patterns serves a double purpose: it makes the segmental root into a pronounceable string and turns the (category-neutral) root into a noun, a verb or an adjective. Consider verb formation in Hebrew. The consonants of the root combine with one of seven possible verbal patterns, yielding a Hebrew verb: [3]

[3] The following morphophonological processes occur throughout the system:

(i) *b*, *k* and *p* are spirantized in certain contexts, yielding *v*, *x* and *f*, respectively.
(ii) *n* assimilates before a stop, resulting in *hipil* instead of *hinpil*.
(iii) *s*, ∨*s*, *z* and *c* undergo metathesis with *t* in the seventh pattern, *hitCaCCeC*.
(iv) ʕ, ʔ and *x* affect the vowels following them, yielding *xešbon* (instead of **xišbon*).
(v) Epenthesis takes place in certain contexts, as in *xašivut (*xšivut)*

Gemination in patterns 3, 4, and 7 does not exist in Modern Hebrew, but an extra consonant slot exists in those patterns (as is evident from the fact that roots with four consonants may only appear in these patterns), and it is therefore represented here.

(3)

Root:	Pattern (Binyan):	Verb:	
ʕmd	1 CaCaC	*ʕamad*	'be standing'
ʕmd	2 niCCaC	*neʕemad*	'stand up'
qpl	3 CiCCeC	*qipel*	'fold'-transitive
qpl	4 CuCCaC	*qupal*	'passive of 3'
md	5 hiCCiC	*heʕemid*	'make stand up'
ʕmd	6 huCCaC	*huʕamad*	'passive of 5'
qpl	7 hitCaCCeC	*hitqapel*	'fold'-intransitive

Even from the restricted set of data in (3) it is evident that there is a large degree of systematicity in the Hebrew pattern system. Indeed, the appearance of one root in several patterns often corresponds to well-known alternations such as active-passive (patterns 3–4 and 5–6 above), causative-inchoative (patterns 1–5 and 3–7 above) or transitive-reflexive (cf. Berman 1978; Doron 1999). But the occurrence of a root in several patterns is not limited to argument-structure alternations. Very often a root appears in several patterns, acquiring a different meaning in each of these patterns. I term this phenomenon *multiple contextualized meaning*, that is, multiple meanings assigned to a root in a particular environment or context. Such multiple contextualized meaning occurs in about fifteen percent of Hebrew roots in the verbal system.[4] Consider the following examples:

(4)

Root: √bxn	Pattern:		
a.	CaCaC	*baxan*	'examine'
b.	hiCCiC	*hivxin*	'discern'

(5)

Root: √btx	Pattern		
a.	CaCaC	*batax*	'trust'
b.	CiCCeC	*biteax*	'insure'
c.	hiCCiC	*hivtiax*	'promise'

In (4)–(5) above, a single root acquires two or three separate meanings when appearing in different verbal patterns. The root itself, e.g., √bxn (4), is only turned into a verb when put in the environment of the head bearing

[4] According to Arad and Shlonsky (2003), about twenty-seven percent of Hebrew roots appear in one pattern only, and another thirty percent do not alternate except for passive. True alternations (transitive-reflexive, causative-inchoative) occur in just over thirty percent of Hebrew roots.

the 'v' feature (the pattern). The particular meaning of that verb is determined according to the verbal morpheme, or pattern: √bxn is interpreted as *examine* in the environment of the first pattern (CaCaC) and as *discern* in the environment of the fifth pattern (hiCCiC). Multiple verbs formed from a single root are typical of Hebrew, but not of English (except for Latinate bound roots such as √fer, √cieve, etc.). English employs two (or more) morphologically unrelated roots to express the range of meanings acquired by Hebrew roots across different patterns (e.g., *examine-discern*). Where English speakers have to learn two different roots, each in a single environment, Hebrew speakers have to learn the two interpretations assigned to a single root in two different environments.

Consider now some examples of the wide range of interpretations that a single root acquires across verbal and nominal environments in Hebrew:

(6) √šmn

a.	CeCeC (n)	*šemen*	'oil, grease'
b.	CaCCeCet (n)	*šamenet*	'cream'
c.	CuCaC (n)	*šuman*	'fat'
d.	CaCeC (adj.)	*šamen*	'fat'
e.	hiCCiC (v)	*hišmin*	'grow fat/fatten'
f.	CiCCeC (n)	*šimen*	'grease'

(7) √bxn

a.	CaCaC (v)	*baxan*	'test, examine'
b.	hiCCiC (v)	*hivxin*	'discern'
c.	miCCaC (n)	*mivxan*	'an exam'
d.	CoCaC (n)	*boxan*	'a quiz'
e.	maCCeCa (n)	*mavxena*	'a test-tube'
f.	aCCaCa (n)	*avxana*	'a diagnosis'

(8) √xšb

a.	CaCaC (v)	*xašav*	'think'
b.	CiCCeC (v)	*xišev*	'calculate'
c.	hiCCiC (v)	*hexšiv*	'consider'
d.	hitCaCCeC (v)	*hitxašev*	'be considerate'
e.	maCCeC (n)	*maxšev*	'a computer/calculator'

f.	maCCaCa (n)	*maxšava*	‘a thought’
g.	CCiCut (n)	*xašivut*	‘importance’
h.	CiCCon (n)	*xešbon*	‘arithmetic/bill’
i.	taCCiC (n)	*taxšiv*	‘calculus’

(9) $\sqrt{}$qlt

a.	CaCaC (v)	*qalat*	‘absorb, receive’
b.	hiCCiC (v)	*hiqlit*	‘record’
c.	miCCaC (n)	*miqlat*	‘a shelter’
d.	maCCeC (n)	*maqlet*	‘a receiver’
e.	taCCiC (n)	*taqlit*	‘a record’
f.	CaCCeCet (n)	*qaletet*	‘a cassette’
g.	CeCeC (n)	*qelet*	‘input’

What is striking here is that in spite of the fact that the range of meanings assigned to the words in each group is quite varied, all members share a common core – namely, the root. The existence of the root is evident both phonologically and semantically. The phonological core is quite straightforward – all the words derived from the same root contain the root consonants. Now consider the semantic core. The semantic content of the root is underspecified. It is convenient to think of this underspecified meaning as of a potential to be incarnated in many different ways. Such incarnation occurs when the root is put in a nominal or verbal environment. It then acquires an actual instantiation as a noun or a verb, an instantiation that is both pronounceable (recall that the consonantal root is unpronounceable on its own) and has a particular semantic interpretation, specific to that verbal or nominal environment. Since we only hear and pronounce roots in the contexts of different words derived from them, it is difficult to access the semantic core of the root. But when we put together the words made from the same root, we can, in most cases, extract some semantic core shared by them. All the words in (6) above have something to do with the general concept of ‘material’ – specifically, some greasy, fatty material. This core meaning acquires a specific interpretation in nominal environments, so that this potential core is incarnated as oil, cream, or fat in different environments. In a verbal environment, too, this core is incarnated as verbs having to do with some fatty material (the actual material is *not* specified; this verb could either be ‘to put on fat’ or ‘to grease something’).

By contrast, all the words made from the root $\sqrt{}$xšb are related to some mental activity, whether thought, consideration, or calculation; the nouns, too, are either processes of thought or calculation, e.g., *taxšiv* ‘calculus’,

or instruments for calculation, e.g., *maxšev* 'computer'. We can think of this mental activity as of the semantic core of the root. Note that the actual activity, thought or calculation, is only specified in each nominal or verbal environment where the root is put. Although the core of √xšb has a potential to be incarnated in many different ways, this root retains its core meaning in all of its incarnations. Crucially, it never forms verbs that are related to different lexical classes, such as motion verbs or verbs of location (cf. Levin 1993 for verb classes).

In some cases, the core meaning of the root is more difficult to pin down. The root √qlt in (9) seems to contain a semantic core of absorption or taking in. The actual instantiations of the root seem almost unrelated to one another. This illustrates how highly specialized the meanings roots acquire in different environments can be. In one verbal environment the root acquires the general meaning of *absorb*, in another the very specific meaning of *recording*. In one nominal environment it acquires the interpretation of *shelter*, in another environment *receiver.* But in this case, too, all the words made from the root share the same component. And just like the case of √xšb, this root never creates verbs belonging to other classes, such as motion verbs.

To summarize this section, note two related points: first, the wide range of unrelated interpretations that may be assigned to roots in different environments. While all the words made of the root √qlt (cf. (9)) may have some common semantic core of taking in or absorption, the words themselves are semantically very varied. Second, note the degree of arbitrariness in the assignment of interpretation. For example, nothing forces the root √qlt to be interpreted as *shelter* in the environment of miCCaC and *receiver* in the environment of maCCeC (note the minimal difference in internal vowels of the pattern). It could have been the other way around (*maqlet* meaning 'shelter', and *miqlat* 'receiver'). Taking the root as the basic Saussurean sign, we can say that not only is the sign itself arbitrary, but the meanings associated with that sign in different contexts also, to a large extent, arbitrary.

