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Hebrew orthography and literacy

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1. Introduction

The purpose of this chapter is to present an overview of the nature of Hebrew orthography and its relation to literacy acquisition in Israel. It provides a linguistic and psycholinguistic description and analysis of different facets of Hebrew orthography, reviews studies on learning to spell and read in Hebrew, and describes the impact of Hebrew typology on emergent literacy and beyond.

Modern Hebrew at the turn of the new millennium is a century-old language that still carries with it the traces of its 4,000-year-old past in its morphology and orthographic system. Hebrew-speaking children have to contend with the remnants of ancient rules in language acquisition, on the one hand, and in the development of literacy, on the other. This chapter will present relevant background facts about the Hebrew language and its speakers / readers / writers. It will then focus on the Hebrew orthography with its unique Semitic features and main problems, trace its acquisition, and show how its learners make use of phonological and morphological information available from oral usage. Special attention will be paid to the differences between the representation of various phonological and morphological categories and their consequences for literacy acquisition and consolidation.

Hebrew has an alphabetical orthography with 22 letters, most of which denote consonants alone, and an ancillary system of 13 vowel diacritic marks termed *nikud* (literally, pointing). Hebrew is written from right to left, either with no vocalization marks and consequent under-specification of vowels, or with full vowel specification when including vocalization marks. Thus the sentence *kotvim ivrit mi-yamin li-smol* '(they) write Hebrew from-right to-left¹' may be written in the non-vocalized version as כותבים עברית מימין לשמאל, which is the universal form of written Hebrew; or in the

vocalized version which is used only for special purposes, with full vowel specification as כּוֹתְבִים עֵבְרִית מִיָּמִין לְשִׂמְאֵל. Side by side with Hebrew script, this chapter makes use of capital Latin letters standing for Hebrew graphemes to facilitate presentation of orthographic matters. For example, this is the Latinized orthographic version of the above sentence: KWTBYM 9BRYT MYMYN LŠMAL². Five of the Hebrew letters have double forms – regular and word-final, e.g., M is spelled ם at word-final position and ך elsewhere³. Three letters have alternative forms with an apostrophe, marking recent loan palatal consonants, e.g., ך Z with an apostrophe ך' is pronounced ž.

Having briefly presented this essential basic information about written Hebrew, we can now proceed to an in-depth introduction about the language, its orthography and its readers / writers.

2. Hebrew morphology

Hebrew is a highly synthetic Semitic language with a rich morphology (Berman, 1987; Ravid, 1990). Morphological density is expressed in a variety of grammatical and lexical semantic notions systematically expressed in morphological form, on the one hand; and in numerous and diverse morpho-phonological structures, on the other. The bulk of content words in Hebrew - all verbs, and most nouns and adjectives - are at least bi-morphemic, constructed of the typically Semitic *nonlinear* structure (McCarthy, 1982). This is a combination of the consonantal *root*, e.g., *s-g-r* 'close', and a vocalic pattern which may be preceded and or / followed by a consonant, e.g., the abstract noun pattern *miCCéCet*. These two are combined by interdigitating the root consonants in their designated sites in the pattern as in *misgéret* 'frame' (Berman, 1997; Ravid, 1990, 2003). Combining the same root *s-g-r*

‘close’ with other patterns yields past tense *sagar* ‘closed’, passive *nisgar* ‘was closed’, causative *hisgir* ‘extradite’ and adjectival *sagur* ‘closed’, as well as *sgira* ‘closing’, *sgirut* ‘introvertness’, *séger* ‘closure’.

A second type of morphological structure in Hebrew is *linear*, a concatenation of a stem (typically a word) and a prefix or a suffix, e.g., *sagár-ti* ‘(I)-closed’. Several lexical noun categories are expressed by linear suffixes, e.g., *iton-ay* ‘journal-ist’, *iton-ut* ‘journal-ism’ (Berman, 1987, 1997; Schwarzwald, 2002). All obligatory and optional grammatical markings of number, gender and person on nouns, adjectives and verbs are expressed linearly, e.g., *kadur-im* ‘ball-s’, *atsuv-ot* ‘sad, Pl,Fm’.⁴

Hebrew nouns and adjectives are obligatorily inflected for gender and number, e.g., *ha-maxbarot ha-adumot* ‘the-notebooks,Fm the-red,Fm,Pl = the red notebooks’. Verbs are obligatorily inflected for gender, number, person and tense, e.g., *ha-maxbarot ha-adumot kol ha-zman ne’elamot* ‘the red notebooks keep disappearing,Fm,Pl’. Prepositions are also obligatorily inflected for gender, number, person, e.g., *ha-maxbarot ha-adumot kol ha-zman ne’elamot lax* ‘the red notebooks keep disappearing to-you,Fm = you keep losing your red notebooks’. In addition, Hebrew has optional bound inflectional forms such as possessive markers on nouns (e.g., *armona* ‘palace-hers = her palace’ and an accusative inflection on transitive verbs (e.g., *re’itiv* ‘I-saw-him’) (Berman, 1978; Ravid, 1995a; Schwarzwald, 2002).

Hebrew derivational morphology is rich and varied, with a large array of derivational affixes of various structures and with an extremely complex root, stem and affix allomorphy. Nouns and adjectives express an array of nominal meanings, ranging over agent, attributive, diminutive, instrument, place, collective, action and abstract nominals. Consider, for example, the variety of meanings deriving from basic

‘take in, abstract’ in the morphological family of root *k-l-t*: *koltan* ‘receptor’, *maklet* ‘receiver’, *miklat* ‘shelter’, *kélet* ‘input’, *haklata* ‘recording’, *taklit* ‘record’, *muklat* ‘recorded’, *kalit* ‘easily remembered’. Verbs express transitivity relations such as causativity, passive voice, reflexivity, change of state, and reciprocity. Consider, for example, the semantic clusters created by verbs related through their roots as in *nirdam / hirdim* ‘fell asleep / caused to sleep’; *katav / hixtiv / huxtav / hitkatev* ‘wrote / dictated / was dictated / corresponded’; and *lavaš / nilbaš / hilbiš / hitlabeš* ‘put on / was worn / dressed somebody / dressed oneself’ (Clark, 1993).

The wealth of morphological structures in Hebrew is reflected in its written form, as shown below, and this reflection promotes morphological perception and strategies in Hebrew speakers / readers / writers, as predicted by Olson’s script-as-model theory of literacy (Olson, 1994).

3. Historical sources of Hebrew structure and orthography

Hebrew has one of the longest written records known to us, deriving from ancient historical periods during which Classical Hebrew was a spoken, living language (Kutscher, 1982). Classical Hebrew (1100 BCE - 250 CE) is usually divided into two distinct and consecutive periods: Biblical and Mishnaic Hebrew (Rabin, 1972). Biblical Hebrew was a derivative of Canaanite (a northwestern Semitic language), the language spoken in the Land of Israel during the time of the First Temple from the beginning of the second millennium BCE until the middle of the first millennium BCE (Bergsträsser, 1982; Driver, 1976). It is recorded in written form in the Hebrew Bible (the Old Testament) and in various inscriptions (Kautzsch, 1910). A post-Biblical form of the language, referred to as Mishnaic Hebrew, was used in the Land of Israel side-by-side with another northwestern Semitic language, Aramaic, up

to approximately the middle of the first millennium CE (Bendavid, 1971). For about 1,500 years, until the 20th century, Hebrew was dormant, no longer a spoken native language, but used extensively in writing in the Jewish Diaspora for liturgical, religious, cultural, scholarly and scientific purposes, serving as the lingua franca of Jews speaking different languages in the world (Kutscher, 1982; Schwarzwald, 2001). Moreover, Hebrew continued to change during this time, acquiring new lexical items and grammatical forms, which are used extensively nowadays in Modern Hebrew (Ravid & Zilberbuch, 2003; Ben Hayyim, 1985).

