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Revisiting Roots in Hebrew: A Multi-faceted View

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The consonantal root in Hebrew has been examined from different perspectives by Semiticists, Hebrew-language scholars, and general linguists – and extensively by Schwarzwald (1973, 1974, 1975, 1980, 1984, 2000, 2002-Units 9-10). This chapter attempts to bridge different approaches to the notion of root in contemporary Hebrew-based research (Shimron 2003). 'Root-based' approaches – typological (Goldenberg 1994), structuralist (Schwarzwald 1996, 2002), and experimental (Ephratt 1997) – regard the consonantal root as a basic structural property of Hebrew. 'Word-based' analyses, in contrast, (*e.g.*, Bat-El 1986, 1989, 1994; Bolozky 1982, 1986, 1999, 2003) espouse Aronoff's (1976, 1994) proposal that derivational processes are based on words or word-stems in Hebrew, as in other languages: New words are derived from existing lexical items, and the root is mainly of etymological or historical relevance, although consonantal elements may help in detecting relationships between words.

Below, it is argued that Hebrew roots cannot be defined in a single, unequivocal fashion. Rather, the notion depends on a cluster of factors, including: (1) **background lexical variables –** the status of a given root in the established lexicon of contemporary Israeli Hebrew (Section 1); (2) **structural linguistic variables** – such as 'full' versus 'defective' roots or interdigited (root plus pattern) versus linear (stem plus affix) derivation (Section 2); and (3) **psycho- and sociolinguistic variables** – acquisition of linguistic knowledge from early childhood to adulthood and varying levels of literacy (Section 3). The study thus proposes a multidimensional, non-monolithic view of 'consonantal roots', dependent on by and for whom, and in what context the issue is addressed (Section 4).

1. Background Lexical Factors

A first, and critical, question is what to include under the label 'Hebrew roots'. since the **number of roots** in the language can range from several thousands to a few hundred, depending on what is counted. The list of **documented roots** generally adopted by Hebrew language scholars and conventional dictionaries

covers roots occurring in various periods, from Biblical, Mishnaic, and Medieval, on to Modern Hebrew. As summarized by Schwarzwald (2002 Unit 2, pp. 15-16), the number of such roots may range from as high as around 5,000 (Ornan 1989-1990), down to some 3,000 – *e.g.*, Er'el (1977) counted 3,407 roots in Even-Shoshan's monumental (1970) dictionary, and Schwarzwald found 3,200 roots in Bahat and Mishor's (1995) contemporary dictionary.[1] Schwarzwald notes (p.c.) that these figures do not necessarily reflect the number of **roots in current usage**, which she sets at around several hundreds. This estimate is confirmed by two sources: Bolozky's (1996) corpus-based count of Hebrew verbs listed by frequency yielded 501 items, increased to 565 verb roots in the later (2008) edition; and Seroussi's (2011) psycholinguistic study of 4,000 derived nouns in Hebrew listed in two or more contemporary dictionaries found an average of 8 to 9 nouns from a given root, giving a total of 450 to 500 – compatible with Bolozky's corpus analysis. Such discrepancies in estimating the number of 'Hebrew roots' reflect differences between diachronic and synchronic measures. And they highlight asymmetries between structurally-oriented versus usage-based analyses, as discussed below.

One problem for specifying 'current Hebrew roots' is the lack of standardized **frequency lists** that cover both spoken and written Israeli Hebrew, of the kind available for European languages. Schwarzwald (1981 p. 38) refers to as many as five such lists dating from Rieger (1935) to Balgur (1968). These were typically pedagogic in orientation; they were meant for Israeli (and even pre-State) school children or new immigrant learners of Hebrew, and were based on rather haphazard methods of selection. There are several other, more contemporary, research-based lists; yet they, too, are only partially relevant to specifying 'current roots' in the lexicon of Hebrew speaker-writers. Choueka's (1989) monumental study concerns written, hence 'documented', pre-Modern Hebrew; Frost and Plaut's (2001) listing of over half a million types, based on a written corpus of three Hebrew-language dailies, specifies frequency of occurrence of letter-clusters, including strings of letters that are not necessarily roots; and Henik, Rubinstein and Anaki's (2005) attempt to establish norms for Hebrew words relies on a collection of 800 familiar Hebrew words, without

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[1]   Choueka & Freidkin's (2001) comprehensive dictionary, which is explicitly aimed at contemporary Hebrew usage, deliberately avoids the root as a lexical entry, indicating that the authors query the ability of Hebrew speakers to independently extract the correct historical root (see, further, Section 2 below).

regard for root structure or even lexical category. In other words, crucial information is lacking in order to provide a sound estimate of root frequency in current Israeli Hebrew usage. And this problem is exacerbated by marked differences between lexical usage in spoken compared with written Hebrew (Berman & Nir 2011; Berman & Ravid 2009; Borochovsky 2010; Rosenthal 2005).

As for what is meant by 'Hebrew roots', an earlier suggestion was to distinguish three classes of roots – obsolete, potential, and active (Berman 1990). **Obsolete roots** are historically attested (*i.e.*, 'documented'), but do not function in current Hebrew usage. This group overlaps partly with Aronoff's (1976) distinction between 'old' and 'new' words, and takes into account an important factor in new-word derivation in Hebrew (Berman 1987a; Ravid 1990, 2003). The idea of **potential roots** is allied to Halle's (1973) distinction between actual and possible words, since potential roots are derivable in principle but not used in practice in the established lexicon. However, in the present context, the sense of 'derivable' goes beyond structural, morpho-phonological constraints on Semitic root-formation (as in Greenberg 1950; McCarthy 1981): It takes into account psycholinguistic factors of how and which roots function in the mental lexicon of language users. The idea of **actively-functioning roots** depends on their role in currently operating word-formation processes, "the extent to which (a root) [...] functions as a living part of the language and determines the shape of new words" (Anderson 1985: 20).