3. Root-Derived Verbs and Noun-Derived Verbs

While most Hebrew verbs are formed from roots, some are formed from existing nouns or adjectives. In what follows I argue that there is an important difference between root-derived and noun-derived Hebrew verbs. The option to take on multiple interpretations in different environments is strictly reserved for *roots*. Noun-derived verbs must share an interpretation with the noun from which they are derived. To illustrate this claim, con-

sider the interpretations assigned to the root √sgr in various verbal and nominal environments:

(10) √sgr

a.	CaCaC (v)	*sagar*	v, 'close'
b.	hiCCiC (v)	*hisgir*	v, 'extradite'
c.	hitCaCCeC (v)	*histager*	v, 'cocoon oneself'
d.	CeCeC (n)	*seger*	n, 'closure'
e.	CoCCayim (n)	*sograyim*	n, 'parentheses'
f.	miCCeCet (n)	*misgeret*	n, 'frame'

From the noun *misgeret* ('frame', 10f) a new Hebrew verb, *misger* 'to frame' is formed:

(11) √sgr

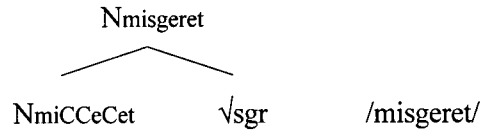
a.	miCCeCet	*misgeret*	'a frame'
b.	CiCCeC	*misger*	'to frame'

Consider the relation between the noun *misgeret* and the verb derived from it. The verb bears a morphophonological similarity to the noun: it contains not only the root consonants, *sgr*, but also the prefix *m-*, which is carried over from the nominal pattern (miCCeCet) into the verbal form. The presence of this prefix overtly indicates the nominal origin of this verb. The vowels of the verb, on the other hand, are those typical of the verbal pattern CiCCeC, not of the nominal pattern in which the noun appears.[5] I assume that the formation of the verb *misger* 'to frame' is as follows: first, the consonants of the root √sgr are combined with the noun-creating morpheme, phonologically spelled out as miCCeCet (12a). The noun *misgeret* 'frame' is then embedded under a v head (12b):[6]

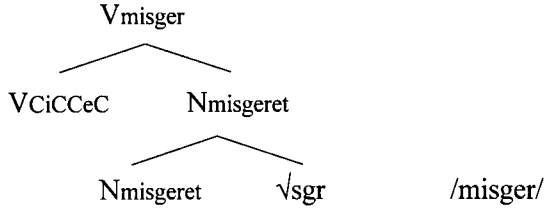
[5] In the active, the vowel melody, {i, e} does not differ from that of the nominal pattern, but in the passive the verb acquires the vowel melody {u, a}, typical of passives: *musgar* 'was framed'. The truncation of the nominal suffix *-et*, as opposed to the prefix *m-* that is carried into the verb, is yet to be explained. If the formation of verbs out of nouns involves stem modification, as argued by Bat El (1994), then perhaps *m-* is taken to be part of the stem and therefore has to be syllabified, while *-et* is a separate affix which could be truncated by Stray Erasure. Cf. Bat El (ibid.) for other cases of truncated final syllables.

[6] The phonological realization of this process involves melodic overwriting, that is, matching the vowels of the stem with those of the third pattern, CiCCeC. See Bat El (1994), and section 6 of this article.

(12)a. Root-derived noun:



b. Noun-derived verb:



But noun-derived verbs differ from root-derived verbs not only morphologically, but also semantically. It may seem natural or even trivial that the verb made from the noun *frame* means to *frame*. But this, I argue, is a crucial property of noun-derived verbs. While root-derived verbs may pick up numerous interpretations in different environments, noun-derived verbs are tied to the meaning of the noun from which they are derived. To illustrate this point, compare the root √sgr in (10) with the noun *misgeret* 'frame' in (11). The root √sgr is assigned numerous interpretations in different environments, but when the basis for the derivation is not the root √sgr itself but a noun derived from it (*misgeret*), that noun seems to force its meaning on any element further derived from it. Although the verb *misger* contains the consonants of the root √sgr, it cannot have access to the underspecified core meaning of the root or to all the interpretations assigned to that root in different environments: something seems to interfere between the verb *misger* and the root √sgr. This interfering element, I argue, is the noun *misgeret*.

Why should the presence of the nominal projection interfere between the root below it and the verb above it, not allowing the verb any access to the root? I argue that this is entailed by a locality principle that constrains the possible interpretations assigned to roots in different environments. Specifically, following Marantz (2000), I postulate the following:

(13) Locality constraint on the interpretation of roots: roots are assigned an interpretation in the environment of the first category-assigning head with which they are merged. Once this interpretation is assigned, it is carried along throughout the derivation.

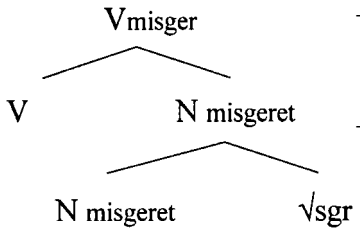
The generalization stated in (13) seems to be correct – and we could leave it at that. It would be theoretically desirable, however, to derive this principle from an independently needed, general locality principle. What (13) argues is that the first category head that merges with the root defines a closed domain for interpretation. Cyclicity and closed domains play an important role in most areas of generative grammar – phonology, morphology, and syntax. The locality constraint in (13) could thus be formulated in a number of ways: it could be stated structurally, but in the lexical component, as a condition governing complex words; it could be formulated as a purely lexical rule, postulating different levels in the lexicon. However, there are some advantages to postulating this locality condition as a *syntactic* condition, in accordance with the single-engine hypothesis adopted here, where all computation is done by the computational system. Such an account requires no further assumptions - the locality constraint on roots follows immediately from the independent syntactic notion of cyclicity. One of the goals of this article is to give a concrete example of how easily this constraint is derived within a syntactic approach to word formation. I will discuss the advantages of such an approach later in this section, as well as in section 6. Let us now consider how this is done.

If we follow the line of argumentation suggested in Marantz (2000), then the first category head merging with the root defines a *phase* (cf. Chomsky 1999), that is, a stage in the derivation where the element built by the computational system is spelled out both semantically and phonologically.[7] The locality constraint in (13) then falls out immediately from the definition of the phase. Once the root has merged with the first category head, the product of the computation is sent off to the interface levels. The interpretation of the output (noun, verb, or adjective) in that environment is then fixed both semantically and phonologically. Whatever comes next in the course of the derivation will not merge directly with the root: it will combine with an element whose features have already been shipped to and interpreted at LF, being assigned there an interpretation in their specific context. Since the phase is a closed domain, any material above it cannot have any access to what is inside and, as a result, further derivational elements cannot alter the interpretation of a 'word', nor can they have any access to the root itself. The only alterations may be those modifications forced by the additional heads. For example, adding a *v* head to the noun

[7] The assumption that the first category head merging with the root defines a phase is not trivial. In Chomsky (1999) phases are defined by specific heads (C, *v*, possibly D) and have an effect on movement. I explore here the possibility that any head that creates a semantic or phonological domain defines a phase. It is possible that the phases that are relevant for movement are those distinguished as 'strong phases' (cf. Chomsky 1999).

misgeret 'frame' changes its category, yielding a verb. Since the verb *misger* 'to frame' is created from a noun, it cannot 'look back' into the closed domain defined by the nominal head. Crucially, the verb cannot access the underspecified core meaning of the root and take on any of the numerous interpretations assigned to the root √sgr (cf. 10 above). Instead, it is tied to the particular instantiation of the root √sgr in the nominal environment of miCCeCet. That is, to the noun *misgeret* 'frame' from which it is derived:

(14)



→V merges with the noun *misgeret* 'frame', and has no access to √sgr

→first category head N defines a phase. Interpretation is assigned to the noun at LF

The locality constraint in (13), as well as the phase hypothesis, are strongly supported by the Hebrew data.[8] In all cases of noun-derived verbs attested, the verbs are tied to their base nouns and have no access to the root. Two more cases (out of many) may serve to illustrate this:

(15) √xzq

a.	CaCaC	*xazaq*	adj., 'strong'
b.	CiCCeC	*xizeq*	v, 'strengthen'
c.	hiCCiC	*hexziq*	v, 'hold'
d.	CiCCa	*xezqa*	n, in math: 'power'
e.	CCaCa	*xazaqa*	n, 'a hold, custody'
f.	CoCeC	*xozeq*	n, 'strength'

[8] Other cases of the prefix m- carried into denominal verbs include: *mixzer* 'recycle' (from *maxzor*, maCCoC, 'cycle', from √xzr), *misxer* 'commercialize' (from *misxar*, miCCaC, 'commerce', from √sxr), *mixšev* 'computerize' (from *maxšev*, maCCeC, 'computer', from √xšb), *missed* 'institutionalize' (from *mosad*, miCCaC, 'institution', from √ysd) and *mider* 'compartmentalize' (from *mador*, maCCoC, 'compartment', from √dwr). In most cases, the roots creating the base words are assigned multiple interpretations across patterns, none of which are available to the denominal verb. For example:

(i)	√xzr	CaCaC	*xazar*	'return/repeat'
		CiCCeC	*xizer*	'court'
		CcaCa	*xazara*	'rehearsal/return'
		maCCoC	*maxzor*	'cycle' → mixzer (CiCCeC, 'recycle')

g.	taCCuCa	*taxzuqa*	n, ‘maintenance’
h.	CiCCeC	*tixzeq*	v, ‘to maintain’, from *taxzuqa* ‘maintenance’

One of the nouns derived from √xzq, *taxzuqa* ‘maintenance’, further creates the verb, *tixzeq* ‘maintain’. This verb retains the nominal prefix *t-* and is tied semantically to the noun from which it is derived: while the root √xzq creates words with varied meanings, the noun, *taxzuqa*, ‘maintenance’ can only form a verb whose meaning is *maintain*. Access to the various meanings associated with the root √xzq is barred once the noun-creating head has merged with the root and fixed its specific interpretation in that environment.[9] Finally, consider the root √xšb:

(16)a.	√xšb	CaCaC	*xašav*	‘think’
b.		CiCCeC	*xišev*	‘calculate’
c.		hiCCiC	*hexšiv*	‘consider’
d.		hitCaCCeC	*hitxašev*	‘be considerate’
e.		taCCiC	*taxšiv*	‘calculus’
f.		maCCaCa	*maxšava*	‘thought’
g.		maCCeC	***m**axšev*	‘computer’
h.		CiCCeC	***m**ixšev*	‘computerize’, from *maxšev* ‘computer’
i.		CiCCon	*xešbo**n***	‘account, arithmetic, calculation, bill’