The major sources of written records about Classical Hebrew are the Hebrew Bible and the Mishna, with some additional sources such as the Dead Sea scrolls and numerous inscriptions. These provide us with a wealth of information about Hebrew orthography. The unique characteristic of Semitic script is best expressed by the 19th century scholar W. Gesenius in the classical text edited by Kautzsch (1910):

“No system of writing is ever so perfect as to be able to reproduce the sounds of a language in all their various shades, and *the writing of the Semites* has one striking fundamental defect, viz. that only the consonants (which indeed form the substance of the language) are written as real letters” (p. 5).

One of the theories for the omission of vowels in Hebrew writing is the extreme prominence of Semitic consonants as carrying the main lexical content of the word. Another theory claims that Semitic writing started out as a syllabary and later on became purely consonantal (Coulmas, 1989). This consonantal character of written Hebrew is as real today as in ancient times, though facilitating systems representing vowels were added in the course of history. Such a skeletal orthography necessitates

heavy reliance on morphological, syntactic and discourse context cues (Shimron, 1993).

As a result of early sound changes in the evolution of North Semitic languages, long vowels in word final position came to be represented in Semitic writing by ‘weak’ consonantal signs, i.e., graphemes representing semi-vowels (e.g., Y ם and W ן representing *y* and *w* respectively). This came to be known as *plene* or full writing, and later on it spread to medial positions as well (Coulmas, 1989). With the increased influence of Greek in the Middle East in post-Alexandrian times and the growing number of loan words whose meaning could not be inferred from the context, Semitic writing was no longer transparent enough for efficient reading. The consonantal letters AHWY (Hebrew אהוי) thus took on an additional value in Mishnaic Hebrew, to indicate vowels between consonant letters in a manner similar to Greek and Latin, and came to be known in this role as *matres lectionis* ‘mothers of reading’ (Bendavid, 1971). This system facilitated consonantal reading, but was not precise and consistent enough.

In the 7th and 8th centuries CE, fuller and more consistent systems of vowel marking were developed in Hebrew. These were competing systems of diacritics, which represented vowels, consonantal spirantization and gemination, as well as the musical cantillation of the reading tradition (Bergsträsser, 1982; Khan, 1997; Rendburg, 1997). The diacritic system which is still used in Hebrew today was developed under the influence of the Nestorian system of Syrian by the Tiberian Masoretes (tradents), and is known as the Tiberian vocalization system (*nikud*, also called vocalization, vowelizing, punctuation). This system is the major source of our knowledge about Classical Hebrew phonology, and especially about its vowels. The

Tiberian system consists of 7 diacritics placed mainly under (and also above and within) letters, to which an eighth (schwa ə) was added to mark vowel absence or a reduced non-high vowel before the accent (Bolozky, 1997). The schwa also participates in a composite diacritic called *hataf*, representing an auxiliary vowel (Blau, 1971; Ravid & Shlesinger, 2001). Tiberian *nikud* represented the vowels of its contemporary phonology at the end of the first millennium fully and accurately (Table 2 below).

4. Modern Hebrew: Demographic and phonological features

Modern Hebrew was revived twice: First, in the middle of the 19th century, Hebrew was standardized into a single *written* language constructed from a variety of previous periods (Biblical, Mishnaic, Medieval) together with contributions from other European languages as well as from Yiddish. Then, at the beginning of the 20th century, Hebrew was revived as a *spoken* language, mostly in pre-state Israel. Modern Hebrew had served as the sole language of teaching at all levels of education by 1914, and by 1920 was already being spoken as a mother tongue by a first generation of native Hebrew speakers (Fellman, 1973). At the time this chapter is being written, the beginning of the 21st century, a fourth generation of Israelis is acquiring Hebrew as its first language.

The Hebrew-speaking community in Israel, now numbering about 5 million people, has always constituted an extreme case of an immigrant society, and as a result Modern Hebrew has undergone swift and radical changes since its revival (Ravid, 1995a). Immigration waves came in more or less every decade in the 20th century, and in 1948 600,000 Israelis took in double their number in Jewish refugees from communities in Europe, Asia and Africa. Immigration to Israel continued

throughout the second half of the 20th century, culminating in a million immigrants mainly from the former Soviet Union in the 1990's (Emmons, 1997; Shuval, 1996). While immigrant adults do not always achieve proficiency in Hebrew and contribute to the intense 'languages in contact' situation, their children invariably join the widening circles of native speakers (Donitsa-Schmidt, 1999; Olshtain & Horenczyk, 2000). Modern Hebrew is thus the only common means of communication between Jewish Israelis. On the one hand, this situation has brought on a consolidation of the colloquial vernacular of spoken Hebrew all Israelis share; on the other hand it also means a continuous pressure for the language to change and adapt itself at the spoken level. This means the gap between spoken and written language increases with crucial implications for the interface of spoken language, orthography and literacy in the Hebrew-speaking population in Israel (Ben Rafael, Olshtain & Gajst, 1994; Levin, Shohamy, Spolsky, Levi-Keren, Inbar & Shemesh, 2002).

Though Modern Hebrew morphology remains essentially Biblical and its syntax mainly Mishnaic, Modern Hebrew phonology is very different from the Classical phonology due to extensive neutralizations (or mergers) of previously distinct phonemes (Bolozky, 1997; Ravid, 1995a). These discrepancies between Classical and Modern Hebrew underlie some of the reading and writing challenges facing Hebrew readers and writers.

Consonants. Several sets of Classical consonants have merged in Modern Hebrew, resulting with loss of several phonological distinctions and with important consequences for orthography and literacy (Laufer & Condax, 1981; Schwarzwald, 2001; Weinberg, 1966). Below I enumerate the main differences between Classical

and Modern Hebrew consonants. These will be taken up again further below in the discussion of homophony and opacity in Hebrew orthography.

- (i) Of the historical set of six stops spirantizing by regular phonetic rule (p, b, t, d, k, g spirantizing into $f, v, \theta, \delta, x, r$), only three stop / spirant pairs are left in Modern Hebrew ($p / f, b / v, k / x$), and they alternate according to complex morpho-phonological conditions (Bolozky, 1997; Ravid, 1995a). This is a fundamental and pervasive feature of Modern Hebrew phonology. For example, the first radical of root $p\text{-}z\text{-}r$ ‘scatter’ occurs as p in *pizur* ‘scattering’ and as f in *mefazer* ‘scatters’. Hebrew speakers perceive the three pairs of alternating phonemes as signifying unified segments (Ravid & Bar-On, 2001).
- (ii) The Semitic class of *emphatic* consonants no longer exists in Modern Hebrew. Subsequently, the voiceless emphatic coronal stop t and the voiceless coronal stop t have merged, as did the voiceless emphatic velar stop q and the voiceless velar stop k (the stop alternant of x).
- (iii) The semi-vowel w is now a full-fledged consonant v , and it has merged with v , the spirant alternant of b .
- (iv) The Semitic class of gutturals and pharyngeals, traditionally termed *groniyot* (glottal stop $ʔ$, glottal fricative h , pharyngeal fricatives $ħ$ and $ʕ$) has been eroded in Modern Hebrew. Most speakers pronounce both $ʔ$ and $ʕ$ as glottal stops or else omit them (Bolozky, 1997). The precise enunciation of h is restricted to formal spoken Hebrew; in

other cases it is deleted. The standard pronunciation of *ħ* is now *x*, and it has merged with the fricative alternant of *k*. A minority of Hebrew speakers with a Mideastern accent retain the pharyngeal fricatives *ħ* and *ʕ* in their speech. For details, see Ravid (1995a).

