Locality constraints on the interpretation of roots: the case of Hebrew denominal verbs

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Abstract: This paper argues that word formation is subject to a strict locality constraint – an evidence for the syntactic nature of word formation. Focusing on Hebrew, it is shown that words made of roots may have multiple varied interpretations, while words made of existing words must depend semantically on the word from which they are derived. This difference is due to the fact that the first nominal or verbal head that merges with the root serves as the immediate environment for determining its interpretation. 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, following from the local syntactic domain for the interpretation of the root.

Key words: roots, Hebrew, denominal verbs, Distributed Morphology

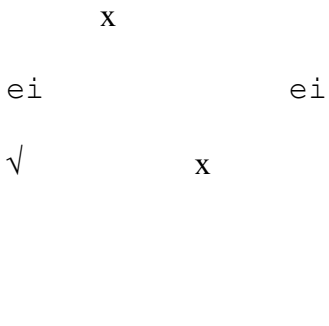
1. Introduction: roots and word formation

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 at two 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

idiosyncracies (gaps, non compositional meanings), while "higher" (syntactic, inflectional, level two) word formation is productive and regular.

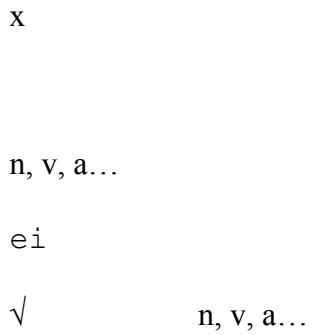
Recent developments challenge the two-place approach for word formation both empirically and theoretically. First, many word formation processes were shown to be syntactic in nature. To mention three very influential cases: Baker's (1988) work on incorporation as head movement, Pesetsky's (1995) work on zero morphemes, and Hale and Keyser's (1998 and subsequent work) on the syntactic nature of "lexical items". Furthermore, 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. 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. 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)



word formation from roots

(b)



word formation from words

The root is not an actual "word"; it takes on its specific interpretation as a noun, a verb or an

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 idiosyncracies - 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. √clums takes *–y* as its adjectival head while √malic takes *–ous*. Word formation from words, on the other hand, does not affect the meaning of the word to which it attaches, and 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 is argued by Marantz to reflect word formation from *roots*: what seems like truncation – *-ous* being lost between *atrocious* and *atrocity* (*atroc-ious-ity) - is in fact the root √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; no derivational relation hold between them, so the absence of *–ous* in *atrocity* is not surprising.

This paper argues that the distinction between roots and words in word formation is universal, but its manifestations may differ from one language to another. Looking at Hebrew, it establishes the following claims:

1. Roots may be assigned a variety of interpretations in different morpho-phonological environments. These interpretations are often unrelated to each other and are by no means predictable from the combination of the root and the word-crating 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 to the word from which they are derived. As this paper shows, 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 two presents a characteristic property of Hebrew word formation: the multiple semantic interpretations roots acquire in different environments. In section three 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

Sections four to six further extend and develop the claim made in section three. Section four extends the analysis cases where no morphological cues are available, especially English zero-related pairs. English verb formation is argued to be subject to the same locality constraint as Hebrew. Another group of word-derived elements, verb-derived nouns, are explored in section five. As the theory predicts, these nouns are dependent in their interpretation on the verbs from which they are derived. Section six 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 three, and for the existence of the consonantal root in Hebrew. Finally, section seven 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 Halle and Marantz (1993 and subsequent work), I take here *roots* to be atomic lexical elements, devoid of all syntactic or functional material. When roots are embedded in a nominal or verbal environment, they become actual "words" – nouns, verbs etc.:

(2) a. N b. V

ei ei

N √root V √root

Noun and verb creating morphology in English may be null (as in pairs such as *file-file*, *shop-*

Hebrew, word-creating morphology is mostly overt 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: [1]

(3)

Root:	Pattern (Binyan):		Verb:	
⌧md	1	CaCaC	⌧amad	(be standing)
⌧md	2	niCCaC	ne⌧emad	(stand up)
xmm	3	CiCCeC	ximem	(heat)
xmm	4	CuCCaC	xumam	(passive of 3)
⌧md	5	hiCCiC	he⌧emid	(make stand up)
⌧md	6	huCCaC	hu⌧amad	(passive of 5)
xmm	7	hitCaCCeC	hitxamem	(become hot)

[1] The following morpho-phonological 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*, _, *z* and *c* undergo metathesis with *t* in the seventh pattern, *hitCaCCeC*.