[9] The prefix *t-* is very often carried into the denominal verb, cf. *tiqšer* ‘communicate’ (from *tiqšoret*, tiCCoCet, ‘communication’, from √qšr), *tiʕes* ‘industrialize’ (from *taʕasiya*, taCCiCiya, industry, from √ʔsh), *taram* ‘donate’ (from *truma*, contracted form of taCCuCa, ‘donation’, from √rwm), *tifqed* ‘function’ (from *tafqid*, taCCiC, ‘function’, from √pqd) and *tiqcev* ‘budget’ (from *taqciv*, taCCiC, ‘budget’, from √qcb). Note the variety of patterns with that prefix – taCCiC, tiCCoCet, taCCuCa, taCCiCiya. As in the case of *misgeret* ‘frame’ (miCCeCet) above, the prefix *t-* is taken into the verbal form, while suffixes are erased, indicating, perhaps, that prefixes and suffixes have a different status in nominal patterns. In these cases, too, roots are assigned multiple interpretations to which the denominal forms have no access:

(i)a.	√pqd	CaCaC	*paqad*	‘command’
		CiCCeC	*piqed*	‘be in charge’
		hiCCiC	*hifqid*	‘deposit, entrust’
		CCuCCa	*pquda*	‘a command’
		taCCiC	*tafqid*	‘a function, job’ → *tifqed* CiCCeC, ‘function’

j.		hitCaCCeC	*hitxašbe**n***	‘settle accounts with someone’, from *xešbon* ‘account’[10]

The root √xšb forms various nouns and verbs. But the verbs *mixšev* (16h, note the nominal prefix *m*) and *hitxašben* (16j, note the nominal suffix,

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b.	√rwm	hiCCiC	*herim*	‘raise’
		CaC	*ram*	‘high’
		maCCoC	*marom*	‘heaven’
		taCCuCa	*truma*	‘a donation: that which was raised’ → *taram* ‘donate’, CaCaC
c.	√qcb	CaCaC	*qacav*	‘ration’
		hiCCiC	*hiqciv*	‘allot’
		CaCCaC	*qacav*	‘a butcher’
		CiCCa	*qicba*	‘pension’
		CeCeC	*qecev*	‘beat, rhythm’
		miCCaC	*miqcav*	‘tempo’
		taCCiC	*taqciv*	‘budget’ → *tiqcev* ‘to budget’, CiCCeC

[10] One reviewer raises a question regarding the semantic relation between two verbs derived from the same noun. As the reviewer notes, some Hebrew speakers also accept the verb *xišben* ‘to keep accounts, make calculations’, derived from the noun *xešbon* ‘account, calculation’. The crucial facts for the argument made here are two. First, recall that the root √xšb has an underspecified meaning, which gets incarnated in different nominal and verbal environments. The noun *xešbon* ‘account’ is such an incarnation. Both verbs derived from *xešbon*, *xišben* ‘keep accounts’ and *hitxašben* ‘settle accounts with someone’, have access to, and contain in them, the meaning of the noun from which they are derived (*xešbon*, ‘account’), namely, of the particular instantiation of the root √xšb in the environment of CiCCon. Second, and most important, neither of these noun-derived verbs have any access to the other instantiations of the root √xšb in other environments – *maxšava* ‘thought’, *taxšiv* ‘calculus’, *maxšev* ‘computer’, etc. These are precisely the predictions made here regarding such cases. Note that we do not predict that two verbs derived from the same noun should be identical – only that they will both include the meaning component of their base noun. (A similar case in English involves two verbs derived from the noun *seed: seed a field* – a location verb, and *seed a watermelon* – verb of removing. While both are related to the noun, their meanings are not identical.)

-n), derived respectively from the nouns *maxšev* (16g) and *xešbon* (16i), depend in their interpretation on their base noun. [11]

Consider the discussion so far. Hebrew denominal verbs were shown here to differ from root-derived verbs with respect to their variety of interpretation. While the constraint on the interpretation of roots could be formulated as a lexical rule or a structural rule applying specifically to words, I suggested that it is best captured in syntactic terms, and argued that the first category head merging with the root creates a phase. This explains the semantic dependency between denominal verbs and their base nouns. It also explains the presence of the nominal prefixes inside denominal verbs, and their absence in root-derived verbs: denominal verbs only have access to the phonological output of the phase, which includes the nominal prefix. Note, furthermore, that the same structural domain constrains both phonological and semantic interpretation. Above this domain, the semantic and phonological output is no longer the root, but an existing noun or verb. Why should these semantic and phonological domains coincide? Under a syntactic approach to word formation, this convergence is straightforward. The phase is the point of semantic and phonological spell out. Everything that merges above that point takes as its input the semantic and phonological incarnation of that element.[12] Note that under the phase-based theory, the opposite case is also predicted: not only should denominal verbs resemble their base nouns, but also, root-derived verbs may have phonological peculiarities, similarly to their semantic peculiarities. Such phonological peculiarities should not occur with denominal verbs, which have no access to the root consonants. As will be discussed in detail in section 6, this prediction is indeed borne out. Root-derived verbs exhibit phonological peculiarities that do not occur with word-derived verbs, and the domain for both semantic and phonological peculiarities is structural and converges at the level of the first category head merging with the root.

So far we were concerned with noun-derived verbs, but the locality constraint on the interpretation of roots applies equally to all non-root-

[11] This is the only case I am aware of, of a nominal *-on* suffix entering a verb. The suffix *-an*, which is very common in adjectives, appears on many deadjectival verbs as evidence for their origin (and, since the vowel is replaced by that of the verb, appears similar to *-on*):

(i)a.	*qamcan*	'miser', from √qmc	→	*hitqamcen* 'act miserly'
b.	*šaxcan*	'arrogant', from √šxc	→	*hištaxcen* 'act arrogantly'
c.	*baxyan*	'one who often cries', from √bkh	→	*hitbaxyen* 'cry often, complain'
d.	*xucpan*	'impudent', from √xcp	→	*hitxacpen* 'act impudently'

[12] I thank an NLLT reviewer for pointing that out to me.

derived elements. Consider the difference between noun-derived nouns and root-derived nouns in Hebrew, as illustrated in (17) and (18):

(17)a.	√yld	CiCoC	*yilod*	'newborn'
b.		CcuCa	*yeluda*	'birth rate'
c.		CCeCa	*leda*	'childbirth'; initial root consonant *y* drops: *yleda
d.		CaCiC	*yalid*	'a native'
e.		CeCeC	*yeled*	'child'

The root √yld forms many different nouns. Any heads that further combine with the noun *yeled* 'child'(17e), made from this root, take as their input the semantics of that noun and not of the root:

(18)a.	√yld + CeCeC	*yeled*	n, 'child, boy'[13]
b.	yeled + ut	*yaldut*	n, 'childhood'
c.	yeled + ut + I	*yalduti*	adj., 'childish, pertaining to childhood'
d.	yeled + ut + i+ ut	*yaldutiyut*	n, 'childishness'
e.	yeled + on	*yaldon*	n, 'little child'
f.	yeled +a	*yalda*	n, 'girl'
g.	yeled + hitCaCCeC	*hityaled*	v, 'act like a child, be childish'

Evidently, nominal and adjectival heads combining with the noun may alter some aspects of it. They may make an abstract noun out of a concrete noun (18b) or out of an adjective (18d), create a property from the noun (as does the adjectival head in 18c), form a diminutive (18e), or change gender (18f). But crucially, all these heads operate on the basis of the noun *yeled* 'child', and not on the basis of the root √yld. They therefore retain the meaning of 'child' and do not have access to the root √yld or to any of the interpretations of that root in other environments; it is impossible to add any of these suffixes to the noun *child* and get, for instance, *birthrate* (17b).[14]

[13] Nouns such as *yeled* belong to the segolite group and are phonologically special. Their singular forms bear non-final stress – which is unusual for Hebrew nouns. This stress is changed into final one in all suffixed forms. Except in the plural form (*yeladim*), such nouns also exhibit vowel contraction in suffixed forms (18b–f), which corresponds to the change of stress from initial to final.

[14] One reviewer notes that suffixes may alter the meaning of the Hebrew words in the following way: *mapa* 'table cloth' vs. *map**it*** 'serviette', *beyca* 'egg' vs. *beyc**it*** 'ovum',

Finally, the locality constraint on root interpretation works trivially with borrowed nouns or verbs. Consider Hebrew verbs that are derived from foreign words:

(19)a. foreign noun: *telephone*
b. borrowed Hebrew noun: *telefon*
c. borrowed verb: *tilfen*, CiCCeC 'telephone'

(20)a. foreign verb: *click*
b. borrowed verb: *hiqliq*, hiCCiC 'click'

Borrowed verbs or nouns are semantically tied to the foreign word and very rarely change their basic meaning in the act of borrowing.[15] I take this as evidence that what is borrowed is not a root, but a noun or a verb, that is, a unit whose lexical and semantic properties have already been sent off to PF and LF (more on this in section 6).

To summarize the discussion so far: the Hebrew data presented strongly support the assumption that word formation is locally constrained and, specifically, is sensitive to the distinction between roots and non-roots. As was illustrated here for Hebrew, a single root may be assigned a number of meanings in the environment of different heads, but this freedom of interpretation is locally constrained by the first category head with which the root merges. Once the root has merged with a head, its interpretation has been decided and is carried upward in the derivation. Further derivation, while sometimes changing grammatical category or adding certain properties (gender, diminutives), may not alter the basic meaning assigned to the root by the head with which it merged first. The contribution of Hebrew to the theory of word formation is twofold. First, because Hebrew roots create several nouns and verbs in different morphophonological environments, Hebrew enables us to appreciate fully the striking contrast between the variety of interpretations associated with word formation from roots, as opposed to the strict semantic dependency forced on word formation from words. This contrast would not have been noticed if we only

mexona 'machine' vs. *mexon**it*** 'car' and *mišpaxa* 'family' vs. *mišpaxt**on*** 'day care'. While true (note, though, that with the *-it* suffix the words formed may be seen as diminutives that have acquired a specialized meaning), this does not contradict the main claim made here, that further derivation of words does not have any access to the *root*, nor to any of the interpretations assigned to that root in other environments.