A new phonological system with several consonant neutralizations and a weakened guttural-pharyngeal class has emerged in Modern Hebrew (Bolozky, 1997; Ravid, 1995a). However, all of the ancient consonantal distinctions are still reflected in the Hebrew orthographic system in the form of distinct graphemes. Table 1 below summarizes consonantal homophony in standard spoken Hebrew and their interface with the orthography, resulting from the mergers described above.

INSERT TABLE 1 ABOUT HERE

Vowels. Comparing Modern with Classical vowels is more complex than tracing consonant neutralizations. First, vowels are more susceptible to historical change than consonants. This is because consonants are perceived categorically, and fluctuations in their articulatory implementation are likely to be filtered out by listeners. Therefore listeners' perceptions of consonants remain stable and robust even in the face of unstable productions, and the diffusion of incipient change is prevented. Vowels, in contrast, are perceived continuously, and therefore listeners are not as consistent and as confident in their decisions as to vowel identity. Thus a change from one vocalic category to another is not blocked as easily as in the consonantal domain (Berg, 1998: 202-204). Second, scholars are not in a position to decide how accurately Masoretic text reading using the Tiberian diacritic system actually reflects the pronunciation of Classical Hebrew (Bergsträsser, 1982; Blau, 1971; Kautzsch, 1910). Though Masoretic readers were extremely conservative in their reading tradition,

some vocalic allophones recorded in the Tiberian system may have developed after the Classical period. There was also much local variation in the realization of the vowels in Tiberian Hebrew (Rendburg, 1997).

Vowel mergers have resulted in no less homophony than consonant mergers. Firstly, Modern Hebrew has five canonic vowels (*a, e, i, o, u*) compared with seven full Classical vowels and four reduced ones (Bolozky, 1997; Schwarzwald, 2001). Secondly, Classical Hebrew vowels were matched one-to-one by corresponding vowel diacritics, but these no longer carry distinct phonological values. Table 2 below summarizes vowel homophony in standard spoken Hebrew and their interface with the orthography – both with diacritic signs as well as with the four graphemes with the double role of marking consonants and vowels (AHWY אָהוּי) in their *matres lectionis* vowel function.

INSERT TABLE 2 ABOUT HERE

Every language, especially one with such a long history as Hebrew, undergoes phonological change, and obviously changes in the orthography always lag behind those in speech. But the Modern Hebrew neutralizations of historical phonological distinctions delineated above have critical, though different, implications for the oral and written behavior of Hebrew users. Consonant and vowel neutralizations have blurred the phonological underpinnings of Hebrew morphology, which are closely related to the historical phonological system. This is one of the main sources for child language errors, some of which persist to middle childhood and adolescence and also mark current Hebrew sociolects (Ravid, 1995a,b). But literacy, with attendant knowledge of written Hebrew, re-introduces these distinctions through the

orthographic system and consequently reveals the underlying morpho(phono)logical system.

Consider first the two verbs *shafxa* ‘she spilled’ (root *š-p-x*) and *patxa* ‘she opened’ (root *p-t-x*), sharing exactly the same form in the past-tense third-person singular feminine pattern *CaCCa*. They take, however, different vowels in singular feminine present-tense pattern *niCCéCet*, namely regular *nishpexet* ‘is being spilled,Fm’ versus irregular *niftaxat* ‘is being opened,Fm’ with a lower vowel pattern *a-a*. This is because final homophonous *x* in these roots derives from different historical consonants: final *x* in root *š-p-x* is the spirantized alternant of *k*, spelled **כ ן**, and it has regular behavior; while final *x* in root *p-t-x* is the neutralized form of pharyngeal *ħ*, spelled **ח ן**, which attracts the irregular low vowel pattern despite currently being homophonous with the other *x*. This is a source of opacity in early child Hebrew: young children often fail to lower the vowel where required, saying, for example, *niftexet* for *niftaxat* ‘is opening,Fm’ (Ravid, 1995a). But the distinction between the two *x*’s and the reason for their different behaviors become apparent later on with the onset of literacy and growing familiarity with the writing system which marks them with two different graphemes, **כ ן** and **ח ן**.

As a second example, consider the behavior of the homophonic words *davar* ‘thing’ and *davar* ‘mailman’ under pluralization: *davar* ‘thing’ / *dvarim* ‘things’; *davar* ‘mailman’ / *davarim* ‘mailmen’. These two nouns sound exactly the same, but behave differently: In both words, the addition of the plural suffix *-im* creates a new stressed syllable at the end of the word. But in *davar* ‘thing’, pluralization results in vowel reduction, while in plural *davarim* ‘mailmen’ no vowel reduction takes place, and the vowel *a* is retained. This difference reflects a Classical Hebrew rule based on

the difference between the historical vowels represented by diacritics *qamats* and *patah* respectively, which have now merged into a single *a* (Table 2): The morpho-phonological behavior of these Hebrew words continues to follow the differential paths dictated by their past identities (Ravid & Shlesinger, 2001). For native Israelis untutored in historical Hebrew grammar – practically the whole population – this difference in the behavior of the two homophonic words is unmotivated and leads to non-reduction and over-reduction of vowel errors in both child and adult language, such as *matsofim* for *metsofim* ‘floaters’ and *sbonim* for *sabonim* ‘soap cakes’ (Ravid 1995a,b). While these errors gradually decrease with age and schooling, this decrease is not related to learning *nikud*, since vowel representation by diacritics is not a widespread shared knowledge domain in Hebrew, as I elaborate below. This is one example of the instability of word-internal Hebrew vowels, which persists in various forms into adulthood, and is discussed below in relation to spelling vowels in Hebrew (Ravid, 1990; Ravid & Kubi, 2003).

Another way of looking at the impact of the phonological discrepancy between historical and current Hebrew consonants and vowels is from the perspective of the acquisition of writing and reading skills. In this respect, consonant and vowel neutralization have different implications for reading and for writing. Consonant neutralization poses no difficulty for novice readers who do not find homophonous graphemes problematic in any way; but it is the main (though not the only) source of spelling errors in gradeschool, since consonant mergers entail homophonous graphemes (e.g., *k* can be spelled either by K כ or Q ק). However, as I show below, the distinct graphemic values of long-lost phonological distinctions reflect current systematic morphological information, which is very helpful in overcoming

homophony and restricting such spelling errors to novice writers. In contrast, vowels and their inconsistent written representation constitute a key issue in the controversy relating to different methods of reading instruction in Israel, focusing specifically on the use of *nikud* diacritics. For Hebrew writers, however, *nikud* marking is a non-issue, while writing the *matres lectionis* graphemes AHWY אהוי is a source of spelling errors continuing long into adolescence (Ravid & Kubi, 2003).

Given this background, I now turn to a detailed description of current Hebrew orthography, with two foci of inquiry: phonology – the representation of consonants and vowels; and morphology – the representation of morphological constructs in Hebrew orthography. The interface of these two linguistic facets is particularly significant in Hebrew literacy acquisition.