In the earlier paper, an 'actively-functioning' root was defined as (1) occurring in more than a single word, at least one of which is a verb, and (2) having an independent semantic content even in isolation. Below, the first condition is elaborated and defended, and the second is reconsidered in terms of whether roots 'have meaning'. The distinction between functioning and potential roots is illustrated in (1a) and (1b) respectively.

(1) 'Functioning' vs potential roots:[2]

(i) a. *Gibor*	'hero'	< g-b-r	b. *rimon*	'pomegranate'	
šixva	'layer'	< š-k-b	kilya	'kidney'	
cédek	'justice'	< c-d-q	cédef	'shell'	
rikavon	'rot(tenness)'	< r-q-b	xilazon	'snail'	
(ii) a. tayas	'pilot'	< t̠-w-s	nagar	'carpenter'	
safran	'librarian'	< s-p-r	raftan	'dairyman'	
mitriya	'umbrella'	< m-t̠-r	pitriya	'mushroom'	
sandal	'sandal'	< s-n-d-l	pardes	'orchard'	

Both words in the pairs in (1-i) are constructed in the prosodic templates of well-attested noun *miškal* patterns, and undergo the same morpho-phonological constraints when inflected (for number, genitive case, etc.). But only the first word of each pair, in (a) but not (b), is based on an 'active' root that functions in verbs (*e.g.*, from *g-b-r* – *gavar* 'defeat', *higbir* 'heighten', *hitgaber* 'overcome'; from *š-k-b* – *šaxav* 'lie, be prone', *niškav* 'lie down', *hiškiv* 'lay down'). The words in (1-ii) illustrate another property of 'functioning' roots: They may occur in words **other** than verbs, but they cannot occur **only** in words derived directly from other words (Aronoff 1976; Berman 1987a) by 'linear' affixation to a stem (Ravid 2006; Schwarzwald 2001, 2003). For example, the agent-noun *nagar* 'carpenter' is the basis for the suffixed words *nagariya* 'carpenter-shop', *nagarut* 'carpentry', but there is no root *n-g-r*; and the noun *réfet* 'cowshed' is the basis for *raftan* 'dairy-farmer', *raftanut* 'dairy-farming', but lacks an associated root *r-p-t*. The strings *n-g-r* and *r-p-t* are **potential** roots in Hebrew: Speakers can recognize them as occurring in the basic nouns *nagar, réfet* respectively, but they have no

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[2] Hebrew forms are rendered in broad phonetic transcription, as pronounced in current usage rather than by their historical or underlying phonological structure (Ben-David & Berman 2007): Stress is word-final, except where marked by an acute accent on the stressed syllable; the 7 morphemes orthographically prefixed to the next word (the conjunctions meaning 'and', 'that', 'when', the definite article, and the prepositions meaning 'in, to, as' – so-called *moše ve-kalev* – are separated by a hyphen from the next word; and intervocalic glottal stops are marked by a single quote (*e.g.*, *ve-ha-be'aya* "nd-the-problem"). Verbs are given in the morphologically simplex form of 3rd person masculine singular. Roots in isolation are rendered by their orthographic representation, as follows, in the order of the 22 letters of the Hebrew alphabet: ?, b~v, g, d, h, w, z, ħ, y, t̠, k~x, l, m, n, s, ʕ, p~f, c, q, r, š, t.

current psychological reality, hence do not exist as active roots in the mental lexicon of Hebrew.

The stock of **currently functioning roots** in Israeli Hebrew needs to be constantly re-assessed. One reason is the accelerated rate of change due to the unique socio-historical circumstances of the re-emergence of Hebrew as a medium of everyday spoken interchange (Berman 1987b; Ravid 1995). For example, the noun *sandal* was recently 'activated' by the verb *sindel* meaning to lock-tie a car, with the associated action nominal *sindul,* extended metaphorically to blocking of an official proposal. Similarly, the consonantal elements *ţ-r-m* in the adverb *térem* 'not yet' (cf. innovations like prefixal *trom-* 'pre-', adjectival *trómi* 'prefabricated') have recently been activated to label the psychological process of priming = *hatrama* (cf. the causative verb *hitrim* 'prime' and passive *mutram* 'be-primed').[3] This example illustrates another facet of root-related psycholinguistic processes in current Hebrew: While such innovations may at first be confined to experts, the semantic field of 'priming', as probing subliminal perceptions, is likely to be extended to domains beyond experimental psychology. Analogously, the root *c-p-r*, recently activated in the verb *licpor* 'to-birdwatch' from the noun *cipor* 'bird' via the agent noun *capar* 'birdwatcher' (cf. the abstract noun *caparut* 'bird-watching'), is also likely to soon extend beyond people involved in bird-watching. Note, too, that this novel verb occurs along with an older verb *licpor* 'to-honk, beep' (cf. the nouns *cofar* 'siren', *cfira* 'beeping'), showing that speakers do not necessarily avoid homophony or even homonymy when they coin new verbs.