[15] As one reviewer notes, some cases of semantic change in borrowing exist, for example, the German word for mobile phone, *handi*, from English *handy*, or the Hebrew word *buk* 'model's portfolio', from English *book*. This suggests that such changes involve narrowing of meaning or specialization , where the borrowed word is used in a specialized sense.

looked at English-type languages, where roots are not assigned multiple interpretations. Second, because the root and the word-creating morpheme are distinct in Hebrew, morphological evidence for the nominal origin of noun-derived verbs is often available. This provides an overt manifestation for the derivational relation between certain nouns and verbs. However, I argued that while the assignment of multiple meanings to roots is language specific, the distinction between root- derived and word-derived is universal. In this case, we expect that even in languages where no morphological cues are available, we will find the same semantic contrast between word formation from words and word formation from roots. This is indeed the case, as will be illustrated for English zero-related pairs in the next section.

4. In the Absence of Morphology: The Semantic Properties of Denominals

Morphological cues are not always available to determine whether a verb is derived from a noun. Consider the following Hebrew pairs:

(21)	noun		verb	
a.	*ceva*ʕ	'paint/color'	*cava*ʕ	'paint/color'
b.	*kis*	'pocket'	*kiyes*	'pick-pocket'
c.	*mišxa*	'paste'	*mašax*	'paste'
d.	*sid*	'whitewash'	*siyed*	'whitewash'
e.	*zefet*	'tar'	*zipet*	'cover with tar'
f.	*galʕin*	'a pit'	*gilʕen*	'pit'

Two possibilities suggest themselves: either both the noun and the verb are derived from the same root, or the noun is derived from the root and the verb is derived from the noun. This is precisely the situation in English, where pairs of nouns and verbs are often zero-related – *hammer*, *tape*, *kiss*, *button*, *anchor*, etc. – with no morphology to indicate any derivational relation between them (cf. Clark and Clark 1979; Levin 1993, and references therein). In this case, too, it could be that both the noun and the verb are derived from the same root, or that one member of the pair is derived from the other.

Based on the universality of the constraint on the interpretation of roots, I argue that in the absence of morphological cues, semantic cues can distinguish between root-derived and noun-derived verbs. Following Kiparsky (1982), I suggest that English verbs that are zero-related to nouns are not a uniform group. Rather, they may be either root-derived or noun-derived.

The crucial observation made by Kiparsky is that English verbs that have zero-related nouns differ with respect to the relation they bear to these nouns. Specifically, such verbs fall into two groups, as illustrated below:

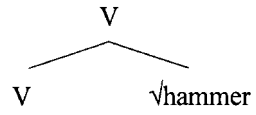
(22)a. I paddled the canoe with a copy of the New York Times.
b. String him up with a rope!
c. She anchored the ship with a rock.
d. He hammered the nail with a rock. (Kiparsky's 1982 example (14))

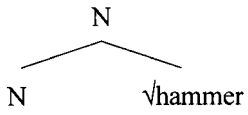
(23)a. *She taped the picture to the wall with pushpins.
b. *They chained the prisoner with a rope.
c. *Jim buttoned up his pants with a zipper.
d. *Screw the fixture to the wall with nails! (Kiparky's 1982 example (16))

A clear distinction is drawn between the two types of verbs above. The verbs in (23) *entail* the existence of the corresponding noun – there is no way to tape, chain, or button without using tape, a chain, or a button. In (22), on the other hand, the meaning of the verb does not entail that of the noun. As Kiparsky notes, *to tape* roughly means 'apply tape'. *To hammer*, by contrast, does not mean 'strike with a hammer', but rather, 'to strike with a flat surface of a solid object'. One can hammer not only with a hammer, but also with a rock or a shoe, but one cannot tape using anything other than tape.[16] Following Kiparsky, I assume that in (22) the zero-related nouns and verbs are independently derived from a common root, while in (23), the noun is derived from the root and the verb is further derived from the noun.[17] Consider *hammer*-type verbs, where both the noun and the verb are derived from the same root:

[16] The difference between *hammer*-type and *tape*-type verbs is also apparent in the range of interpretations associated with the first group, but not with the second. Thus, there is *hammer out an argument, hammer out a revised version of the paper*, and *hammer away*. These interpretations share the manner component of the verb *hammer* – they refer to fashioning, shaping, or resolving issues – but they are not semantically tied to the instrument 'hammer'. Such an interpretation is very rarely associated with *tape*-type verbs, where the verb invariably means 'perform an action using the entity' – *tape*, *button*, *bicycle*, etc. (An exception to this is *chain up*, which does not involve a chain.)

[17] I differ from Kiparsky in assuming that the derivation in question takes place not in the lexicon, but in the syntax. Instead of ordered levels in the lexicon, there is structural hierarchy in the syntax, defined by the first category head that merges with the root.

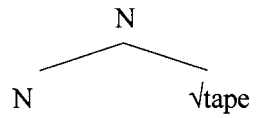
(24)a. 

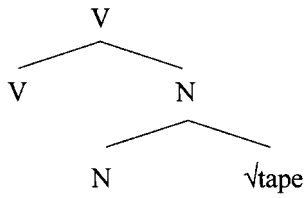
b. 

The root √hammer, from which both the noun and the verb are derived, has a core meaning. I assume this meaning is a certain *manner* – shaping, forming, etc. This core meaning is manifest in both the noun and the verb derived from the root. The default interpretation of roots in verbal environment is that of an action or an event. In a verbal environment, the root √hammer is interpreted as an *action* performed in a certain manner (the precise manner, hammering, is given by the properties specific to the root, cf. Levin 1999). In a nominal environment, the default interpretation of roots is that of an entity. The root √hammer, when embedded in a nominal environment, is interpreted as an entity or as an instrument used in that particular manner (the specific entity, a hammer, is determined by the root).

It is expected that the noun *hammer* and the verb *hammer* will have close meanings – both are derived from the same root. But because they are both derived from a *root*, none entails the existence of the other.[18]

Now consider the tape-type group, where the verb is derived from the noun:

(25)a. 

b. 

In this case, the noun denotes an entity, and the corresponding verb refers to some activity which necessarily involves that entity. The specific type of activity will depend on the particular noun involved – *tape*, *chain*, or *button* – as well as on the specific syntactic structure of the verb (e.g., *bicycle* is a motion verb, *tape* is a location verb). Note that I am assuming that the difference between *hammer*-type and *tape*-type verbs is based on

[18] The diagnostics and intuitions are much sharper with concrete nouns. Thus, manner-instrument verbs (*tape, button, bicycle*), location verbs (*sugar, salt, frame*), and verbs of removing (*stalk, pit*) clearly indicate the relation between the verb and the noun. As one reviewer notes, in cases such as *love, hate*, or *request* (historically noun-derived) and *exit*, *produce*, or *release* (historically verb-derived), the distinction is less clear. For Latinate verbs such as *request*, *release*, and *produce*, see discussion later on in this section.

synchronic evidence, concerning speakers' intuitions, and not on historical and etymological evidence. [19]

There is an implicit assumption in Kiparsky (1982) that the meaning of the noun enters into the meaning of the verb when the verb is noun-derived. The reason why this should be the case is not discussed. Let me make this claim explicit. Word-derived words take as their input something whose meaning has already been fixed (cf. (13)). Therefore, the meaning of the noun *must* be carried into the meaning of the noun-derived verb.

Consider now the argument made so far. In section 3, I argued (based on morphological evidence) that a verb that is structurally derived from a noun also depends on it semantically. In this section I extended the analysis to cases where no morphological cues exist, arguing that when a verb semantically depends on a noun, it must be structurally derived from it. In other words, the entailment works both ways: a derivational relation between a noun and a verb entails a semantic relation between them, and a semantic relation between a noun and a verb entails a derivational relation between them. This follows from the theoretical assumptions made so far. Consider the following claim:

(26) Each specific interpretation of the root is only available in a specific (syntactic and phonological) environment.

(26) is an extension of an assumption present in practically any theory: semantic polysemy aside, the relation between sound and meaning is unique. If the sound /dog/ refers to a dog, then the sound /bɛ:r/ does not refer to it. (26) refers to *roots*, taking into account the multiple environments where roots may be assigned an interpretation. In English, this means that the root √hammer is assigned the meaning of the instrument *hammer* only in a nominal environment, not in a verbal one, and the interpretation of an activity (in a certain manner) only in a verbal environment. In Hebrew, where a single root may form numerous nouns and verbs, (26) claims that each nominal or verbal environment is associated with *one* specific interpretation.[20]

[19] Note that, historically, *tape*-type verbs may turn into *hammer*-type verbs. One such example is the French verb *sucrer*. Historically (according to the Petit Robert Dictionary) it is derived from the noun *sucre* 'sugar'. In present-day French, though, it is being used like English *sweeten*, and does not imply necessarily the use of sugar: one can *sucrer* with honey, saccharine, etc. One reviewer suggests an asymmetry between *tape*-type verbs and *hammer*-type verbs, in that *hammer*-type verbs should not evolve into a verb whose action *must* imply using a hammer. If this asymmetry turns out to be correct, it may be possible to reanalyze a noun as a root, thus using *sucrer* with no reference to sugar.