5. Modern Hebrew orthographic versions

There is general agreement that Hebrew orthography is alphabetical, with the typical phoneme / grapheme relationship between consonants and Hebrew letters. It is a mainly consonantal orthography, reflecting its fundamental Semitic root-based underpinnings: 18 of the 22 letters indicate consonants alone, while the four *matres lectionis* אהוי AHWY have a double consonant-vowel function (Coulmas, 1989). As a result, in line with claims that the ancient Semitic script may have been a syllabary (Gelb, 1963), experienced readers of non-vocalized Modern Hebrew may be using syllabary short-cuts to overcome vowel opacity by referring to morphophonemic structures (see below).

Modern Hebrew officially employs two versions of the same orthography, one shallow and transparent and another deep and opaque. The full, transparent and shallow version is the *vocalized* orthography, which represents both consonants and

vowels. This version provides precise, in many cases redundant, phonological information about the written Hebrew word. The main information is vocalic: In addition to the full representation of all consonants by 22 letters, the five vowels *a, e, i, o, u* are represented by 9 diacritic vocalization *nikud* marks, combining to form 13 marks (Table 2). Thus each Modern Hebrew vowel has at least two, in some cases three, corresponding written signs. For example, the vowel *e* is represented by the marks *serey*, *segol* and *hataf-segol* appearing under the letters, as in examples *séfer* ‘book’ spelled סֵפֶר, and *emet* ‘truth’ spelled אֱמֶת. But precise vocalization of a Hebrew word represents much more than its superficial phonology: the occurrence of specific *nikud* marks in the Hebrew word is governed by the Classical Tiberian system, which still underlies Hebrew morpho-phonological behavior (Baayen, 1985). Thus, for example, all words belonging to a certain morphological pattern have exactly the same *nikud* pattern, with allomorphic modifications allowing for root types. For example, instrument nouns of pattern *maCCeC maklet* ‘receiver’ (מְקַלֵּט), *mashpex* ‘funnel’ (מְשַׁפֵּךְ), *mavreg* ‘screwdriver’ (מְבַרֵּג), and *maxshev* ‘computer’ (מְחַשֵּׁב) all take the same *nikud* pattern, reflecting their phonological and morphological affinity. The historical phonological differences between *nikud* marks standing for the same current vowel are no longer in existence, but they continue to correspond to general morpho-phonological principles in Hebrew. Thus for example the first vowel *a* in *tsalaf* ‘caper’ and *tsalaf* ‘sniper’ is spelled with two different *nikud* diacritics (צֹלֵף vs. צָלֵף), corresponding to different behavior in plural formation: Vowel reduction in *tslafim* ‘capers’ versus vowel retention in *tslafim* ‘snipers’ (Ravid & Shlesinger, 2001).

Diacritic marks also distinguish between the stop and spirant versions of the letters P,K,B פ,כ,ב (Table 1). Thus *kotev* ‘is writing’ is spelled כּוֹתֵב with a dot (termed

dagesh) inside the letter K כּ to mark the stop *k*, while *yixtov* ‘will write’ is spelled יִכְתֹּב without the *dagesh* to mark the spirant *x*. The *dagesh*, like vowel marks, expresses lost phonological dimensions, such as gemination, and again its precise distribution in the Hebrew word is subject to Tiberian morpho-phonology.

In sum, the vocalized version gives Hebrew readers / writers specific phonological information about the fully vocalized word. A straightforward hypothesis, assuming that full phonological information is superior to under-specificity in psycholinguistic terms, would predict that Hebrew users prefer vocalized texts in reading and writing. But the facts say differently. The vocalized version with *nikud* marking is restricted to two contexts: (i) initial reading and writing instruction, and consequently texts for novice readers - children’s books and texts for new immigrants; (ii) to ensure precise reading as in the case of Biblical and poetic texts, and to disambiguate specific words in standard non-vocalized texts. Despite its phonological under-specification, the non-vocalized orthography is the default version of written Hebrew, used across the board for literacy activities, including school instruction from about 4th grade onwards (Share & Levin, 1999).

INSERT TABLE 3 ABOUT HERE

The universally used orthographic version of Hebrew, the *non-vocalized* orthography, represents all consonants by all letters, while vowels are partially and ambiguously represented by *matres lectionis* אהוּי, which serve a double function as designators of consonants and vowels. For example, both initial consonantal (or rather, semi-vowel) *y* and final vowel *i* in the word *yalduti* ‘childish’ are represented by the letter Y י in the written string YLDWTY ילדוּתִי. The stop / spirant distinction is not marked in the non-vocalized version. Vowel representation

by AHWY is far from consistent and systematic, as shown by Table 3. Two vowels (*a, e*) are both represented by two letters (A, H א ה) and are almost never marked word-internally (except cases where A א stands for a root letter). Therefore written strings such as *géver* ‘man’ and *gavar* ‘overpowered’ belonging to the frequent patterns *CéCeC* and *CaCaC* (Ravid, 1990; Schwarzwald & Cohen-Gross, 2000) do not contain any vowel letters, and appear in their bare consonantal form as GBR גבר. Not only are strings such as this homophonous, they also promote thinking of words as consonantal roots by demoting the perceived status of internal vowels (Schiff & Ravid, submitted). Two other vowels (*o, u*) are represented by one letter (W ו), while *i* is marked by the letter Y י. These three are marked both word-internally and in final position, e.g., *kotev* ‘is writing’ spelled KWTB כותב and *pakid* ‘clerk’ spelled PQYD פקיד, although Y י is subject to further, more subtle constraints (see below). Taken together, *matres lectionis* AHWY אהוי fall into two groups: AH אה and WY וי, differing in their vocalic values, orthographic distribution and morphological functions.

Consonants are the more stable part of the written Hebrew word, since each and every consonant is represented in writing, while vowels are under-represented, especially in word-medial position. Note, for example, the 11-letter written string WKŠBMKTBYK וכשבמכתביך pronounced *uxšebemixtaváyix* ‘and-when-in-your Fm Pl-letter-s’: All 9 consonants are represented in this written string, including the root morpheme *k-t-b* ‘write’ and affixal elements - two conjunctions, a preposition, a pattern prefix, and a genitive suffix; but only two (*u* and *i*) of the seven vowels in the word are represented in writing.

AHWY אהוי are not really alternative but complementary ways of marking vowels in written Hebrew, since they are not discarded in vocalized script. In fact, all

AHWY אהוי are obligatory at word-final position in both orthographic versions, while Y י and W ו are marked in many cases in word-internal positions, so that the actual additional phonological information in vocalized script is mostly vowels *e* and *a*, and stop / spirant alternation.

Vowels may thus be represented in four different ways in written Hebrew:

- (1) *By vocalization diacritic marks in vocalized script.* For example, *a* is represented twice in the vocalized written string סָפֵר *sapar* ‘hairdresser’ by two diacritic marks.
- (2) *By zero marking in non-vocalized script.* For example, *a* is represented twice in the non-vocalized string ספר *SPR* denoting *sapar* ‘hairdresser’ by zero marking.
- (3) *By the graphemes AHWY in non-vocalized script.* For example, *i* and *u* are represented in the non-vocalized string סיפור *SYPWR* *siṣpur* ‘story’ by Y י and W ו respectively.
- (4) *By a combination of vocalization marks and AHWY in vocalized script.* For example, *yafe* ‘pretty’ is spelled יָפֵה; The string יָפְ without final H ה, though vocalized, is incorrect.

6. Morphological units in written Hebrew

The rich and varied morphological constructs of Hebrew are systematically and consistently reflected in its orthography. To understand morphological patterning in written Hebrew, it is best to conceive of the written Hebrew word as consisting of two layers: the core, which contains root letters and internal vocalics, and the envelope, which comprises function letters. For example, consider the words in Table

4, derived from roots *k-r-n* ‘shine’ and *m-s-r* ‘transmit, hand over’, in their normal non-vocalized forms.