Potential roots are thus typically candidates for shifting to the status of actively functioning elements. Evidence for this process is the ease with which young preschool children coin possible but non-occurring verbs from familiar nouns. When asked what a *nagar* does, 2-year-olds might respond with *bone, ose aronot* ('builds, makes closets'), but by age 3, children will relate to the consonantal elements of the input word, to construct a form like *menager* 'carpents' (Berman 2003). And in their spontaneous speech output, too, preschool children demonstrate early reliance on consonantal elements in coining new words: They produce coinages like *mešaked* to describe the act of putting *škedim*

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[3]   The innovative root *ţ-r-m* also suggests that speakers are not disturbed by root-homophony of coinages, since the same-sounding consonants *t-r-m* occur in the actively functioning root with the sense 'donate, contribute'.

'almonds' in soup or *mašlig* for sliding on snow, from *šéleg* 'snow' (Berman, 2000).

Consider, next, the role of **semantics** in specifying the repertoire of current Hebrew roots. Berman (1990) proposed that actively-functioning roots have 'independent semantic content even when not embedded in a word', but, in fact, this criterion is too stringent. Instead, for a root to be defined as currently functioning, (a) it must be associated with at least one semantic core of meaning; (b) this core meaning may vary in transparency in different words (*e.g.*, the sense 'ride, drive' of the root *r-k-b* is more opaque in *rakévet* 'train' than in *roxev* 'rider' or *réxev* 'vehicle'); and (c) the same root may have unrelated meanings and be fully polysemous (as in the earlier example of *c-p-r*).

Research underscores both the variability **and** the 'semantic unity' of root meaning (Ravid 2003). Semantic **variability** is shown by the fact that *šmot pe'ula* 'action nominals' from the same root and with the same surface form may be interpreted as both canonic abstract derived nominals or as concrete terms – *e.g.*, *knisa* 'entry ~ doorway', *kabala* 'acceptance ~ receipt', *sidur* 'arranging ~ prayerbook' (Berman 1973, 1976, 2010; Ravid & Avidor 1998; Seroussi 2011). Schwarzwald (1976) defined as 'homonymous' no less than two-fifths of the roots she reviewed in different morphological patterns. And Ravid's (p.c.) ongoing dictionary-based study of verbs in current usage found over 20% to have more than one meaning, with dozens of verb roots functioning in semantically unrelated or only remotely related items. **Verb polysemy** occurs both in the same and, more commonly, across different morphological *binyan* patterns. For example, *darax* in the P1 *qal* pattern, from the root *d-r-k,* stands for 'step, tread' and also for the unrelated sense of 'cock (a weapon)', and the verb *xilel* in the P3 *pi'el* pattern from the root *ħ-l-l* can mean either 'play (a flute)' or 'desecrate (the Sabbath)'.[4] In different patterns, the root *ʔ-b-q* means 'struggle' in P2 *ne'evak* and 'powder' in P3 *ibek*, while the root *z-q-q* means 'purify' in verbs in some patterns, but 'need, require' in others. The variability of root-based semantics played a role in Bar-On's (2000) developmental study of perception of root elements by Hebrew-speaking school children and adults: She selected pairs of words with shared consonantal elements, in the same or different lexical category, 19 root + meaning-related (*e.g.*, *šatíax* 'carpet' ~ *mištax* 'surface', *xatif* 'munchie' ~ *xotef*

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[4] And Ravid's son Assaf, when aged 5;8, gave a third meaning to this root when he said *ha-til šam **mexalel** ba-xalal* 'the-rocket revolves in space there', from the noun *xalal* 'space'.

'grab') and 16 unrelated (*e.g.*, *crif* 'hut' ~ *coref* 'silversmith', *mazgan* 'air-conditioner' ~ *mozeg* 'pour'). Participant responses yielded different levels of relatedness from high via medium (*e.g.*, *rexov* 'street' ~ *raxav* 'wide', *xalifa* 'suit (of clothing)' ~ *maxlif* 'change') to low – where adults and children alike rated the two words in a pair as unrelated. Bar-On concluded that some roots clearly share a single core of meaning, while in other cases, the very fact of a shared consonantal base (*e.g.*, in *rašam* 'noted, wrote-down' ~ *hiršim* 'impressed', or *pašut* 'simple' ~ *mitpašet* 'spread-out, get-undressed') leads speaker-writers to seek a semantic relation between words.

The semantic variability of roots is also attested to by **speaker judgments**. For her study of derived nouns in Modern Hebrew, Seroussi (2011) deliberately selected roots that occurred in various, more or less related semantic categories. For example, the root *ħ-b-r* occurs in closely related instrument nouns like *maxbéret* 'notebook', *xovéret* 'folder' and the more abstract product noun *xibur* 'composing, composition'; in less obviously related, potentially polysemous nouns like *xéver* 'league', *xevra* 'society, company', *xavura* '(social) group'; and with an even remoter sense in the nouns *xaver* 'friend', *xaverut* 'friendship', *xaveri* 'friendly'. Hebrew-speaking graduate-level students in linguistics often failed to agree about whether words with a shared consonantal basis 'have the same meaning' -- for example, *pagoš* 'bumper' versus other words from the root *p-g-š* in the sense of 'meet' (cf. *pgiša* 'meeting', *mifgaš* 'encounter'); or *gdil* 'tassel' versus words from *g-d-l* with a clear meaning of 'large, big' (cf. *gódel* 'size', *gidul* 'growth'). In other words, speakers tend to assign meanings to roots, but the notion 'related meaning' remains vague and hard to define.