[20] For example, in (7) above the root √bxn is assigned the interpretation 'exam' only in the nominal environment miCCaC, and 'test-tube' only in the nominal environment

Let us see how (26) applies to denominal verbs. Recall that the root √tape does *not* equal the noun *tape*: the root is only interpreted as an entity (*tape*) when put in a nominal environment. There is no way to get directly from the root √tape to the verb *to tape*, which entails the meaning of the noun *tape*, without first going through a nominal projection. Since roots acquire their interpretations as nouns only when embedded in a nominal environment, whenever a verb entails the meaning of a noun it cannot be derived directly from the root. There must be a nominal projection intervening. This is particularly evident in Hebrew, as seen in (10)–(11) above. The root √sgr may be assigned many different interpretations; the interpretation *frame* is only available in the nominal environment miCCe-Cet. There is no way to get from the root √sgr to the verb *misger* 'frame' without first going first the noun *misgeret* 'frame', as is evident by the nominal prefix it carries. The verb must be derived from that particular noun – not from any other noun that the root creates (e.g., *seger* 'closure', *sograyim* 'parentheses'). In contrast, root-derived verbs will never entail the meaning of their corresponding (root-derived) noun – because the interpretation of the noun is only available at the nominal projection, which is lacking in that case.

Given the assumptions made here, we would expect to find not only semantic, but also phonological evidence that should distinguish between root-derived and noun-derived English verbs. Such evidence does exist, and it concerns stress assignment in zero-related pairs. There are several correlations that hold between stress assignment and semantic relation in zero-related pairs. First, as has been observed initially by Hayes (1981), as well as by Kiparsky (1982), Raffelsiefen (1993) and Myers (1984), when zero-related pairs share the same stress pattern, there tends to be a tight semantic relation between the noun and the verb (27). When stress assignment is different in the verbs and the nouns, the semantic relation between the two is in most cases quite tenuous (28):

(27) díscipline$_{N,V}$, cóntact$_{N,V}$, dócument$_{N,V}$, expériment$_{N,V}$, bálance$_{N,V}$, cómment$_{N,V}$, hérald$_{N,V}$. (Myers 1984)

of miCCaCa. I assume this is part of the (universal) knowledge of language the child has; once *mivxan* means 'exam', then *mavxena* cannot have that meaning (and, similarly, an English-speaking child hearing two different phonological items, assumes them to be lexically distinct).

(28) récord$_N$/recórd$_V$, súbject$_N$/subjéct$_V$, óbject$_N$/objéct$_V$,
próject$_N$/projéct$_V$, rébel$_N$/rebél$_V$, digést$_N$/dígest$_V$,
cónduct$_N$/condúct$_V$, ábstract$_N$/abstráct$_V$, cómbine$_N$/combíne$_V$,
éxploit$_N$/explóit$_V$, próduce$_N$/produce$_V$, défect$_N$/defect$_V$,
cóntest$_N$/contést$_V$, cónvict$_N$/convíct$_V$, cóntract$_N$/contráct$_V$.
(Raffelsiefen 1993; Myers 1984)

Under the assumptions made here, the convergence of stress difference and freer semantics vs. similar stress and tight semantic relation is hardly surprising. It is immediately derived if we assume that the difference between the two groups lies in the relation between the verb and the noun. In (27), the verbs are derived from the nouns. They therefore share the typical nominal stress in English – recall they take as their input both the semantics and the phonology of their base noun – as well as the interpretation of the noun. In (28), on the other hand, both the noun and the verb are derived from a common root. They are assigned typical nominal and verbal stress, respectively, and are assigned meanings that are sometimes far apart. Thus, the relation between a *cómbine* (a machine for harvesting grain) and the verb *combíne*, between the noun *défect* and the verb *deféct*, or between the noun *súbject* and the verb *subjéct* is quite free. This is opposed to zero-related pairs that share their stress pattern – *discipline*, *experiment*, *comment*, etc. – where the semantic relation between the two is clear.

Further phonological evidence distinguishing English zero-related pairs comes from triplets of zero-related forms. As noted by Kiparsky (1982) and Myers (1984), many nouns that have zero-related verbal forms may further create zero-derived verbs:

(29)a. permít$_V$ – pérmit$_N$ → pérmit$_V$
b. affíx$_V$ – áffix$_N$ → áffix$_V$
c. protést$_V$ – prótest$_N$ → prótest$_V$
d. digést$_V$ – dígest$_N$ → dígest$_V$
e. compóund$_V$ – cómpound$_N$ → cómpound$_V$
f. contráct$_V$ – cóntract$_N$ → cóntract$_V$

In such cases, there is a striking difference between the two verbs in each triplet. The verb that does not share the stress pattern with the noun also has a different interpretation, while the verb that shares the nominal stress is also semantically dependent on that noun. I take this as evidence that the verbs with the nominal stress pattern, such as *áffix* and *pérmit*, are derived from their corresponding noun, while verbs such as *affíx* and *permít* are root-derived.

So far we have been concerned with a particular group of English zero-related pairs, the group Kiparsky calls noun-instrument pairs. But the same semantic criteria hold for other lexical groups. I will discuss here two such groups – location and locatum verbs – and show that the same semantic contrast appears within each group. Consider first location verbs:

(30)a. They housed their guests in their barn/their castle.
b. John shelved the books on the mantelpiece
c. *John boxed the apples in his bag.
d. *John bottled the vodka in the jar.
e. *John corralled the horses into the stable.

The verbs in (30) are all location verbs (naming the *location* into which the object goes, cf. Levin 1993), yet they differ with respect to the semantic relation the verb bears to the corresponding noun. One can shelve not only on a shelf, but also on the windowsill or the mantelpiece. *To box*, on the other hand, means 'put in a box' – and not in any other location (bag, bottle, etc.). This difference is immediately explained if we assume that (30a–b) are root- derived, hence the verb (e.g., *house*) does not necessarily entail the meaning of the noun, while (30c–d) are noun-derived, hence *to jar* or *to box* must mean put in a jar or a box, respectively. Locatum verbs, that is, verbs naming the entity that is being located or applied, show the same distinction:

(31)a. She dusted the cake with sugar.
b. She powdered her face with crushed chalk.
c. *She sugared her tea with jam.
d. *She starched the collar with chemicals.

Again, the contrasts in (31) are immediately derived if we assume that *dust* and *powder* (31a–b) are root-derived, defined independently of the noun: one can powder using crushed chalk. Similarly, the verbs in (31c–d) are derived from their corresponding noun: *to starch* entails 'apply starch', *to sugar* 'apply sugar' (the same for *salt*, *pepper*, *flour*).[21]

[21] For lack of space I limit my discussion here to location and locatum verbs. Note, interestingly, that verbs of removing (Levin 1993), which are very similar to location verbs, seem to be all noun-derived. They include in their meaning the entity that is removed – a shell, pits, or a stalk:

(i)a. She shelled the lobster/the peas/the nuts (*the banana).
b. She pitted the orange (*the melon).
c. She stalked the artichokes.

We may now return to the Hebrew verbs in (21) and show that they behave like their English counterparts. Consider the pair 'paint' (21a) and 'whitewash' (21d):

(32)a. Dani cavaʕ et ha kirot be laqa
Dani painted OM the walls with varnish
Dani painted the walls with varnish.

b. *Dani siyed et ha kirot be laqa
Dani whitewashed OM the walls with varnish.
Dani whitewashed the walls with varnish.

cavaʕ only specifies 'add color': the material used is not part of the denotation of the verb.[22] The related noun, *cevaʕ*, can be whatever is prototypically used for coloring: liquid paint, a crayon, etc. The noun and the verb are related in their meanings, which is expected, given that they are derived from the same *root*, √cvʕ, but neither of these semantically entails the other. In contrast, *siyed* roughly means 'cover with whitewash'. The noun *sid* refers to a specific material, whitewash. In this case, the verb entails the noun and is derived from it: one cannot whitewash using any material other than whitewash (cf. 32b).

By applying the same criteria, we can distinguish the root-derived verbs in (21b–c) from the noun-derived verbs in (21e–f). Nouns and verbs derived from the same root often have more specialized meanings: the noun *kis* (21b) denotes a container in a general sense (not only a pocket in one's clothes) while the verb *kiyes* has the specialized meaning 'to pick-pocket'.[23] The noun *mišxa* can be any material with a paste texture, and the verb specifies a manner (*paste*), but not the material applied. This stands in contrast to the noun-derived verbs in (21e–f), where the meaning of the verb depends on that of the noun. One may not use the verb *zipet* 'cover with tar' if the material applied is not *zefet* 'tar', and one may only use *gilʕen* 'pit' if the entity removed is a pit.

Note that although universal locality principles force noun-derived verbs to include the meaning of the noun, languages have some choice in

[22] The verb may include a manner component, similar to English *paint* (meaning: apply material with some instrument – brush, crayon, etc, in a particular manner, i.e., splashing material all over the surface is not painting). But this manner component is optional, and in its absence the verb may take a non agentive external argument (as in "The blood that spilled all over the place colored John's shirt deep red").

[23] Note that the verb *kiyes* does not entail the noun *kis*: one can pick-pocket a wallet, a handbag, a pouch, etc.

specifying the type of relation between the verb and the noun.[24] However, the possible interpretations assigned to noun-derived verbs seem to form a limited set:

(33)	noun	verb
a.	material/entity	apply/put material/entity (*tape, sugar, saddle*)
b.	entity	remove entity (*pit, stalk, core*)
c.	instrument	use instrument (*lasso, pitchfork*)
d.	location	put something in location (*pocket, box, bottle, shelve*)
e.	entity	typical activity related to that entity (*button*)
f.	material/entity	become material/entity (*cake*)
h.	entity	create/bring about entity (*calve*)[25]

To conclude: starting with the observation that zero-related nouns and verbs fall into two groups, based on their relation to their corresponding noun, I argued that this semantic relation directly results from the difference in the derivation of the verb in each of these groups. In one group the verb and the noun are derived from the same root, in the other the verb is derived from the noun. Both English and Hebrew distinguish between word formation from roots and word formation from words, but while in Hebrew nominal morphology often appears on noun-derived verbs, in English the morphophonological evidence is less direct. Crucially, however, the semantic effect is similar. In both languages noun-derived verbs are tied in their interpretation to their base noun.