INSERT TABLE 4 ABOUT HERE

Note that all the words in Table 4 contain at least the three root letters QRN קרנ or MSR מסר, which form the internal part of the word, its core. All 22 Hebrew letters may represent root radicals. The Semitic root, which underlies most of the Hebrew lexicon, is represented in consistent orthographic form even when alternating phonologically (see above), thus preserving its morphological unity. Moreover, in speech the root is a discontinuous unit, interdigitated by vowels, but in writing it often appears as an intact continuous sequence, enhancing its unity. These features contribute to the root being the phonological, semantic, and orthographic core of the written Hebrew word (Frost, Forster & Deutsch, 1997; Ravid, 2003). 11 of the 22 letters in the Hebrew alphabet (ANY ŠLMH KWTB אבגי שזחטכ) consistently represent non-root morphemes (verbal and nominal pattern affixes, linear derivational suffixes, and inflectional suffixes indicating tense, number, gender and person) in addition to representing root elements (Ravid, 2001).

Morphemic function letters always appear in the external envelope of the written Hebrew word, that is to the right and to the left of the orthographic root. For example, *hakrana* HQRNH הקרנה ‘screening’ is framed by H and H, which indicate the action nominal pattern *haCCaCa*; *timsóret* TMSWRT תמסורת ‘transmission’ is framed by T and T, which indicated the abstract noun pattern *tiCCóCet*. Other examples are listed with their particular details in Table 4. No function elements appear within the core of the written Hebrew word, except for vowels *i*, *o*, *u* marked by letters WY וי (recall that *a* and *e* are not allowed written representation word-

internally): But note that these vocalics do not carry separate morphological information, since they constitute part of the whole pattern (as does W ו in *timsóret* TMSWRT תמסורת ‘transmission’ and Y י in *hikrin* HQRYN הקרין ‘shone’, for example). This layered structure of written morphological constructs in Hebrew has important implications for reading and for writing, since experienced Hebrew readers will know that the lexically meaningful part of the word is represented in its middle, while letters framing the word carry grammatical and categorial meaning.

In addition to morphemic function letters in its envelope, the written Hebrew words may be prefixed by a series of *attached* function letters designating syntactic constructs, phrasal and clausal clitics (Spencer, 1991; Ravid, 2001). These letters fall into three subsets⁵: (1) *conjunctions* *ve-* ‘and’ spelled W ו and the relative marker *she-* spelled Š ש; (2) *definite article* *ha-* ‘the’ spelled H ה; and (3) *prepositions* *me-* ‘from’ spelled M מ, *be-* ‘in’ spelled B ב, *ke-* ‘as’ spelled K כ, and *le-* ‘to’ spelled L ל. For example, *umehabayit* ‘and-from-the-house’ is spelled WMHBYT ומהבית. Attached function letters thus extend the external envelope of the written word.

Having presented the structure of Hebrew orthography and the language it reflects, we can now turn to an overview of literacy acquisition in the context of these factors.

7. Emergent orthographic knowledge

Both general and Hebrew-specific features emerge early on in children’s writing, as evidenced in a number of studies on early writing development in Hebrew-speaking preschoolers by Levin and her colleagues (see summary in Share & Levin, 1999). For example, Tolchinsky-Landsmann & Levin (1985) found that by age five, most children used the right-to-left Hebrew-specific direction. Referential and

phonological strategies (i.e., representing referent size and length in phonological units) are typical of Israeli preschool writing, with the phonological strategy becoming more dominant with age (Levin, Korat & Amsterdamer, 1996; Levin & Tolchinsky-Landsmann, 1989; Tolchinsky-Landsmann & Levin, 1987). It is interesting to note that the most advanced preschoolers already used a morphological strategy whereby they used more signs for phonologically longer bi-morphemic words, e.g., *etsim* 'trees' suffixed by the plural marker *-im* (Levin & Korat, 1993).

Five writing levels were identified by Levin et al., (1996) in Hebrew-speaking children's emergent orthographic acquisition in the age range of four to seven years: *scribbling*, non-orthographical productions indistinguishable from drawing; *pseudo-writing*, arbitrary signs in writing-like form; *random letters*, Hebrew letters unrelated to the phonological string represented; *phonetic writing*, essentially breaking the grapho-phonemic code which associates graphemes with phonemes (cf. Goswami, 1999; Treiman, 1993), evidenced by letters representing phonological units in the spoken word; and *orthographic writing*, which involves incorporating orthography-specific and morphological components into the spelling (cf. Ellis, 1994; Jones, 1991; Treiman, Zukowski & Richmond-Welty, 1995). Writing at the last level occurred only in the oldest children in the sample (seven-year-olds), while all other levels occurred in all age groups (Levin et al., 1996; Share & Levin, 1999). There is evidence that Israeli children go through parallel development in learning to read: from using non-linguistic pragmatic-contextual information in 4-year-olds, to relying on logographic, phonetic and alphabetical strategies in 5-year-olds, combined with growing phonemic awareness and letter-sound knowledge (Share & Gur, 1999). Language-specific features, such as writing direction, exercise their unique impact on the acquisition of

writing, as evidenced by a recent study on neglect dyslexia (Friedmann & Nachman-Katz, 2004).

A particularly helpful strategy in the very initial stages of learning to read and write Hebrew is knowledge of letter names, most of which are full-sized words with typical Hebrew morpho-phonemic structure (e.g., *gimel* for G ג). Levin, Patel, Margalit & Barad (2002) asked Hebrew-speaking kindergartners and first graders to provide orally initial or final letters of spoken words, to spell words in writing and to select a written word out of two as standing for an oral word. Their study provides rich converging evidence that letter names in Hebrew provide scaffolding to the alphabetic principle and to a mental model of the orthography. For example, children succeeded more in providing the initial letter or in spelling it if the word started with a letter-name sequence, e.g., *kaftor* ‘button,’ spelled with K כ (letter name: *kaf*). This was true even in the case of partial letter names, e.g., *ta* in *taf*, the letter name of T ת, helped spell *talmid* ‘student’ TLMYD תלמיד).

Given this background, the main focus from now on will be on the interface of phonological, morphological and orthographic features of Hebrew with literacy development at the phonetic and the orthographic levels.

8. Orthographic features and the development of Hebrew literacy

Three knowledge domains are necessary for the acquisition of writing and reading skills in Hebrew (and, in different measures, for other alphabetical systems, cf. Blanche-Benveniste & Chervel, 1974): Mapping phonology onto graphemic segments; becoming familiar with the internal conventions of the orthographic system; and learning about morphological regularities in the spelling system (Ravid & Gillis, 2002). The first two domains are learned in kindergarten and first grade and

consolidate in the earlier grades of primary school, while integration of morphological knowledge takes place in later gradeschool. Moreover, the three domains interact in different ways in learning to read and to write, and in learning about the written representation of consonants and vowels.

8.1 Novice reading and writing

Breaking the grapho-phonemic code and learning about the internal properties of the orthographic system are basic and critical in formal literacy. And from the very beginning, even though learning to read and to write are obviously related (Levin, Share & Shatil, 1996), they take place at different paces and are affected by different properties of Hebrew orthography.