In fact, speakers may even assign meaning to roots in the context of **unfamiliar words**. Seroussi's database of 4,000 derived nouns included numerous archaic or arcane items and esoteric officially stipulated coinages (Nir 1982) – words that were judged by a team of research assistants as unknown or uninterpretable. Large numbers of native-speaking adults were administered questionnaires requiring them to rank nouns in the data-base on a 5-point scale from 'not at all familiar' to 'very familiar indeed'. Unexpectedly, respondents rated the vast majority of the nouns listed as well-known or highly familiar, assigning a rank of 4 or 5 to over 80% of the nouns given them. This unexpected finding suggests that even unknown lexical items have a **'pseudo-familiarity'** for Hebrew speakers, due to the powerful impact of consonantal roots that they know, or think they know – even in uncommon or specialized words like *gdil* 'tassel' (cf.

gadol 'big'), *tikróvet* 'refreshments' (cf. *karov* 'near'), *laktanut* 'eclecticism' (cf. *léket* 'anthology').

This makes good sense typologically, since the bulk of Hebrew nouns are made up of a consonantal root combined with an established morphological *miškal* pattern. Once Hebrew speakers see a string of letters constructed from these two elements, however arcane or esoteric it may be, they will tend to regard it as 'legitimate', hence a 'possible' word in their language. Sociolinguistic and historical factors conspire with this structural bias to make Hebrew speakers treat words that they do not actually know as 'familiar', since the language is in a highly dynamic state of flux and new words are constantly entering, while 'old' words still form an integral part of the mental lexicon (Nir 1982, 1993; Schwarzwald 2001; Yannai 1974). Seroussi's respondents clearly based the familiarity they felt for unknown words on their root consonants, apart from, or in combination with, their associated affixal *miškal* patterns (cf. esoteric *gdil* vs. commonplace *clil* 'sound', obscure *tikróvet* 'refreshments' vs. everyday *tispóret* 'haircut', unfamiliar *laktanut* vs. familiar *paršanut* 'commentary').

In sum, the question of whether roots 'have meaning' can be answered in different ways. In the present context, root-semantics is relevant to specifying what constitutes an active root, reformulated as follows: A root is **'active' in current Hebrew** on condition that (1) it occurs in more than a single word, (2) at least one of these is a verb, and (3) these words share at least one agreed, readily identifiable, and hence 'transparent' core of meaning. By this analysis, the same string of consonants may, in fact, represent more than one root -- as noted earlier for *c-p-r*, or *ʔ-b-q* with the two distinct meanings of 'struggle' and 'powder' (Ravid 1990; Schwarzwald 1976). And the relative accessibility of a root interacts with the factor of 'family size' (Moscoso del Prado Martín, Deutsch, Frost, Schreuder, De Jong & Baayen 2005) – here, how many words from a given root occur in the lexicon of speaker-writers at a given point in time.[5] Finally, given the lack of established criteria of lexical frequency in Israeli Hebrew, whether a root is specified as 'currently functioning' depends critically on actual usage – by whom a root is used and in what contexts, as discussed in Section 3 below.

[5] Family size also depends on type / token distinctions. For example, only a few word-types are constructed from the root *š-q-r* '(tell a) lie, falsehood', but these have high-frequency token occurrences.

2. Factors of Linguistic Structure: The Impact of Morphology

Three structural facets of the phonology-morphology interface and processes of new-word formation are noted as affecting the status of the root in Modern Hebrew: the distinction between 'full' and 'defective' roots; the relative impact of consonantal root versus *miškal* pattern; and interdigited compared with linear word-formation.

Consider, first, the structural distinction between so-called 'full' and 'defective' roots. The former are canonically structured, perceptually salient roots consisting of three obstruent consonants (sometimes four or more: Yannai 1974; Berman 2003), all of which surface in all words made out of them. These contrast with a mixed group of 'defective' or 'weak' roots, which contain one or even two phonologically weak elements: the sonorant *n,* the glides *y, w,* and/or the back consonants – the historical glottals *?, h* and pharyngeals *ħ, ʕ.*[6] The morpho-phonological consequences of radicals that fail to surface in some or all words formed from them are well described in the literature (*e.g.,* Schwarzwald 1977, 1980, 1984, 2003). They have been calculated to account for as many as one-third of the verbs and nouns in current Hebrew (Bolozky 2008; Seroussi 2011) and, as is often true of irregular or non-canonic forms (Bybee 2006; Schwarzwald 1978, 1981), words based on weak roots are typically high-frequency items in everyday usage, and common among children's early verbs – *e.g., b-?-w* 'come', *s-y-m* 'put', *l-q-ħ,* 'take', *n-t-n* 'give', *y-š-b* 'sit', *š-t-y* 'drink' (Berman 1978; Berman & Armon 1996; Ravid in press-a). Psycholinguistic evidence from different sources underscores the effect of the structural opacity of weak roots on the perception of non-expert, native speaker-hearers of Hebrew. Findings from experimental studies with Hebrew speakers from early pre-school age (Berman 2003) via school children and adolescents (Bar-On 2000; Ravid 2003; Seroussi 2011) and on to adults (Berent & Shimron 1997; Frost et al 2000; Velan et al 2005) all point to the **opacity** of such roots and their inaccessibility even to well-educated speakers and writers of contemporary Hebrew. For example, young children