[24] It is an open question to what extent a language has a free hand in choosing which of the possible interpretations is assigned to the noun-derived verb. A few English verbs, such as *seed* and *string*, may, in different contexts, be interpreted either as verbs of location (*seed a field, string a violin*) or as verbs of removing (*seed the melon, string the beans*). On the other hand, could English have in principle a verb *saddle* meaning 'remove a saddle'? English has many location verbs, as opposed to a very limited set of source verbs (*mine* and *quarry*, cf. Levin 1993), but it is not clear to me whether this is an arbitrary property of English or a general tendency among languages resulting from a grammatical reason. I leave this for future research.

[25] An interesting question, which is beyond the scope of this paper, is the interaction between the semantics of the noun (in particular, mass or count) and the semantics of the verb derived from it (Harley 1999). Some correlations suggest themselves, for example, verbs denoting a location cannot be derived from mass nouns, but only from quantized entities (*box*, *bottle*), while those denoting a locatum (located object) may be derived from both (*sugar* vs. *saddle*). For detailed discussion of these properties of denominals, see Clark and Clark (1979), Farrell (1998), Harley (1999) and Kiparsky (1997).

A final word is called for regarding the term 'denominal verb', which is sometimes used to refer to all English verbs that have a zero-related noun. A finer-grained examination of zero-related verbs and nouns suggests that this group is not uniform, and not all the verbs in this group are noun-derived. Based on the semantic and morphological evidence presented here, I suggest reserving this term only to verbs that are structurally derived from the noun.[26]

5. The Remaining Piece: Verb-Derived Nouns

The discussion so far has mentioned three groups: root-derived verbs, root-derived nouns, and noun-derived verbs. A fourth group suggests itself: verb-derived nouns.[27] The question arises whether in this group, too, there is a distinction between root-derived and verb-derived elements. Nominal forms have received much attention in recent years, and a considerable amount of work has been dedicated to their typology (for some recent references see Engelhardt 2000; Alexiadou 2002, and references therein). The existence of verb-derived nouns is hardly disputed. Gerunds (e.g., *destroying*, *growing*, or *reading*) are universally taken to contain a VP layer in them, and event nominalizations (e.g., *assignment*, *examination*) are also assumed by many to contain a VP.[28] As expected, verb-derived nouns depend in their meaning on the verbs they are derived from (e.g., *examination* and *examining* both share the meaning of *examine*). A detailed study of nominalizations is beyond the scope of this paper (see references above, especially Marantz (1997) and Alexiadou (2002), for evidence distinguishing root nominalizations and verb nominalizations). I therefore concentrate here on two specific, less studied, groups of verb-derived nouns – English zero-related pairs and their Hebrew counterparts, where verbal morphology is overt. As expected, both types of verb-derived nouns depend in their interpretation on their base verb, as predicted by

[26] The facts discussed here motivate a finer-grained analysis of this group of verbs in theories that derive zero-related pairs through noun incorporation, e.g., Hale and Keyser (1998). This distinction can be captured as follows: true denominals involve noun incorporation, but in other verbs what incorporates is the root, rather than a noun.

[27] I ignore here word formation without category change, that is, verb-derived verbs and noun-derived nouns.

[28] Cf. Borer (1991), Alexiadou (1999), Engelhardt (2000).

the locality constraint on the interpretation of roots. Consider, first, the following English pairs:

(34)	noun	verb
a.	kiss, cough	kiss, cough
b.	roast	roast
c.	walk, jump	walk, jump
d.	slap, kick	slap, kick

At first glance, these pairs seem identical to those discussed in section 4, such as *tape* or *button*. But the relation between the noun and the verb is different here. It is the noun that seems to be semantically dependent on the verb, in the following way: a kiss is an outcome of a kissing event – and owes its existence to the activity of kissing. A roast is the result of roasting something. A walk is a (temporally) bounded 'piece' of walking activity. While noun-derived verbs include in them the *entity* specified by the noun, verb-derived nouns entail the *activity* denoted by the verb. There is no way to bring about a cough or a jump without the activity of coughing or jumping, just like one cannot use the verb *tape* if the material applied is not tape. The interpretation of the noun-derived as a result of the activity or as a temporally bounded activity seems to depend on the lexical class to which the verb belongs (cf. Harley 1999):

(35)	lexical class	noun interpretation
a.	change of state ('roast', 'crack')	result of change of state ('a roast', 'a crack')
b.	activity ('wipe')	the smallest 'piece' of activity ('a wipe')
c.	semelfactive ('kick,' 'cough')	the smallest 'piece' of activity ('a kick')[29]
d.	motion verb ('walk', 'jump')	motion bounded in time/ quantity ('a walk')

If the verb is an action verb, the noun denotes a bounded piece of the event. This boundedness could either be arbitrary (e.g., a walk is any 'piece of walking' bounded in time, not necessarily with a specific destination), or it could be taken as a single event in a series of activities (a kick is a single occurrence, the verb kick could be a single kick or a series of kicking), or a *result* that is part of the meaning of the verb (the verb *roast* could

[29] See Levin (1999) for the similarity between activities and semelfactives.

be interpreted as either an activity or an accomplishment, the noun *roast* encodes the accomplishment – something that has been roasted).

Noun-derived verbs of the 'noun-instrument' class (e.g., *pitchfork*) were shown to have corresponding pairs where both the noun and the verb are root-derived (e.g., *hammer*). The question arises whether the verbs in (34) also have such corresponding pairs of the same lexical class (e.g., motion verbs, change of state verbs). While I will not pursue this matter in detail here, I believe that such cases do indeed exist. Consider the verb *run* and the noun *run*. Unlike a walk or a jump, a run has a meaning independent of the motion verb *run*. That is, a run does not require a running event in the same way a walk requires a walking event. Similarly, a break does not depend semantically on the change of state verb *break*. Hayes (1981), Kiparsky (1982), Myers (1984), and Raffelsiefen (1993) point out other cases where the semantics of the verb is quite independent of its zero-related noun. Remarkably, in all these cases there is a strong correlation between the semantic and phonological properties of the noun and the verb. Nouns that are assigned typical nominal stress are also semantically independent of their corresponding verb:

(36) recórd$_V$/récord$_N$, permít$_V$/pérmit$_N$, convért$_V$/cónvert$_N$, éxploit$_N$/explóit$_V$, próduce$_N$/produce$_V$, défect$_N$/defect$_V$, cóntest$_N$/contést$_V$, cónvict$_N$/convíct$_V$, cóntract$_N$/contráct$_V$

The pairs in (36) are derived from a common root – which explains their relatively independent meanings. In other pairs, the nouns share the verbal stress pattern, indicating their verb-derived status, and are also semantically dependent on the verb:

(37) consént$_{N,V}$, rebúff$_{N,V}$, deféat$_{N,V}$, divórce$_{N,V}$, attáck$_{N,V}$, debáte$_{N,V}$, dispáir$_{N,V}$, suppórt$_{N,V}$, demánd$_{N,V}$, escápe$_{N,V}$, rewárd$_{N,V}$, refórm$_{N,V}$, distréss$_{N,V}$

To conclude the discussion of English zero-related pairs, note that a closer examination of this group forces a finer-grained analysis. These pairs are often treated uniformly due to their morphological properties.[30] However, members of this set were shown here to fall into three sub-groups. In one group, both the noun and the verb are derived from the same root (*hammer*,

[30] See, notably, Kiparsky (1982), Myers (1984), and Raffelsiefen (1993) for a different view. Interestingly, the authors that advocated a difference in derivation were also those concerned with the phonological properties of this group. I believe this is not a coincidence, as the correspondence between sound and meaning in this case tends to coincide at the same structural level.

run). In another group, the noun is derived from the root and the verb is derived from the noun (*tape*). Finally, in a third group, the verb is derived from the root and the noun is derived from the verb (*kiss*). This claim is at odds with some current work, which takes all zero-related pairs to be noun-derived (most notably, see Hale and Keyser 1998), but I believe that the distinction between these three classes is well grounded, given the semantic and morphophonological evidence brought up here.

Hebrew provides further support for the existence of verb-derived nouns. Each Hebrew verbal pattern (with the exception of the two passive patterns) has a nominal pattern related to it:

(38)	verbal pattern	related nominal pattern
a.	CaCaC	CCiCa
b.	niCCaC	hiCCaCut
c.	CiCCeC	CiCCuC
d.	hiCCiC	haCCaCa
e.	hitCaCCeC	hitCaCCCut

These nominal patterns are related to their verbal counterparts both morphologically and syntactically: they retain the syllable structure and some of the prefixes of the verbal pattern, as well as the argument structure of the verb (cf. Engelhardt 2000). Interestingly, many Hebrew nouns of the type *kick*, *walk*, etc., appear in verb-related nominal patterns:

(39)	root		verb	related noun	
a.	√str	*satar*	'slap'	*stira*	'a slap'
b.	√bʕt	*baʕat*	'kick'	*beʕita*	'a kick'
c.	√hlk	*halax*	'walk'	*halixa*	'a walk'
d.	√xbq	*xibeq*	'hug'	*xibuq*	'a hug'

The nouns in (39) bear an overt morphological relation to the correlating verb. As expected, they are also tied in their interpretation to that verb. The evidence for this semantic relation is in fact even stronger. Recall that Hebrew roots often acquire numerous interpretations across different verbal patterns (cf. section 2). Note, now, the relation between the root and the corresponding verbs and nouns:

(40)	√btx	verbal pattern		derived nominal pattern	
a.		*biteax*	'insure'	*bituax*	(insurance)
b.		*hivtiax*	'promise'	*havtaxa*	'a promise'

(41)	√bšl	verbal pattern		derived nominal pattern	
a.		*bišel*	'cook'	*bišul*	'cookery, cooking'
b.		*hivšil*	'mature, ripen'	*havšala*	'ripening'

The root √bšl acquires two verbal interpretations in the context of two verbal patterns, 'cook' and 'ripen'. The noun *bišul* 'cookery' is semantically tied to the verb *bišel* 'cook' from which it is derived. Crucially, the noun has access neither to the root √bšl nor to any of the interpretations assigned to it in other contexts. *Bišul* 'cookery' can never mean *havšala* 'ripening', just as *bituax* 'insurance' in (40a) cannot take on the meaning of 'promise', assigned to the root in another verbal context (40b). The relation between verbal patterns and derived nominal patterns is not completely regular. In particular, nouns may appear in these patterns even when there is no corresponding verb (in which case they are derived from a root) or if the corresponding verb appears in another pattern.[31] This irregularity does weaken the generalization made here, namely, that if a noun appearing in these nominal patterns has a corresponding verb, then it must be derived from that verb. In other words, while there may be some gaps in the morphological system (non-existing verbs or nouns), if a verb has a related nominal form, then this form is semantically and morphologically dependent on it.