(iv) ⌧, ☜ and *x* affect the vowels following them, yielding ***xe***_*bon* (instead of **xi*_*bon*).

(v) Epenthesis takes place in certain contexts, as in *xa*_*ivut* (**x*_*ivut*)

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 (cf. patterns 3-4 and 5-6 above), causative-inchoative (patterns 1-5 and 3-7 above), transitive-reflexive, and being in a state vs. falling into a state (cf. Berman 1978, Doron 1999). But the occurrence of a root in several patterns is not limited to argument-structure alternations. I argue that a root may appear in several patterns, acquiring a different meaning in each of these patterns. I term here this phenomenon *contextualized meaning*, that is, meaning assigned to a root in a particular environment or context. Such contextualized meaning occurs in about fifteen per cent of Hebrew roots in the verbal system. [2] Below are a few examples of this phenomenon:

(4)		Pattern :		
Root: √ptx	a.	CaCaC	patax	(open)
	b.	CiCCeC	piteax	(develop)

(5)		Pattern:		
Root: √bxn	a.	CaCaC	baxan	(examine)
	b.	hiCCiC	hivxin	(discern)

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 by the fact that roots with four consonants may only appear in these pattterns), and it is therefore represented here.

[2] According to Arad and Shlonsky (in preparation), 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 above thirty percent of Hebrew roots.

(6)		Pattern:		
Root: √btx	a.	CaCaC	batax	(trust)
	b.	CiCCeC	biteax	(insure)
	c.	hiCCiC	hivtiax	(promise)

In (4)-(6) above, a single root acquires two or three separate meanings when appearing in different verbal patterns. The root itself, e.g. √ptx (4), is only turned into a verb when put in the environment of the head bearing the "v" feature (the pattern). The particular meaning of that verb is determined according to the verbal morpheme, or pattern: √ptx is interpreted as *open* in the environment of the first pattern (CaCaC) and as *develop* in the environment of the third pattern (CiCCeC). Multiple verbs formed from a single root is 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. open-develop, 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 the wider range of interpretations that a single root acquires across verbal and nominal environments in Hebrew:

(7) √bxn

a.	CaCaC (v)	baxan	(to test, examine)
b.	hiCCiC (v)	hivxin	(to 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) √qlt

a.	CaCaC (v)	qalat	(to absorb, receive)
b.	hiCCiC (v)	hiqlit	(to 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)

(9) √x_b

a.	CaCaC (v)	xa_av	(to think)
b.	CiCCeC (v)	xi_ev	(to calculate)
c.	hiCCiC (v)	hex_iv	(to consider)
d.	hitCaCCeC (v)	hitxa_ev	(to be considerate)
e.	maCCeC (n)	max_ev	(a computer / calculator)
f.	maCCaCa (n)	max_ava	(a thought)
g.	CCiCut (n)	xa_ivut	(importance)
h.	CiCCon (n)	xe_bon	(arithmetic / bill)
i.	taCCiC (n)	tax_iv	(calculus)

In all of these cases, the root obviously has some core meaning (e.g. √x_b is related to some mental activity, √qlt – to a notion of absorption), but it is assigned a specific interpretation *relative to* certain verbal or nominal environments in which they are put.

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. 8) may have some common semantic core, 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 (cf. 8) 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 a shelter, and *miqlat* – a receiver). Taking the root as the basic Saussurian sign, we can say that not only the sign itself is arbitrary, but the meanings associated with that sign in different contexts is to a large extent arbitrary as well.