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[6] For lack of space, no distinction is made here between the words constructed from the 'weakest' root elements – the glides *y, w* – all of which are 'defective' and those with a weak *n,* which fails to surface only in some words and in certain environments, and so is more transparently accessible to speakers. For example, young children introduce a 'missing' *n* in forms like *natánti* in place of normative *natáti* 'I-gave' from the root *n-t*-n, or *ensa* rather than normative *esa* 'I-will-go' from *n-s-ʕ.*

misconstrue abstract roots when coining words – producing forms like the verbs *legazez* 'to-crack (nuts)' from the noun *egozim* 'nuts', or *lekasen, lekases* 'to seat' from the noun *kise* 'chair' (Berman 2000). Laks' (submitted) study of morphological variation in Hebrew verb paradigms highlights the irregularity and opacity of such verbs: Of 12 native-speaking adults asked to provide the future form of the verb *yavaš* 'become dry', with the weak initial radical *y*, 5 said they couldn't, 3 had to think about it for a few minutes and hesitantly gave the correct answer (**yiyvaš* → *yivaš*), and only 2 came up with the correct answer immediately. Laks concludes that speakers' hesitation and their inability to conjugate such verbs shows that the rules underlying these defective paradigms do not constitute an active part of their grammatical knowledge. Such variation also clearly depends on usage-based factors of register, literacy, and frequency, as discussed further in Section 3 below. Importantly, across Seroussi's (2011) test battery, fully transparent roots provided participants with a strong basis for guessing at the meaning of unfamiliar words; words with defective roots, in contrast, elicited a more conservative approach and stricter adherence to the nearest sense of each specific root. This significantly **differential strategy** – exploiting the full root as an anchor for further searches, but limiting the scope of the search with defective roots – also interacted with age, being more marked with adolescents and adults than with younger school children.

Difficulties of non-experts in retrieving defective roots as the basis for word-formation and perception in their language might appear to contradict the psychological reality of the consonantal root in the mental lexicon of Hebrew speaker-writers – as argued for in this study. Instead of this being the case, the phenomenon supports a **multi-faceted** view of the role and status of the consonantal root in Hebrew. On the one hand, transparently canonic or 'regular' roots constitute integrated (though non-pronounceable) entities that are readily retrievable in both known words and unfamiliar lexical items or nonce words constructed out of them. On the other hand, weak or defective roots are typically **inaccessible** to untutored speaker-writers.[7] Different types of roots and root

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[7]   This inaccessibility is also **relative**, depending on the family size and relative transparency of words constructed from a given root. For example, as noted, initial *n* in a verb-form like *esa* 'I-will-go' is readily retrievable by analogy with other items in the same paradigm, in a verb like *nasáti* 'I-went' or a noun like *nesi'a* 'journey'; but native-speaking university students are puzzled when asked to specify the root elements of a noun like *magaš* 'tray' from the root *n-g-š*, even more so for a verb like *mevin* 'understand' from *b-w-n*.

elements thus clearly differ in their perceptual salience and psychological accessibility. But this does not detract from the centrality of consonantal elements as the basis for word-formation and interpretation in the bulk of the content lexicon of Hebrew. In the case of canonic roots, these can be retrieved by speakers as largely identical to their abstract historical (and orthographically represented) counterparts. Weak roots, in contrast, are perceived as **consonantal skeletons**: These typically diverge from the normative radicals, but they are recognizable as such even by naïve speakers when processing the words in their language.

A second structural variable concerns **root versus pattern**. Experimental evidence points to the relatively greater weight in the mental lexicon of Hebrew speaker-writers of the consonantal root compared with the prosodic templates of the *miškal* patterns. In an experimental study of morphological awareness in kindergarten, grade- and middle-school children compared with adults, Ravid & Malenky (2001) found that 'root perception emerges very early on [...] while pattern perception continues to challenge older age groups.' And Seroussi's (2011) results across different written tasks (word-relatedness, word associations, interpretation of words in context, sentence construction, definitions) consistently underscore the weight of root-based morphology rather than pattern- or word-based phonology in processing of Hebrew derived nouns by adolescents and adults. These findings are consistent with what has been demonstrated by online experimental studies of Frost and his associates (*e.g.*, Frost, Deutsch & Forster 2000; Frost, Forster & Deutsch 1997; Velan & Frost 2010). The conclusion drawn by psycholinguists approaching the issue from different perspectives is that, unlike in many European languages, morphology plays a more major role in organization and structuring of the mental lexicon of Hebrew speaker-writers than phonological templates or sound combinations. Thus, while roots plus patterns combine as the two driving forces in processes of **new-word formation** among speakers of Israeli Hebrew from an early age (Berman 1987a, 2000; Bolozky 1986, 1999; Ravid 1990), consonantal elements play a dominant role in **speaker perceptions** of lexical familiarity, word relatedness, and word meanings from childhood across adolescence into adulthood.