Since the 1980's, Israeli scholars have made a particular contribution to general understanding of writing development in preschoolers and in the early grades of primary school and its importance in the context of emergent and early literacy (e.g., Levin & Korat, 1993; Tolchinsky-Landsmann & Levin, 1985). Levin, Share & Shatil (1996) tested 349 Israeli children in kindergarten on writing, concepts of print and vocabulary, and again in first grade on spelling and reading. They found that kindergarten writing made a unique contribution of achievement in 1st grade over and beyond other types of language and literacy knowledge. The results of these studies were disseminated by education leaders in the teacher population, with the result that many kindergartens now actively encourage writing activities (Teubal, 2002).

One critical feature of Hebrew orthographic conventions which novice readers and spellers have to learn is the attached function letters (4 prepositions, 2 conjunctions, and the definite article) prefixing written words. Studies have shown that adult Hebrew readers are sensitive to the syntactic functions of these letters

(Koriat, Greenberg & Goldshmid, 1991). In one study, attached function letters in texts presented to adult students were separated by a hyphen from the main word (e.g., H-ZMN ה־זמן for *ha-zman* ‘the time’, instead of HZMN הזמן), with the idea that this would enhance morphological transparency and would increase reading rate. But in fact the opposite effect was observed - reading slowed down (Loewenstein & Kozminsky, 1999). This indicates to what extent orthographic conventions are embedded in the decoding mechanism of Hebrew readers. Novice spellers learn early on that these function letters should be attached to the next word. Seidman (2000) tested children twice, in kindergarten and in 1st grade, on writing sentences containing attached function letters, e.g., *aba ve-ima nas’u le-eylat* ‘daddy and-mommy went to-Eilat’, spelled ABA WAMA NS9W LAYLT אבא ואמא נסעו לאילת. Correct function letter attachment was performed in kindergarten only 10% of the time, but 8 months later, in the middle of 1st grade, performance increased to 70%. An analysis of syntactic functions showed that both kindergartners and 1st graders were more successful at attaching prepositions (e.g., in, to) to the next word than conjunctions (and, that) and the definite article. A likely explanation is that sentential conjunctions were perceived as having a more independent and separate standing than prepositions, which form part of a PP.

8.2 The strange developmental history of *nikud*

A second unique feature of Hebrew writing is vowel representation by *nikud* diacritics. Neither the consonantal nor the vocalic homophony described above (in section 4) constitutes an obstacle to early decoding success in Hebrew, since children find it easy to assign the same reading to multiple signs. Share & Levin (1999: 96) note that the most conspicuous fact about learning to *read* Hebrew in school is the

rapid mastery of decoding skills. A number of reports confirm that accurate reading of real and nonce vocalized Hebrew words (i.e., with *nikud* diacritics) in first grade is already about 80% (Geva & Siegel, 1991; Geva, Wade-Woolley & Shany, 1993; Haimowitz, 2003; Shatil, Share & Levin, 2000). The most obvious explanation of this fact is the transparency of the vocalized system and the fact that it provides full phonological information about both consonants and vowels (Frost, 1992; Shimron, 1993).

Nevertheless, using *nikud* diacritics is currently at the center of an educational controversy in Israel. Concern about reading comprehension abilities in the upper grades of primary school and junior highschool has recently led to an investigation of reading instruction methods used in Israeli 1st grades, and especially phonic versus ‘whole language’ methods (Shapira, 2001). Phonic methods, which emphasize a meticulous bottom-up building of phonological-orthographic skills, teach reading (and writing) using *nikud* vocalization marks, thus providing novice readers with the fullest information about both consonants and vowels in the word. More ‘holistic’ methods attribute reading success to children’s ability to guess the meaning from large text units; they de-emphasize the role of grapheme-phoneme correspondence and use full words, sentences and texts in early reading instruction, omitting *nikud* marks. Anti-phonic proponents in Israel claim that focusing on phonological non-meaningful units such as syllables, nonce words, and even single words – in which *nikud* vocalization is crucial for decoding - is technical rather than ecologically valid and does not promote real text comprehension later on (Teubal, 2002; Wahl, 2002). At this time, reports by leading Israeli researchers clearly support using *nikud* marks in the context of reading instruction, starting with focus on phonological awareness and letter names

in kindergarten and followed by formal phonics-oriented methods in 1st grade (Levin, 2002; Shapira, 2002).

Nikud diacritics play an interesting – even paradoxical - role in Hebrew literacy development. For the initial stages of reading, vocalization seems to be very helpful (Navon & Shimron, 1984). This is because it provides full phonological information about the written word and renders it orthographically shallow so that the semantic value of word is reached easily and efficiently (Frost, 1992). Research on reading Arabic, another mainly consonantal Semitic language which uses diacritics to disambiguate homophonous strings, also indicates a facilitating effect of pointing on readers, mediated by context (Abu-Rabia, 2001). With this in view, all reading materials for novice readers (children and non-native speakers alike) are presented with *nikud*. However, this widespread and well-justified use of *nikud* in initial reading instruction is mitigated by two developmental inconsistencies: Reading and writing.

Reading. Making progress in reading and achieving reading comprehension requires more abilities than phonological decoding of single words, and always involves abandoning vocalized script (Ravid, 1996; Ravid & Shlesinger, 2001; Shimron, 1999). Studies on reading vocalized and non-vocalized Hebrew words indicate that single pointed words are read faster than non-pointed words, but when words are presented in context, the effect of pointing diminishes (Koriat, 1985; Navon & Shimron, 1985). In a recent study, Shimron (1999) found that pointing did not have a powerful effect on gradeschoolers' memory, and interacted with task conditions and reader skills. As they progress in gradeschool, children stop relying on *nikud* diacritics in their reading texts (Share & Levin, 1999). This process starts as soon as they are able to decode Hebrew words, since literacy-promoting notices, notes, forms,

newspapers, and signs at home, in school and on the street, including television subtitles, are almost always non-vocalized. Most written materials used in gradeschool are non-vocalized by 5th grade. This poses a special problem for children with dyslexia and other forms of linguistic impairments, since their orthographic lexicons are not well established (Friedmann & Gvion, 2002). Towards junior highschool, formal knowledge of *nikud* becomes required in Hebrew Language instruction, which focuses to a large extent on morpho-phonological processes (Ravid, 1995a; Avinun, 1996). At this time, teachers report problems where knowledge of *nikud* is necessary: by the end of gradeschool the overwhelming majority of the children do not know the names of *nikud* marks, and many of them do not know how to pronounce them in nonce or rare words (Ravid, 1996; Ravid & Shlesinger, 2001). It is only in highschool, as a result of intense re-focus on meta-morphological manipulation of written and spoken isolated words that *nikud* marks regain prominence and knowledge in students.

Ravid conducted two experiments on reading *nikud* marks in children, adolescents and adults. Ravid (1996) examined reading inflected words in 75 Hebrew-speaking 1st graders, 4th graders, and college students in two conditions - vocalized and non-vocalized. They were asked to read aloud 20 literate forms of words in which some of the vowels differed from their colloquial spoken forms (e.g. *xitsim* 'arrows' rather than colloquial *xetsim*). Reading accurately the *nikud* marks resulted in a different form than the colloquial one. Adults' reading in both conditions was the most accurate of all three groups and with the fewest self-repairs, indicating mastery of the orthographic system including *nikud*. 1st graders read vocalized words more accurately, though also with more self-repairs, than 4th graders. This reflected novice

readers' close attention to *nikud* marks and inability to access lexical semantics through addressed reading. 4th graders not only read *nikud* less accurately than 1st graders, they also performed equally in both vocalized and non-vocalized conditions, relying on their oral representations in reading without attention to *nikud* diacritics.