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 ability to take on multiple interpretations in different environments is strictly reserved for *roots*. Word-derived verbs must share an interpretation with the noun from which they are derived. To take an example, consider the interpretations acquired by 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) a. miCCeCet misgeret (a frame)

b. CiCCeC misger (to frame)

Consider the relation between the noun *misgeret* (frame) and the verb derived from it. The verb bears a morpho-phonological similarity to the noun: it contains not only the root consonants, s.g.r., but also the prefix *m*-, which is carried over from the nominal pattern (miCCeCet) into the verbal form, thus wearing its nominal origin on its sleeve. 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. [3] 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): [4]

(12) a. N misgeret

ei

[3] In the active, the vowel melody, i/e, does not differ from that of the 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.

[4] The phonological realization of this process involve melodic overwriting, that is, matching the vowels of the stem with those of the third pattern, CiCCeC. See Bat-El 1994, and section six of this article

N miCCeCet √sgr

/misgeret/ Root-derived noun

b. V misger

ei

V CiCCeC N misgeret

ei

N misgeret √sgr

/misger/ 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 all the interpretations assigned to that root: 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.

(13) argues that the first category head that merges with the root defines a closed domain for interpretation. Such closed domains play an important role in current syntactic theory: (13) can be shown to fall out of a general principle if we make the assumption that the first category head merging with the root indeed defines a *phase* (cf. Chomsky 1999). [5] This head is a phase, because once the root has merged with the first category head, the interpretation of the output (noun, verb or adjective) is fixed. Whatever comes next in the course of the derivation will not combine directly with the root: it will merge 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 it have any access to the root itself. The only alterations may be those forced by the additional heads: adding a v head to the noun *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

[5] Cf. Marantz (2000), where this claim is explicitly made. 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 of movement. I explore here the possibility that any head that creates a semantic or phonological domain defines as a phase. It is possible that the phases that are relevant for movement are those distinguished as "strong phases" (cf. Chomsky 1999).

head and take on any of the numerous interpretations associated with the root √sgr (cf. 10 above):

(14) V misger → V merges with the noun *misgeret* (frame), and has no access to √sgr

ei

V N misgeret → first category head N defines a phase. Interpretation is

wi assigned to the noun at LF

N misgeret √sgr

The locality constraint in (13), as well as the phase hypothesis, are strongly supported by the Hebrew data. Two more cases (out of many) may serve to illustrate this:

(15) √xzq

a.	CaCaC	xazaq	(adj., strong)
b.	CiCCeC	xizeq	(v, to strengthen)
c.	hiCCiC	hexziq	(v, to hold)
d.	CiCCa	xezqa	(n, in math.: power)
e.	CCaCa	xazaqa	(n, a hold, custody)
f.	CoCeC	xozeq	(n, strength)
g.	taCCuCa	**t**axzuqa	(n, maintenance)
h.	CiCCeC	**t**ixzeq	(v, to maintain, from *taxzuqa*, maintanance)

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. Finally, consider the root √x_b:

(16)	a.	√x_b	CaCaC	xa_av	(think)
	b.		CiCCeC	xi_ev	(calculate)
	c.		hiCCiC	hex_iv	(consider)
	d.		hitCaCCeC	hitxa_ev	(be considerate)
	e.		taCCiC	tax_iv	(calculus)
	f.		maCCaCa	max_ava	(thought)
	g.		maCCeC	max_ev	(computer)
	h.		CiCCon	xe_bo**n**	(account, bill)
	i.		hitCaCCeC	hitxa_be**n**	(keep accountancy, from *xe_bon*, account)

The root √x_b forms various nouns and verbs, but the verb *hitxa_ben* (16I, note the nominal suffix, -*n*), derived from the noun *xe_bon* (16h) depends in its interpretation on its base noun.

The locality constraint on the interpretation of roots applies equally to all non root-derived elements. Consider the difference between noun-derived nouns and root-derived nouns in Hebrew, as illustrated in (17) and (18):

(17)	√yld	a.	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, for example, forms many different nouns, but any heads that further combine with the noun *yeled* (child, 17e) may no longer alter its basic meaning:

(18)	a.	√yld + CeCeC	yeled	(n, child, boy) [6]
	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 make an abstract noun out of a concrete noun (18b), 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 basic meaning of "child" and do not have access to any of the interpretations of the root √yld in other environments; it is impossible to add any of these suffixes to the noun *child* and build, for instance, *birthrate* (17b).