A **third structural** variable is the type of derivational process, interdigited root plus **pattern affixation** versus linear stem/word plus external affixation. **Linear derivation** – typically by suffixing to a word or bound stem – is well established at all levels of current Hebrew usage (Ravid 2006; Schwarzwald 2001, 2003). Some such suffixes are unambiguous (*e.g.*, *-ut* in forming abstract nouns and *–i*

for denominal adjectives (Bolozky & Schwarzwald 1992; Ravid & Shlesinger **1987**). Others are multifunctional, for example, the ending –*on* occurs with diminutives, collective nouns, and periodicals. Structurally, these and other suffixes are often added linearly to words which are themselves root-based – *e.g.*, *maxševon* 'calculator' from *maxšev* 'computer' (cf. the root *ħ-š-b*), *yalduti* 'childish' from the bound stem of *yéled* 'child' with root *y-l-d* – plus the suffixes – *ut* to form the abstract noun *yaldut* 'childhood' and –*i* to form the adjective *yalduti*. Both synthetic interdigitation with roots and linear concatenation with stem-external affixes are productive means of extending the lexical repertoire of current Hebrew. However, as shown below, speaker-writers from early childhood rely on root-pattern interdigitation no less – often more – than linear affixation for coining new words or interpreting unfamiliar lexical items.

3. Speaker-Based Psycholinguistic Factors

An impressive body of evidence has accumulated regarding speaker perceptions of root elements in Hebrew in recent decades. Insights from such research are reviewed below in relation to pre-literate children in early childhood (Section 3.1), and school children and adolescents compared with adults at different levels of literacy and expertise (Section 3.2).

3.1 Perception of Root Elements in Early Childhood

Young pre-schoolers' perception of consonantal strings as distinct structural and semantic elements is critical evidence for the psychological reality of roots, since they represent truly naïve, **untutored** speakers of the language. Data are available on this issue from both structured experiments and spontaneous usage. One set of studies tested children's interpretation of unfamiliar words by providing them with non-occurrent, but possible, lexical items in different experimental contexts. Even three-year-olds proved occasionally able to interpret novel nouns on the basis of their related verbs, and this was common for children aged 4 to 5 years. For example, they would explain the hypothetical agent-noun *xapas* as 'someone who searches' on the basis of the related verb *le-xapes* 'to-search', or innovative *mafzera* as 'an instrument for scattering' from *le-fazer* 'scatter' (Berman, Hecht & Clark 1982; Clark & Berman 1984). We interpreted this as demonstrating the ability to perform **root-extraction**: identifying the consonantal elements *x-p-s* and *f-z-r* in non-occurrent, hence unfamiliar nouns and then re-inserting them in appropriate *binyan* patterns in the form of familiar verbs. Similar findings

emerged when children in the same age ranges were required to connect novel verbs to familiar nouns. For example, given hypothetical *le-saner*, they interpret it as 'put on an apron' (cf. the noun *sinar* 'apron'), they recognize non-occurrent but possible *le-hafjim* as deriving from the noun *pijáma* to mean 'put on pyjamas', and they connect novel *li-mgof* to the familiar noun *magafáyim* 'boots' as meaning 'put on boots' (Berman 2003). The novel items presented to participants often had quite distinct surface shapes from established words whose roots they shared; yet even when faced with structural opacity or the limitations of a juvenile vocabulary, untutored speakers exploit the peculiarly Semitic device of attending to consonantal elements when interpreting new words.

This conclusion is confirmed by studies demonstrating preschoolers' ability to **produce** novel lexical items relating to established words in different semantic categories. Various experiments (summarized in Berman 2000) showed that young children were able to coin novel agent, instrument, and place nouns from established verbs. For example, when asked 'What would you a call a person whose job it is to jump [=*likpoc*], a person who likes to jump?', children would typically respond with a possible though novel noun like *kafcan*. They were also able to coin novel verbs from established (place, object, instrument) nouns and (state to causative) adjectives. For example, when told 'I'm putting these beads in a box [=*kufsa*], what do I do with the beads when I put them in the box?', they would respond with possible verbs like *kofes, mekafes, makfis* (Berman 2003). Moreover, children aged three to four years (but less so 2-year-olds) could change familiar active verbs to their passive, resultative counterparts; for example, when shown a picture and told 'Here's a razor to shave [=*legaléax*] the man, and here the man is ...', they would generally respond with a possible resultative form like *galúax* or established *megulax* '(clean) shaven' (Berman 1994); and given familiar intransitive verbs like *zoxel* 'crawl' or *soxe* 'swim', children could coin novel causative verbs sharing the same consonants but in different *binyan* patterns, *e.g.*, *mazxil* 'makes crawl', *masxe* 'makes swim' respectively (Berman 1993a, b). Across varied tasks, children proved able to rely on the consonantal elements in familiar words to coin novel, but semantically plausible and structurally acceptable lexical items in their language.

This same ability is even more dramatically demonstrated by children's innovative coinages in their **spontaneous speech output**. These may fill apparent gaps in the lexicon, due to their not knowing the accepted word (*e.g.*, a boy aged 3;9 asks for *ma'ataf* 'wrapper' for his present instead of established *atifa* 'wrapping' from the verb *la'atof* 'to-wrap'; and a three-year-old girl says her

mother should *lehašin* 'to-make-sleep' her (from the intransitive verb *lišon*) in place of conventional *lehaškiv* 'to-lay-down' or *lehardim* 'to-put to sleep'. Coinages may also fill genuine lexical gaps, as when a child says of a mechanic that he is *takan* 'fixer' from the verb *le-taken,* or a boy refers to his father's razor as *maglexa* from the verb *lehitgaléax* 'to-shave'; or in coining verbs, a boy aged 2;8 asks his mother if she has finished *lekarem* his body, from the loan noun *krem* 'crème', while another boy asks his mother *tešarveli li et ha-xulca* 'sleeve me the shirt = roll up my sleeves' from the noun *šarvul* (Berman 2000; Berman & Sagi 1981).