Ravid & Shlesinger (2001) tested 100 participants in five age groups (5th, 7th, 9th and 11th graders, and adult students) on reading aloud the same words in three conditions – twice without *nikud* marks, and once more with *nikud* marks. Once again, vocalization indicated that these words differed from their colloquial spoken forms. Results showed that all study groups read the non-vocalized words as inaccurately on the first two conditions. On the third, vocalized, condition, reading accuracy in the two older groups (11th graders and adults) improved, while the three younger groups performed equally badly in all three conditions. These two studies attest to the ability of older, more literate Hebrew users to elicit phonological information from *nikud* compared with the 'blindness' of gradeschoolers to this information. The use and knowledge of *nikud* in reading does not simply increase with age and schooling. Rather, it is learnt, lost and re-learnt throughout childhood and adolescence. First graders use *nikud* functionally as scaffolding on the way to literacy; older gradeschoolers ignore it; adolescents re-acquire facts about *nikud* for metalinguistic purposes.

Writing. In contrast to the U-shaped developmental curve of using *nikud* diacritics in reading, the situation in writing is simpler: At no point in development do Hebrew non-expert writers use *nikud*. At the very time preschoolers and first graders are relying heavily on vocalized script in learning to read, they almost completely shun *nikud* in writing (Levin & Korat, 1993). In a recent study (Haimowitz, 2003),

kindergartners and first graders were asked to write the same syllables with different vowels (e.g., *ro, ra, re*), and words ending with vowels carrying familiar and obligatory morphological information such as verb and adjective inflection (e.g., *halxu* ‘they walked, *xola* ‘she is sick’) and inflected prepositions (e.g., *ito* ‘with him’). In the first task, which forced children to mark the vocalic difference between syllables, kindergartners used inappropriate *nikud* marks (e.g., marking *a* for *e*) 33.75% of the time, and appropriate *nikud* marks 3.75% of the time. In first grade there was only appropriate marking 75% of the time. In the second task, writing words with vowels, none of the kindergartners used appropriate *nikud*, while first graders used it 35%-48% of the time, depending on the vowel. Thus children are reluctant to use *nikud* in writing during emergent and formal literacy training – at the time when it is very prominent in reading - unless forced to by a complete lack of context. In later years even this sparse usage of *nikud* in writing declines. Gradeschoolers never employ it in their written texts (Berman & Ravid, 1999), and even educated adults (e.g., kindergarten teachers) are unwilling to write using *nikud*. Texts with *nikud* are produced only by highly trained individuals with specialized knowledge in formal Hebrew grammar.

The developmental history of *nikud* in Hebrew readers and writers is puzzling. Why should a system which renders the orthography transparent and consequently more readable be completely shunned in writing and discarded early on in reading? The principal reason is its redundancy. For non-novice Hebrew readers, vocalization is predictable from the morphological, orthographic, syntactic and discourse contexts, with very narrow margins for error. Hebrew pattern morphology places heavy restrictions on possible vowel combinations both structurally (Cohen-Gross, 2000)

and semantically (Ravid, 1990). Syntax further eliminates possible vowel combinations, e.g., passive morphology in active contexts. Veteran readers make semantic decisions using structural cues indicating content versus function words, and relying on their knowledge of phrase and clause structure. Orthographic conventions of placing *matres lectionis* אהוּי, on the type of vowels that cannot be represented by them, and on attached function letters (see above) provide more precise information about the word. Finally, ambiguity can be resolved by larger context cues (Shimron, 1999). Thus educated adults find *nikud* necessary only in extreme cases of extreme ambiguity or foreign words. This idea is supported by a wide range of studies that point at the centrality of morphological structure and meaning in reading and writing Hebrew (Ben-Dror, Bentin & Frost, 1995; Frost, 1995; Frost, Forster & Deutsch, 1997; Ravid, 2001, 2003). For all of these reasons, *nikud* is superfluous for non-novice Hebrew readers who shed the need for vocalization as soon as addressed reading is achieved (Shimron, 1999).

But literate Hebrew users not only discard *nikud* in many cases, they are also averse to using it. This seems strange in view of the fact that vocalization adds important information to the written string and makes it orthographically transparent. I propose that *nikud*, while an essential tool in novice readers, interferes with normal processing of Hebrew texts later on. Non-novice readers process written information fast and efficiently by addressed reading – i.e., top-down processing, using morphological and syntactic cues. Processing *nikud* diacritics requires processing of a different kind – assembled or bottom-up reading. This hinders the normal process of information processing during reading. In fact, letters and *nikud* diacritics are two different notational systems, with letters occupying most visual and cognitive space

while *nikud* provides secondary, categorial, often redundant information about the word and occupies a small part of visual space. It requires additional processing power to process both types of information simultaneously, which is only available to literate adults, and especially to highly analytic language experts. Processing vocalized text slows down contextual reading and forces the reader to pay attention to features which are not semantically crucial in Hebrew, such as internal vowels (Ravid, 1990, 1996; Ravid & Kubi, 2003).

9. Gaining orthographic mastery in gradeschool and beyond

Spelling takes a different route than reading, though the underpinnings of Hebrew structure and orthography govern development along similar lines. Unlike accurate decoding of short sequences, which takes place early on in gradeschool, the shift from phonetic to orthographic (i.e., correct) spelling takes much longer. This is because even vocalized Hebrew, like most orthographies, is not entirely shallow, that is, it does not represent phonological information fully and accurately (Frost, 1992). As we have seen above, homophonous graphemes, which provide alternative spellings for the same grapheme, occur in Hebrew mainly in the consonant system. As shown in Table 1, there are two types of one-to-many relationships between current Hebrew consonants and letters: Firstly, a number of phonemes are expressed each by two graphemes, reflecting historically distinct segments. For example, *t* is spelled as either ט T or as ת T (Bolozky, 1997). Conversely, three letters denote two distinct sounds, a stop and a spirant, e.g., the letter ב indicates both the phonemes *b* and *v*. Altogether there are 13 homophonous Hebrew letters, which together designate 6 phonemes.

$t = \text{ט } T \quad \text{ת } T \quad ?/0 = \text{א } A \quad \text{ח } H \quad \text{ה } 9 \quad \text{ע } E$

$k = \text{ק } q \quad \text{ק } Q \quad \text{כ } C \quad v = \text{ו } v \quad \text{ב } b$

$x = K \kappa \ H \eta \quad s = \check{S} \psi \ S \varsigma$

Early spelling errors typically occur within the 13 homophonous letters, which constitute the major source of consonantal spelling errors in Hebrew found in the writing of Hebrew-speaking gradeschoolers up to 6th grade (Eylon, 1992).

Consonantal spelling errors specifically derive from two homophony conditions:

identity and *similarity*. Most homophonous letters represent identical sounds, e.g., K ק / Q כ both stand for *k*, and W ו / B ב both stand for *v*. For example, the word *merkava* ‘carriage’ was erroneously spelled by a third grader as MRQWH מרקה instead of MRKBH מרכבה (Ravid, 2001). The three guttural-pharyngeals A א / H ה / ʕ ע (sometimes accompanied by Y י) stand for similar, rather than identical, sounds, which are often interchanged in speech or omitted completely (Ravid, 1995a). As a result, they are also often confused or deleted in writing, e.g., *hevin* ‘understood’ erroneously spelled ABYN אבין instead of correct HBYN הבין. Such errors persist throughout gradeschool and sometimes beyond.

This might lead us to expect that novice Hebrew spellers make the same amount of spelling errors across the board in homophonous letters, with the factor of word frequency an aid in remembering word shapes and spelling patterns. In fact, spelling errors in Hebrew are critically affected not only by phonological and orthographic considerations, but also morphological distinctions. In a series of studies Ravid and her associates have shown that morphology and its representation in different classes of words and of morphemes is an important factor in the development of Hebrew orthographic spelling.