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 (to telephone)

[6] Note the vowel contraction in (18b-f), which corresponds to the change in stress from initial (*yeled*) to final (all suffixed forms).

(20) a. foreign verb: click

b. borrowed verb: hiqliq, hiCCiC (to click)

Borrowed verbs or nouns are semantically tied to the foreign word, and very rarely (if ever) change their basic meaning in the act of borrowing. 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 six).

To summarize the discussion so far: the Hebrew data presented in this section strongly support the assumption that word formation is locally constrained, and, specifically, sensitive to the distinction between roots and non-roots. As was illustrated here on 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 of the assigned to the root by the head with which it merged first. Here is the contribution of Hebrew to the theory of word formation: because Hebrew roots create several nouns and verbs in different morpho-phonological 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.

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⌦	(paint/color)	cava⌦	(to paint/color)
b.	kis	(pocket)	kiyes	(to pick-pocket)
c.	mi_xa	(paste)	ma_ax	(paste)
d.	sid	(whitewash)	siyed	(to whitewash)
e.	zefet	(tar)	zipet	(cover with tar)
f.	gal⌦in	(a pit)	gil⌦en	(to pit)

Two possibilities suggest themselves: either both the noun and the verb are derived from the same root, or the verb is derived from the noun. This situation is rather like the English one, 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.

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:

(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. (22a-d From Kiparsky's 1982 example 14)

(23) *She roped him up with a rope!

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! (From Kiparky's 1982 example 16)

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), 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. 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 s further derived from the noun. [7] Consider *hammer*-type verbs, where both the noun and the verb are derived from the same root:

(24) a. V b. N

ei ei

V √hammer N √hammer

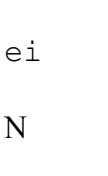
One of the characteristic interpretations of roots in a verbal environment is *manner* (i.e., do something in a certain manner). Similarly, the default interpretation of nouns in a nominal environment is *entity*. When embedded in a verbal environment, the root √hammer has a meaning of a manner verb (the precise manner, hammering, is given by the properties specific to

[7] 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.

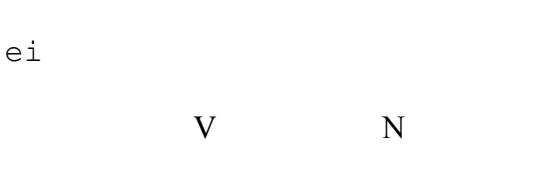
the root, cf. Levin 1999). In a nominal environment, the same root is interpreted as an entity (the specific entity, a hammer, is determined by the root). It is expected that the noun *hammer* and the verb *hammer* will have close meanings - both are derived from the same root. But because they are both derived from a *root*, none entails the existence of the other.

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 involving 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* – location verb). 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 more 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 three 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 /bear/ 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. [8]

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 going through a nominal projection. Since roots acquire their interpretations as nouns only when embedded in 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

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

available in the nominal environment miCCeCet. There is no way to get from the root √sgr to the verb *misger* (frame) without going first through 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.

The criteria for distinguishing root-derived and noun-derived verbs apply to other lexical classes of English verbs. Consider the following group:

(27) a. They housed their guests in their barn / their castle.

b. John shelved the books on the mantelpiece

a. *John boxed the apples in his bag.

b. *John corralled the horses into the stable.

The verbs in (27) are all location verbs (indicating 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. (27a-b) are root-derived, while (27c-d) are noun-derived. One can shelve not only on a shelf, but also on the window-sill or the mantelpiece. *To box*, on the other hand, means "put in a box" – and not is any other location (bag, bottle, etc.). [9]

[9] Locatum verbs, verbs naming the entity that is being located or applied, show the same distinction:

(i) 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.