6. The Phonological Properties of Denominals and the Status of the Consonantal Root

Throughout the discussion, I took Hebrew roots to consist of three segments, or consonants. This assumption is not uncontroversial. The status of the Semitic consonantal root has recently been subject to some debate. Work in phonology (Bat El 1994; Ussishkin 1999) has denied the status of the consonantal root in Hebrew, while psycholinguistic evidence supported its existence (see Prunet et al. 2000, who discuss mainly Arabic).

[31] Irregularities seem to fall into three types. First, a verb-derived noun may appear not in the relevant, verb-derived pattern, but in another pattern which is not specifically verb-derived: *qacar* 'to harvest', from √qcr, does not have **qcira*, but *qacir* 'a harvest'. In other cases, the noun-derived verb appears in a nominal pattern derived not from the matching verbal pattern, but from another pattern: *šiʕul* 'a cough' appears in the nominal pattern derived from the (non-existing) verb **šiʕel* , while the verb *hištaʕel* appears in another pattern. Finally, a noun may appear in one of the verb-derived nominal patterns even when no corresponding verb exists. Thus, the root √špt, which creates the verb *šafat* 'to judge' and its derived noun *šfita* 'judging', forms also *šiput* 'judgment', which does not have a corresponding verb **šipet*.

Interestingly, the argument against the consonantal root is drawn entirely from denominal and borrowed verbs. It runs as follows: there is sound phonological evidence that denominals and borrowed verbs are formed not from a consonantal root, but from an existing word. If we generalize this to all Hebrew verbs, we get a unified account of the Hebrew verbal system, with the notion of the consonantal root made redundant.

The phonological evidence regarding denominals is indeed convincing. In fact, it is precisely what is predicted, given the assumptions made here. Denominals and borrowed verbs were shown to differ from root-derived verbs with respect to their semantic interpretation. If, as I suggested, the nominal head that merges with the root creates a phase, then we should expect denominals to differ from root-derived verbs not only semantically, but also phonologically. Just as a denominal verb takes as its semantic input the noun from which it is derived, it also takes that noun as its phonological input, and therefore we expect that different phonological mechanisms should be involved in the formation of noun-derived and root-derived verbs. My argument here is twofold. First, I examine the phonological arguments against the consonantal root. These arguments, I maintain, are in fact arguments supporting the claim that denominal verbs are formed on the basis of existing words rather than roots, and not arguments against the consonantal root itself. Second, I then show that root-derived and noun-derived Hebrew verbs differ not only semantically but also phonologically, thus further supporting the structural distinction between them.

Consider, first, Bat El (1994), where four sources of evidence in favor of the word-based approach for denominals are presented. First, Bat El notes that denominal verbs carry affixes that are typical of nouns, such as *m-*, *t-* (this has also been shown here in section 3). Second, cluster transfer in borrowed verbs preserves the original consonant cluster of the word from which they are derived. The arrangement of the consonants within the Hebrew verbal pattern differs according to the phonological form of the base:

(42)	Base		Derived verb	
a.	*transfer*	'transfer'	*trinsfer*	'transfer'
b.	*streptiz*	'striptease'	*striptez*	'perform a striptease'
c.	*sinxroni*	'synchronic'	*sinxren*	'synchronize'

Consonant clusters in the base word are kept together in the verbal form. Note that this is not due to phonological restrictions: Hebrew phonology would allow forms such as **tirnsfer*, **stirptez*, or **snixren*, where the cluster is broken. Furthermore, Bat El shows that borrowed and denominal

verbs strongly tend to appear in the verbal pattern in which the phonological structure of the base word is best preserved. For example, when the base word has the vowel *i* in it, the verb will appear in the fifth pattern, which has the vowel melody *i/i* in the active voice:

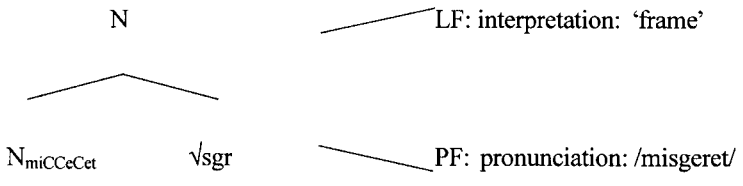
(43)	Base		Derived verb	
a.	*qliq*	'a click'	*hiqliq*	'to click'
b.	*fliq*	'a slap'	*hifliq*	'to slap'
c.	*špritz*	'a splash'	*hišpritz*	'to splash'

Finally, Bat El (1994) and Ussishkin (1999) show that when the base noun is monosyllabic, thus requiring some modification to make the base fit into the prosodic structure of the verbal pattern, the form of the denominal verb is predictable from the form of the nominal base.

Based on this evidence, Bat El argues that borrowed and denominal verbs are formed by a process called Stem Modification (that is, replacing the vowels of the base word by those vowels typical of the verbal pattern) rather than by root-to-template association, as originally assumed in McCarthy (1981). Having established the Stem Modification analysis for borrowed and denominal verbs, Bat El then extends this analysis to all Hebrew verbs.

It is at this point that I depart from Bat El's assumptions. I argue that it would be wrong to generalize from word-derived verbs to all Hebrew verbs, precisely because of the property that characterizes these verbs, their being made from existing words. Category heads, as argued in section 3, serve as the immediate environment for fixing the meaning of a root, where its semantic and phonological features are shipped off to the interface levels. Shipping off phonological features to PF means that the unit has to be phonologically incarnated. Any further phonological modifications will operate on that particular incarnation, not on the root. A head that merges above the phase level thus has no access to the lexical representation of the root – only to that of the word it creates. Similarly, it has no access to the phonological representation of the root – only to the actual phonological output at the phase level, that is, the noun or verb. Consider, for example, the representation of the root √sgr (cf. (10)–(11) above), in the nominal environment *miCCeCet*:

(44)



Because, after it merges with a category head, the derivation no longer has access to the phonological representation of the root √sgr, any word-derived verb must be phonologically derived by manipulation on existing phonological structures. When a verb is formed from a foreign word, e.g., *telephone*, or from a root-derived noun, e.g., *misgeret* 'frame', the interpretive component has access only to the meaning of the *noun*, and the phonological component has access only to the phonology of the *noun*. We thus expect borrowed and denominal verbs to be formed by Stem Modification of the noun rather than by root-to-template association. This is the only choice the grammar has: it cannot extract the consonants of the root, to which it has no access; all it has is the existing stem. All the phonological properties of denominals – preservation of clusters, preservation of the base word, nominal morphology carried into the verb (resulting, according to Bat El, from the requirement that all the consonants of the base be syllabified) – are precisely what we expect, given their being derived from existing words. And this is also where these verbs differ from root-derived verbs.

The root, recall, is not an actual (semantic or phonological) word. It has been shown here that the root-derived words may have semantically idiosyncratic interpretations in different environments – idiosyncrasies that do not exist in word-derived words. If what I argued so far is on the right track, then we expect that root-derived words will have not only semantic idiosyncrasies, but also phonological idiosyncrasies. Furthermore, we expect that word-derived words will not exhibit such phonological idiosyncrasies. This turns out to be the case in Hebrew. Note the following phonological idiosyncrasies in certain Hebrew verbs. Initial *n* assimilates before a stop (45a), initial *y* assimilates before *c* (45b), middle glides are dropped, giving rise to a contracted form (45c–d), and two final identical consonants yield a change in vowels of some patterns (45e) and a contracted form in others (45f):

(45)	Root[32]	Pattern	Verb	
a.	√ncl	hiCCiC	*hicil*	'save' (*hincil, cf. yinacel)

[32] I refer here to 'consonants' as to consonants of the (hypothetical) root – but note that my argument does not presuppose the existence of the root. For ease of presentation, example (45) lists the (hypothetical form of the) root, alongside the attested form of the verb (for assimilated forms, I give other forms of the same verb in parentheses, where the assimilated consonant appears). The evidence upon which I rely here is not that of (45) alone, but of (45) and (46) taken together. My observation is not simply that the (hypothetical forms of) roots differ from the attested forms of verbs from which they are

b.	√ycb	hiCCiC	*hiciv*	'to position' (*hiyciv, cf. yicev)
c.	√qwm	CaCaC	*qam*	'rise' (*qawam)
d.	√qwm	hiCCiC	*heqim*	'raise' (*hiqwim)
e.	√sbb	CiCCeC	*sovev*	'turn around' (tr., *sibev)[33]
f.	√sbb	hiCCiC	*hesev*	'turn towards' (tr., *hisbiv)

The verbs exhibiting idiosyncrasies are those verbs that are traditionally taken to be formed of consonantal roots. On the other hand, there are Hebrew verbs that do not exhibit such idiosyncrasies. Crucially, those verbs are independently argued to be created from existing words. Examples are given in (46). If the base word contains an *n*, this consonant does not assimilate (46a–b). Medial glides are preserved (46c–d), even if not pronounced in the base word, and identical consonants do not give rise to a vowel change if they are part of the base from which the verb is derived (46e):

(46)

	Base		Pattern	Verb	
a.	*neged*	'opposite'	hiCCiC	*hingid*	'to put in opposition' (*higid)
b.	*necax*	'eternity'	hiCCiC	*hinciac*	'make eternal' (*hiciax)
c.	*tiq*	'file'	CiCCeC	*tiyeq*	'to file' (*toqeq)
d.	*dox*	'report; acronym'	CiCCeC	*diveax*	'to report' (*doxeax)
e.	*rax*	'soft' (from √rkk)	CiCCeC	*rikex*	'to soften' (*roxex)

It is striking that phonological processes such as assimilation occur in verbs that are assumed to be root-derived (45a–b) and not in those that

associated. Instead, it is that certain verbs show certain quirkiness in the phonology of their attested forms, which other verbs do not display. It is then striking that verbs of the first kind are those that, on other grounds, are likely to be root-derived, while those of the second kind are, on other grounds, likely to be word-derived.