These and numerous other such instances demonstrate that Hebrew-speaking children quite naturally fill gaps in their lexicon, as in other languages, by constructing new words out of known words (Clark 1993). But in Hebrew they do this most typically by re-shaping the consonantal (hence root) elements of the source word in the form of a different prosodic template or morphological pattern (*binyan* for verbs, *miškal* for nouns), rather than by adding external affixal elements to the existing source word. True, Hebrew-speaking preschoolers also innovate by linear suffixation, most often by adding *–ut* to coin abstract nouns like *cmi'ut* 'thirstiness' from *came* 'thirsty' or *nixut* 'rest' from *lanuax* 'to-rest' (cf. established *cima'on*, *menuxa*, respectively) or by agentive *–an* (*e.g.*, *akfan* 'passer' from *la'akof* of a driver overtaking cars, *marbican* 'hitter' for someone who likes hitting = *le-harbic*). However, children use linear affixation only when coining novel nouns, occasionally adjectives: By age three years, they invariably construct verbs interdigitally, combining consonantal elements with one of the five non-passive *binyan* patterns. And children even prefer constructing new nouns, too, by combining a possible root with a noun pattern (*e.g.*, *maCCeC(a)* or *miCCaCa* for instruments and places, *CaCaC* and *CaCCan* for agents, *CiCuC, CóCeC*, or *CCiCa* for abstract nominals). Non-linear forms like these accounted for over two-thirds of the nouns coined by children in structured elicitations, and as high as three-quarters of hundreds of novel nouns recorded in their spontaneous speech output (Berman 2000).

Findings from these studies query the validity of claims for 'pure' processes of root-extraction in early childhood. Rather, young pre-literate children initially relate both to consonantal elements (often in the form of a non-normative 'consonantal skeleton') **and** to the overall shape and prosodic contours of words in order to interpret unfamiliar words and to construct novel lexical items. In the first task, they are aided by the perceptual salience and high-frequency of repeated consonantal elements in the content vocabulary of Hebrew; in the

second, they can rely on their early recognition of what constitutes a 'possible' word in their language. Children thus exploit different types of morphological and phonological clues in developing their lexicon in Hebrew as in other languages. Importantly, the idea that children employ varied sources of information for lexical 'bootstrapping' is consistent with a more general principle: Learners rely concurrently on 'a confluence of cues' – perceptual, structural, semantic, and discursive – in acquisition of linguistic knowledge in varied domains (Berman 1993b, 1994, 2005).

Children are aided in this by the interplay of two factors underlying the process of language-acquisition: target-language typology and usage-based experience. **Typological imperatives** foster early sensitivity to the morpho-lexical patternings available or required for word-formation in the ambient language (Berman 1986; Bowerman & Choi 2003; Slobin 2001). In Hebrew, this process is supported by the occurrence of 'word families' with numerous words clustering around the same root-related core meaning (*e.g.*, from *g-d-l-gadal* 'grow (Intrans)', *gidel* 'raise', *gadol* 'big', *gódel* 'size', *gidul* 'growth', *migdal* 'tower'; from *k-t-b -katav* 'write', *katuv* 'written', *ktav* 'writing', *któvet* 'address', *mixtav* 'letter'). Experientially, children are aided by exposure to context-based **distributional alternations** of words with a shared consonantal base across syntactic categories (*e.g.*, Verb-Noun strings like: *mesaxek misxakim* 'plays games', *paras prusa me-ha-uga* 'cut (a) slice from-the-cake'), even with words from weak or defective roots (*e.g.*, *hi ráca ba-meruc* 'she ran in-the-race' from the root *r-w-c, ha-tayas hetis et ha-matos* 'the-pilot flew the-plane' with the agent noun, verb, and object instrument noun based on the shared root *t́-w-s*).

3.2 The Impact of Literacy and Expert Knowledge

Attention to the consonantal elements of words is a critical facet of morphological awareness in preschool children prior to formal instruction in reading and writing (Ravid & Malenky 2001). **Root-extraction**, as a more abstract and autonomous process, consolidates more gradually, under the impact of increasing literacy. Once children learn to read and write, perception of the consonantal core of words in their language is greatly enhanced, underscoring the idea that "consonants indeed form the substance of the language" (Gesenius 1910, p. 10). Intriguing evidence for this claim is provided by a contrastive study of Hebrew- and Spanish-speaking children, in which children were asked to write down a set of similar words in each language, like those meaning *chocolate, pizza, radio, telephone* (Tolchinsky & Teberosky 1997, 1998). The 5-year-old preschoolers

produced strings where the number of letters mapped quite directly onto the number of syllables in the target words in both languages. By age 7 years, however, the Hebrew-speaking children would write consonants, while their Spanish-speaking peers wrote vowels to represent each syllable.

Even in the early school grades, when children rely on vocalized orthography for reading Hebrew, they tend to focus on consonants, since the diacritic marks used to represent vowels are perceptually less salient and structurally less crucial – and not required by 3rd or 4th grade readers (Bar-On 2010). Increased exposure to written language heightens awareness of 'morpho-orthography'. Specifically, readers come to discriminate between word-pattern versus root-consonant elements in groups of words like *miškéfet* 'telescope', *mirpéset* 'porch', *miktéret* 'pipe', and even *maxbéret* 'notebook'. Knowing how to read thus heightens the distinction between the stable, repeated 'outlying' pattern consonants – here, word-initial *m* and final *t* – in contrast to the alternating root or base elements – *š-q-p, r-p-s, q-t-r, h-b-r* respectively (Bar-On and Ravid 2005; Ravid, in press-b).