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):

(28) a. Dani cava⌦ et ha kirot be laqa

Dani painted the walls with varnish

b. *Dani siyed et ha kirot be laqa

Dani whitewashed the walls with varnish.

cava⌦ only specifies "add color": the material used is not part of the denotation of the verb. [10] The related noun, *ceva⌦*, can be whatever is prototypically used for coloring: liquid paint, a crayon, etc. The noun and the verb are related in their meaning, which is expected, given that they are derived from the same *root*, √cv⌦, 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. 28b).

Dust and *powder* (a-b) are root-derived, defined independently of the noun: one can powder using crushed chalk. The verbs in (c-d) are derived from their corresponding noun: *to starch* entails "apply starch", *to sugar* – apply sugar (same for *salt*, *pepper*, *flour*) . 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:

(ii) a. She shelled the lobster / the peas / the nuts.

b. She pitted the orange.

c. She stalked the artichokes.

[10] The verb may include a manner component, in a similar way as 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").

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. [11] The noun *mi_xa* 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 *gil⌦en* (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 specifying the type of relation between the verb and the noun. However, the possible interpretations assigned to noun derived verbs seem to form a limited set, e.g.: [12]

(29)	noun	verb
a.	material/entity	apply/put material/entity (*tape, sugar*, *saddle*)
b.	entity	remove entity (*pit*, *stalk*, *core*)
c.	instrument	use instrument (*lasso*)
d.	location	put something in location (*pocket, box, bottle, shelve*)

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

[12] 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 verb (*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.

e.	entity	typical activity related to that entity (*button*)
f.	material/entity	become material/entity (*cake*)
h.	entity	create/bring about entity (*calve*) [13]

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 different syntactic structure of each of these groups. In one group the verb and the noun are derived from the same root, in the other – the noun is derived from the verb. The term "denominal verb" is sometime used to refer to all English verbs that have a zero related noun. I suggest reserving this term only to verbs that are structurally derived from the noun. As shown above, there are semantic and syntactic grounds for that distinction. [14]

5. The remaining piece: verb-derived nouns.

The discussion so far mentioned three groups: root-derived verbs, root-derived nouns, and noun-derived verbs. A fourth group suggests itself: verb-derived nouns. The question

[13] 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 (cf. 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 Kiarsky (1997).

[14] We also need 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). It is likely that true denominals involve noun incorporation, but in other verbs what incorporates may be the root, rather than a noun.

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 much work has been dedicated to their typology (for some recent references see Engelhardt 2000, Alexiadou to appear). 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. [15] As expected, verb-derived nouns depend in their meaning with 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 to appear, for evidence distinguishing root nominalizations and verb nominalizations). Concentrating here on two specific groups of verb-derived nouns - English zero-related pairs and their Hebrew counterparts, where verbal morphology is overt, I argue that verb-derived nouns depend in their interpretation on their base verb, as expected, given the locality constraint on the interpretation of roots. Consider, first, the following pairs:

(30)	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 four, such as *tape* or *button*. But note that here it is the noun that seems to be semantically dependent on the verb. 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

[15] Cf. Borer 1991, Alexiadou 1999, Engelhardt 2000.

activity. While noun-derived verbs include in them the *entity* specified by the noun, verb-derived nouns seem to 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):

(31)	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) [16]
d.	motion verb (walk, jump)	motion bounded in time/quantity (a walk)

If the verb is an action, the noun denotes a bounded piece of the event. This boundedness could either be arbitrary (e.g. a walk is any "a 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 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 show to have corresponding pairs where both the noun and the verb are root-derived (e.g. *hammer*). The question arises whether the verbs in (30) 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 indeed exist. Consider the verb *run* and the noun *a run*. Unlike a walk or a jump, a run, has a meaning independent of the motion verb *run*. A break does not depend

[16] See Levin 1999 for the similarity between activities and semelfactives.

semantically on the change of state verb *break*. The existence of such root-derived pairs is further supported evident from Hayes (1981), cited in Kiparsky (1982). Hayes shows that in English root-derived pairs the two members may differ both phonologically (in their stress pattern), and semantically (the interpretation of the noun is more idiosyncratic). Such pairs include recórd$_V$-récord$_N$, permít$_V$-pérmìt$_N$, convért$_V$-cónvert$_N$ In other pairs, in which Hayes takes the noun to be verb-derived, the noun is tied to the verb both in its stress pattern and in its semantic interpretation (exháust, consént, debáte).