[33] As one reviewer remarks, there are certain Hebrew word-derived verbs with such vowels – *xoqeq* 'legislate' and *koded* 'codify'. Crucially, these verbs are derived, respectively, from the nouns *xoq* 'law' and *qod* 'code'. The form of verbs such as *xoqeq* and *qoded* arises not from an idiosyncrasy of the root, but from the phonology of the word from which they are derived. As observed by Bat El (1994), word-derived words strive to preserve the phonological structure of their base word. This is also predicted by the theory advocated in this paper, where the noun-derived verb has as its input the phonological form of that noun. Of course, in order for forms such as *xoqeq* to exist, Hebrew phonology must allow such variation in vowels. But it is important that only verbs derived from monosyllabic words containing *o* may have this form (note that other verbs derived from monosyllabic bases, such as *qav* 'line', always have their vowels modified, as in the verb *qivqev* 'draw a line'). A further observation is that forms containing *o* vowels often have free variants with *i*. This is correct both for root-derived verbs (cf. *sivev*, colloquial variation of *sovev* 'turn', and *kidded*, free variation of *koded* 'codify'). I believe such modification takes place post-syntactically, at the level of PF, readjusting the output of phonology.

are independently argued to be word- derived (46a–b). If we retain our assumption, that the verbs in (45) are root-derived and those in (46) are word-derived, this fact is immediately and elegantly explained. The derivation in (46a) has no access to the phonology of the root √ngd, only to the word *neged*, a particular phonological incarnation of the root. This incarnation serves as the base for any further derivation, as in (46a).

These phonological distinctions do not always divide root-derived and word-derived verbs neatly. For example, some root-derived verbs also keep their middle glides. In the third pattern, many of them have two forms, one that drops the middle glide and one that retains it.[34] In addition, certain phonological changes, such as metathesis of *t* with *s*, *š*, and *c* in the hit-CaCCeC pattern and changes in the final syllable when the final consonant is *h* occur both in root-derived and in word-derived verbs.[35] But the crucial point here is that *no* word-derived verb shows the mutations typical of roots, such as those in (45). Root-derived verbs may yield phonological idiosyncrasies, just like they can yield semantic and lexical idiosyncrasies (i.e., specialized meaning in certain contexts), but word-derived verbs can only alter the lexical and phonological output of an already existing word, and therefore do not exhibit such idiosyncrasies.

Consider the argument so far. We started in section 3 with the observation that root-derived and word-derived words differ in their range of semantic interpretations. In this section, it has been shown that the two types of words differ also in their phonological behavior. Specifically, root-derived words may exhibit phonological idiosyncrasies associated with roots, while word-derived words take the phonological form of their base word. This phonological difference further motivates the initial distinction between root-derived and word-derived words. It also provides a strong argument supporting the existence of the consonantal root in Hebrew: first, by showing that one must not generalize from the behavior of denominal and borrowed verbs to all other Hebrew verbs, and second, by pointing out the phonological peculiarities in root-derived verbs and the absence thereof in word-derived verbs. But these phonological data also support the theoretical idea explored here concerning the single engine hypothesis for word formation and the cyclic (phase-based) nature of that engine. Note that the first category head merging with the root defines a closed domain *both*

[34] For example, the root √qwm has, according to the dictionary, two forms in the pattern CiCCeC: *qiyem* 'fulfill, bring into being' and *qomem* 'raise (tr.), bring up'. The first form retains the medial glide while in the second the final consonant is doubled to make up for the medial glide.

[35] Both metathesis and final *h* involve changes at the edge of the stem, and are therefore perhaps not related to the association of the root with the pattern, but to the actual phonological output.

semantically and phonologically: semantic and phonological peculiarities occur below, but not above that domain. Why should properties of sound and meaning coincide at this particular level? If word formation is indeed performed by the syntax, and the output of the syntax may be spelled-out at different points, or phases, then the convergence of the boundary for sound and meaning at the same structural level follows immediately. If the first category head that merges with the root creates a phase, then the properties of the syntactic construct are spelled out both semantically and phonologically. In this case, we expect the first category head merging with the root to be a domain for both special semantics and special phonology. While it is perfectly possible to account for these facts under a theory that assumes word formation in the lexicon (e.g., by postulating morphological conditions on the structure of complex words), the coincidence of semantic and phonological domains is immediately and elegantly explained in a theory that assumes a cyclic, syntactic engine for word formation.

7. The Cross-Linguistic Perspective

Both English and Hebrew were shown here to be subject to the same universal locality constraint on the interpretation of roots. But the two languages also differ substantially. Hebrew roots may be assigned numerous interpretations in different morphophonological environments, while English roots lack that property (with the exception of Latinate bound roots combined with prefixes, as noted above). It is predicted that all languages where a single root may be assigned multiple interpretations will exhibit a sharp contrast between the variety of meanings assigned to the root as opposed to the strict dependency in meaning between word-derived elements and their base word. This prediction is borne out, as will be illustrated here for Russian and Georgian. Consider Georgian first:[36]

(47) Root: $\sqrt{}$cx

a.	*acxobs*	'to bake', v
b.	*namcxvari*	'cake'; literally, participle of *bake*
c.	*sicxe*	'fever', n
d.	*cx**el**i*	'hot', adj.
e.	*acx**el**ebs*	'to heat', v, from *cxeli* 'hot'

(47a–d) are derived from the root $\sqrt{}$cx. (47e), the verb *acxelebs*, is derived from the adjective *cxeli* (note the adjectival suffix *-el* which is carried into

[36] Georgian examples are from Léa Nash (p.c.).

the verb). While the root √cx may be assigned numerous interpretations, the adjective-derived verb must depend in its meaning on that adjective.

The same phenomenon exists in Russian. A large number of Russian roots may acquire radically different interpretations in the environment of different prefixes. Consider one typical example, the root √kaz:

(48) √kaz

a.	*skazat'*	'say'
b.	*rasskazat'*	'tell'
c.	*otkazat'sja*	'refuse'
d.	*dokazat'*	'prove'
e.	*prikazat'*	'order'
f.	*okazat'sja*	'turn out'
g.	*pokazat'*	'show'

The root may acquire many interpretations in combinations with different prefixes, but once its meaning has been assigned, it is retained throughout all further derivation:

(49)a.	*prikazat'*	v, 'to order'
b.	*prikaz*	n, 'an order, command'.

(50)a.	*pokazat'*	v, 'to show, indicate'
b.	*pokazatel'*	n, 'an indicator, index'
c.	*pokaz*	n, 'a showing, demonstration'
d.	*pokazuxa*	n, 'a show'
e.	*pokazatel'niy*	adj., 'significant, revealing'

(51)a.	*rasskazat'*	'to tell, narrate'
b.	*rasskaz*	'a story'
c.	*rasskazcik*	'narrator'

Once the root √kaz has merged with the prefix *pri* or *po*, it no longer has any access to the meanings assigned to it in the environment of other prefixes, and all the words further derived from it also share the specific meaning of the root in the context of that prefix.

Having established the universality of the distinction between word formation from roots and from words, consider now the possible sources for differences between languages. It is universally accepted that language

variation is located in the lexicon and in morphology (cf. Borer 1984). What this is usually taken to mean is that, roughly, different languages have different words.

Of course, the initial inventory of roots and features differs from one language to another. Languages may have a subset of the features made available by UG, and this subset is not identical in all languages (for example, Russian, but not English, has a Prepositional case feature and grammatical gender). The inventory of roots is not uniform either. In sheer numbers, some languages, like English, have a large number of roots, while others, like Hebrew, have a relatively small number. Furthermore, roots themselves are not uniform: different languages cut the conceptual pie in different ways, specifying different signs, or roots. To take an example from kinship terms: Arabic has two signs, one for a maternal uncle (*xaal*) and another for a paternal uncle (*ʕamm*), while in English there is only one sign, *uncle*.

In this paper, however, I suggested that language variation lies not only in the initial lexical inventory, but also in the *number* of interpretations assigned to each root in different morphosyntactic and morphophonological environments. This was illustrated here on English and Hebrew. Hebrew makes available several interpretations for the same root, across different environments, while English normally allows at most one interpretation of the root for each category head, n, v, or adj.

Another source of variation is the degree of freedom languages have in deciding what kind of verb is formed from a particular root. Even if two languages have similar roots, there could still be some difference in the verbs each language creates. For example, while English *pocket* is a verb of location, its Hebrew counterpart *kiyes* 'to pickpocket', is a verb of removing. This difference is related, I assume, to the type of (abstract) preposition present in such structures. Finally, languages have the option either to derive both a noun and a verb from the root or to derive first a noun, and from it a verb. It has been shown in section 4 that in both English and Hebrew, within the same lexical class (e.g., instrument-manner verbs), the verb may either be root-derived (*hammer*) or noun-derived (*pitchfork*).

Spelling out the set of possible choices available to languages gives a finer-grained formulation of the widely-held view ascribing language variation to morphology. But the most important claim of this paper is that all languages are subject to locality constraints on the interpretation of roots, independently of their morphological properties. No matter what their initial cards are or what moves they make, all languages play by the rules.

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