Bar-On (2000) gave school children and adults a series of written tasks designed to assess their 'root perception'. Participants were required to (1) extract the root consonants from a given word in spelling another word from the same root; (2) derive words via the root occurring in another word (*e.g.*, the verb *dorxim* '(they) tread' from *midraxa* 'sidewalk'); and (3) detect relations between unrelated words with homonymous roots (*e.g.*, *ózen* 'ear' ~ *ma'azin* 'listens' versus *šémeš* 'sun' ~ *mešumaš* 'used'). Bar-On interprets her findings as evidence for the fact that roots are represented as autonomous entities even by grade-school age. However, school children were able to identify as root-related mainly pairs that were both structurally and semantically transparent; high-school students and adults, in contrast, recognized quite distantly-related words as constructed from shared consonantal elements.

Other studies, too, demonstrate that root perception undergoes development across school-age (Ravid 2003). Grade-school children's tendency to rely heavily on root-based structural cues in relating to lexical items presented in isolation gives way to greater attention to the **semantic** content of the target words among older students and adults (Seroussi 2011). In the domain of **spelling**, older school children cope increasingly well with root-consonants, in addition to their earlier mastery of 'function letters' that represent affixal rather than stem elements (Ravid, in press-b; Ravid & Malenky 2001). Increased literacy also makes students more aware of differences between root consonants that sound the same but represent distinct letters (*e.g.*, *r-q-b* 'rot' versus *r-k-b* 'ride' and also 'compose,

combine'). Moreover, high school students are able to process opaque, 'defective' roots more accurately and more effectively than younger school children, as demonstrated by Seroussi in a range of tasks. These developments can be attributed to the combined factors of (1) a larger, more sophisticated repertoire of lexical items – enabling speakers to relate more words to one another via a shared consonantal root; (2) enhanced analytical abilities in general and meta-linguistic morphological awareness in particular – for dissecting words into their abstract components; and (3) greater exposure to consonantal orthography in writing – facilitating Hebrew-specific reliance on an 'orthographic root' (Berman & Ravid 2009; Ravid, in press-b; Ravid & Tolchinsky 2002),

Yet even educated, literate adults do not necessarily demonstrate the same expert knowledge of root structure as Hebraists and Semitic scholars. Hebrew-language specialists know the historical origins of distinctions between root letters that are neutralized and no longer evident in current Hebrew pronunciation; they have command of the diacritic notations indicating consonant germination or differentiating long from short vowels (Schwarzwald 2003); and they alone are thoroughly familiar with current coinages and stipulations of the Hebrew Language Academy, which are often inaccessible to non-expert speakers, even if well-educated in other domains (Nir 1982; Ravid 1995, 2005; Seroussi 2011). As a result, perception of abstract normative roots often eludes non-Hebrew specialists when interpreting unfamiliar words or deciding whether certain words are related by shared roots – most particularly though not only in the case of weak or defective roots.

4. Concluding Remarks

The main conclusion emerging from this 'revisiting of Hebrew roots' is the futility of sweeping *en bloc* generalizations about root perception or the existence of consonantal roots as independent entities in the Hebrew lexicon. The factors impinging on the domain are many and varied – in line with connectionist models of lexical networks that depict distinctions between words and their degree of analyzability as graded rather than binary, dependent on a range of factors such as frequency and both morphological and semantic transparency (Gonnerman et al. 2007; Plaut & Gonnerman 2000; Seroussi 2011). The variables relevant to the current overview of root perception in Modern Hebrew include type of processing – in production (word-formation) or perception (word-interpretation); in structured experimental settings versus spontaneous speech output; in words

analyzed in isolation or in context; and in writing and/or speech. Importantly, they not only involve but also depend on the level of literacy of the population in question.

It follows that both 'root-based' and 'word-based' approaches noted at the outset of this paper need to be taken into account as factors in the mental lexicon of Hebrew. On the one hand, consonantal roots are key facets of how speaker-writers of contemporary Hebrew from a young age construct new words and interpret unfamiliar items in their language – by means of the two complementary processes of **root-extraction** and **inter-digitation** of consonantal roots with vocalic and other affixal elements. On the other hand, words may themselves form the basis for new-word formation and unfamiliar-word interpretation – particularly in the case of nouns (Berman & Seroussi 2011) and adjectives (Ravid & Levie 2010), rarely if ever for verbs. As a specific illustration: One of the less familiar nouns in Seroussi's (2011) study was the architectural term *gamlon* 'gable', which respondents often interpreted linearly as combining the familiar noun *gamal* 'camel' with the suffix –*on*. In contrast, when given a largely unfamiliar verb like polysemous *ligmol* 'wean' or 'recompense', school children will readily use interdigitation of root plus pattern to derive abstract nouns like *gmila, gimul, gmilut.* In other words, Hebrew speakers themselves adopt a multifaceted approach to the structural elements underlying the content vocabulary of their language: From early preschool age, and as a function of increased literacy from grade-school to adolescence and beyond, they will apply a variety of strategies in order to interpret unfamiliar words or to construct new ones in their language. Consonantal root elements play a crucial but not a solitary role in these processes.

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