A close examination of English zero-related pairs forces a finer-grained analysis of this group. While often treated uniformly due to their morphological properties, members of this set were shown here to fall into three sub-groups: in one, both the noun and the verb are derived from the same root (*hammer*), in another – the noun is derived from the root and the verb is derived from the noun (*tape*), and in the last group the verb is derived from the root, and the noun is derived from the verb (*kiss*). While this claim is at odds with some current work, most notably Hale and Keyser (1998), where all zero-related pairs are taken to be noun-derived, I believe it is well-grounded, given the semantic (and in some cases morphological – cf. Kiparsky 1982, Hayes 1981) evidence discussed here.

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

(32)	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:

(33)		root	verb	related noun
	a.	√str	satar (slap)	stira (a slap)
	b.	√b⌧t	ba⌧at (kick)	be⌧ita (a kick)
	c.	√hlk	halax (walk)	halixa (a walk)
	d.	√xbq	xibeq (hug)	xibuq (a hug)

The nouns in (33) bear 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 two). Note, now, the relation between the root and the corresponding verbs and nouns:

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

(35)	√b_l	verbal pattern		derived nominal pattern	
	a.	bi_el	(cook)	bi_ul	(cookery, cooking)
	b.	hiv_il	(mature, ripen)	hav_ala	(ripening)

The root √b_l acquires two verbal interpretations in the context of two verbal patterns, *cook* and *ripen*. The noun *bi_ul*, cookery, is semantically tied to the verb *bi_el* (cook) from which it

is derived. Crucially, the noun has access neither to the root √b_l nor to any of the interpretations assigned to it in other contexts. *Bi_ul* (cookery) can never mean *hav_ala* (ripeing), just as *bituax* (insurance) in (34a) cannot taken on the meaning of *promise*, assigned to the root in another verbal context (34b). The relation between verbal 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. [17] The correct generalization is that once a noun appearing in these nominal patterns has a corresponding verb, then it must be derived from it. 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 consonantal root has recently been subject to some debate. Work in phonology (Bat-El 1994, Ussishkin 1999) has denied the status of the consonantal roots, while psycholinguistic evidence supported its

[17] Irregularites seem to fall into three types. First, a verb-derived noun my 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: *_i⊠ul*, a cough, appears in the nominal pattern derived from the (non existing) verb **_i⊠el* , while the verb, *hi_ta⊠el*, appears in another pattern. Finally, a noun may appear in one of the verb-derived nominal pattern even when no corresponding verb exists. Thus, the root √dqr, which creates the verb daqar (to stab) and its derived noun *dqira* (a stab), forms also *diqur* (acupuncture), which does not have a corresponding verb, *diqer*.

existence (Prunet et al. 2000). Interestingly, the evidence against the consonantal root is drawn entirely from denominal and borrowed verbs. The argument is 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 it 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 show that the phonological arguments against the consonantal root are in fact arguments supporting the claim that denominal verbs are formed on the basis of existing words rather than roots. 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 been also shown here in section three). 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:

(36) Base Derived verb

b.	streptiz	(striptease)	striptez(to perform a striptease)
c.	sinxroni	(synchronic)	sinxren(syncronize)

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 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:

(37)

	Base	Derived verb
a.	qliq (a click)	hiqliq (to click)
b.	fliq (a slap)	hifliq (to slap)
c.	_pritz (a splash)	hi_pritz (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 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). Based on borrowed and denominal verbs, she extends the stem modification 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. Words, as

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 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 word. Consider, for example, the representation of the root √sgr (cf. (10) - (11) above), in two environments, one verbal and one nominal:

(38) N qLF: interpretation: "frame"

wo

$N_{miCCeCet}$ √sgr pPF: pronunciation: /misgeret/

Because after merging 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 *word*, and the phonological component has access only to the phonology of the *word*. We thus expect borrowed and denominal verbs to be formed by stem modification. This is the only choice the grammar has: it cannot extract the consonant 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 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 roots may have semantically idiosyncratic interpretations in different environments. Now, Hebrew roots may also have phonological idiosyncracies. In root-derived verbs, initial *n* assimilates before a stop (39a-b), middle glides are dropped, giving rise to a contracted form (39c-d), and two final identical consonants yield a change in vowels of some patterns (39e) and a contracted form in others (39f):

(39)	Root	Pattern	Verb
a.	√ng_	hiCCiC	higi_ (hand in; *hingi_)
b.	√ncb	hiCCiC	hiciv (to position; *hinciv)
c.	√qwm	CaCaC	qam (rise; *qawam)
d.	√qwm	hiCCiC	heqim (raise; *hiqwim)
e.	√sbb	CiCCeC	sovev (turn around, tr., *sibev)
f.	√sbb	hiCCiC	hesev (turn towards, tr., *hisbiv)

Verbs derived from *words* behave differently in this respect. If the base word contains an *n*, this consonant does not assimilate (40a-b). Medial glides are preserved (40c-d), even if not pronounced in the base word, and identical consonants do not give rise to if they are part of the base from which the verb is derived (40e):

(40)	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)

In (39a-b) and (40a-b), the phonological process of assimilation is sensitive to whether the basis for the derivation is a root or a word. The derivation in (40a) 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 (40a).

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. [18] In addition, certain phonological changes, such as metathesis of t with *s*, _ and *c* in the hitCaCCeC pattern and changes in the final syllable when the final consonant is *h* occur both in root-derived and in word-derived verbs. [19] But the crucial point here is that *no* word-derived verb shows the mutations typical of roots, such as those in (39). Root-derived verbs may yield phonological idiosyncracies, just like they can yield semantic and lexical idiosyncracies (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 idiosyncracies. This phonological difference further motivates the distinction between root-derived and word-derived words, and, in turn, further supports the existence of the consonantal root in Hebrew.

[18] For example, the root √qwm has, according to the dictionary, two forms in the pattern CiCCeC: *qiyem* and *qomem*. The first form retains the medial glide while in the second the final consonant is doubled to make up for the medial glide.

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

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 morpho-phonological 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 on Russian and Georgian. Consider Georgian first:

(41) Root: √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)	(L. Nash, p.c.)

(41a-d) are derived from the root √cx. (41e), the verb *acxelebs*, is derived from the adjective *cxeli* (note the adjectival suffix *–el* which is carried into 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, of the root √kaz:

(42) √kaz

a. skazat (say)

b. raskazat (tell)

c. otkazatsja (refuse)

d. dokazat (prove)

e. prikazat (order)

f. okazatsja (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:

(43) a. prikazat (v, to order)

b. prikaz (n, an order, command).

(44) a. pokazat (v, to show, indicate)

b. pokazatel (n, an indicator, index)

c. pokaz (n, a showing, demonstration)

d. pokazuxa (n, a show)

e. pokazatelniy (adj., significant, revealing).

(45) 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. These differences, I assume, lie in their lexicon and in their morphology (cf. Borer 1984). Specifically, variation in word formation is limited to two factors: the basic lexical building blocks of each language, and a limited set of choices it makes.

Consider the first component. 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 one. Furthermore, root 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 and another for a paternal uncle, while in English there is only one sign, *uncle*).

Now consider the set of choices available to languages. First, as was illustrated here on English and Hebrew, languages vary with respect to the type and the number of interpretations assigned to each root. Hebrew makes available several interpretations for the same root, across different environments. English normally allows at most one interpretation of the root for each category head, n, v or adj. Once a verb is formed, languages have some freedom in deciding what lexical class a verb should fall into. For example, while English *pocket* is a verb of location, its Hebrew counterpart, *kiyes*, is a verb of removing (to

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 four 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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