INSERT FIGURE 1 ABOUT HERE

Let us turn first to the evidence showing that content words are more difficult than grammatical words. Ravid (2001) analyzed 378 compositions by children from

grades 1-6. All the words in each composition were counted and classified into content words (nouns, verbs, adjectives, and manner adverbs) and grammatical words (pronouns, prepositions, conjunctions, quantifiers, etc.). Spelling errors were located and counted in both word types. There was a general decline in errors with grade, but content word errors were more numerous than errors in grammatical words and took longer to disappear (Figure 1). One reason is that content words have a high type frequency, while the token frequency of each word is low, and the frequency of different lexical classes varies according to register and genre. This means that there is a lower chance of encountering them in print and work out a systematic analysis of their spelling to begin with, depending on the topic and the context. In contrast, grammatical words, a small, closed class occurring obligatorily in any kind of text, have a low type and high token frequency. This makes for numerous occurrences of the same word, which are thus likely to create deep memory traces in spellers early on. Moreover, content words are longer and more likely to contain roots whose spelling is unpredictable, while grammatical words are usually shorter and often fused with function suffixes (e.g., *kamó-xa* ‘like-you’) whose spelling is predictable.

Secondly, there is converging evidence from a number of my studies using different methodologies that homophonous root letters are more problematic in spelling development than homophonous function letters. First, in the same study described above (Ravid, 2001) the 15,997 homophonous root letters and 6618 homophonous function letters in the children’s compositions were analyzed for spelling errors. There were seven times as many root letters errors (694) as function letter errors (91); function letter errors almost disappeared by second grade, while root letter errors declined gradually from third grade onwards. A second study described in

Ravid (2001) was a dictation of 36 items to 72 gradeschoolers (grades 2, 3, 4). Here, too, root letter errors exceeded function letter errors in all grades, and by grade 4, there were 3 times as many root letter errors than function letter errors (Figure 2 (i-ii)).

INSERT FIGURE 2 ABOUT HERE

These results have been replicated since in a number of studies. For example, Ravid & Bar-On (2001) conducted a series of experiments in which children and adolescents were given dictations with and without spelling primes. Figure 3 presents the amount of homophonous root and function letter errors in the no-prime condition. Here, too, there were twice as many errors in root letters in 3rd and 4th grade, but by 5th grade this difference was much smaller. In a cross-linguistic study of Hebrew and Dutch Gillis & Ravid (2001) compared success in spelling homophonous root and function letters in Hebrew with homophonous stem and function letters in Dutch. While Hebrew showed the expected patterning of root and pattern spelling, Dutch showed an opposite patterning – correct stem letter spelling came earlier and was easier than spelling function letters, although stem spelling is idiosyncratic and function letter spelling is guided by clear rules in Dutch. This difference in learning patterns between the two languages is attributed to the typological differences between Hebrew, which is a morphologically rich language, and Dutch, which is morphologically sparse. Children learning these two languages are assumed to be attuned from early on to meaning-carrying constructions in their language. Paying close attention to morphological constructions, their meanings and permutations, in Hebrew entails using morphological strategies in learning to read and write (see also Ravid & Gillis, 2002, for a detailed explanation).

INSERT FIGURE 3 ABOUT HERE

INSERT FIGURE 4 ABOUT HERE

The development of orthographic spelling thus typically takes place across the gradeschool years. Most function letters are already spelled correctly by 3rd to 4th grade, while correct spelling of root letter is a long and protracted process that is delayed to the end of gradeschool (6th grade). This of course relates to normal development: In children with special needs, especially those who have specific difficulties in language, root letter errors linger on and are harder to eradicate. However, this Hebrew-specific patterning of root and function spelling errors is not violated even in children with SLI (Lapidot, 2003).

Root spelling lags behind the spelling of function letters, but it, too, consolidates across the gradeschool years together with the increase in density and accessibility of systematic morphological knowledge and awareness (Karmiloff-Smith, 1992). A study by Weil & Fromowitz (1998) focuses on the relationship between oral and written perception of the root morpheme in 48 3rd grade girls who were asked to spell words with homophonous root segments and then to provide words with analogous structures. For example, “which word does tahaluxa ‘parade’ remind you of”? Morphological responses consisted of words with the same root (3rd graders are not able to give pattern responses, see Ravid & Malenky, 2001); non-orthographical responses relied either on phonologically or semantically similar words. A reverse relationship was found between participants’ spelling and morphological ability: the fewer spelling errors in root letters, the more morphological root responses. Moreover, follow-up interviews of participants with the highest and lowest numbers of morphological responses revealed different understanding of word structure. Weak students’ explanations of their own choices were almost exclusively associative for both semantic and morphological response types. For example, to

explain the choice of semantic *tmuna* ‘picture’ for target *mazkéret* ‘souvenir’, one weak student said “because a souvenir can be a picture”. But “high” participants responded in ways indicating their ability to analyze a given word into its root-and-pattern structure.

A number of studies indicate that Israeli gradeschoolers rely on morpho-phonological cues in learning to spell root letters. These cues are more elusive and less straightforward than semantic cues, and therefore take more time and exposure to written language to detect. Nevertheless, evidence has been accumulating that gradeschoolers make increasing use of morpho-phonology in spelling. For example, homophonous root segments historically deriving from low guttural and pharyngeals attract lower vowels, unlike homophonous root letters from other origins, which retain the default vowel pattern. Compare, for example, the spelling of the homophonous root segment *x* in *mélex* ‘king’ spelled MLK מלך with *mélax* ‘salt’ spelled MLH מלח. The first word retains the default *CéCeC* pattern, indicating that *x* should be spelled by K כ; whereas in the second one *x* is preceded by a lower vowel, a clear sign of its pharyngeal origins, and therefore should be spelled with H ה. Ravid (2002) tested children across gradeschool (1st-6th grade) on spelling of words with such homophonous segments. Results indicate that even the youngest spellers in 1st grade find marked ה H which attracts lower vowels easier to spell correctly than כ K, and that towards 3rd grade the morpho-phonological cues start making sense, resulting in more correct spelling of the unmarked segment as well.

Another morpho-phonological phenomenon that assists spellers in recovering the homophonous segment is stop/spirant alternation. In such cases, the homophonous segment that displays stop/spirant alternation can be distinguished from the one that

does not. For example, *v* has two possible spellings – *W ן* and *B ן*, and *k* can be spelled by either *Q ך* or *K ך*. The second of both pairs displays stop/spirant alternants *b/v* and *k/x*, while the first one stays constant (*v* and *k* respectively). This differing morpho-phonological behavior is a reliable cue for spelling. Again, this is rather sophisticated knowledge, which requires exposure and attention to both spoken and written cues. Therefore it is not available at the very beginning of learning to spell – but it does become available towards the middle of gradeschool (Gillis & Ravid, 2001).

Finally, voicing assimilation sometimes interferes with phonological identification and may lead to spelling errors in root letters. For example, root *z-k-r* ‘remember’ may sound *s-k-r* as a result of assimilation of voiced *z* to voiceless *k*, rendering *mazkéret* ‘souvenir’ as *maskéret* in casual speech. As a result, MZKRT מזכרת may be spelled erroneously as MSKRT מסכרת, masking the identity of root *z-k-r* ‘remember’. A strong memory trace of the root and a good ability to analyze a given word into its root and pattern structure help in overcoming assimilation interference and in correct spelling. Evidence shows that by third grade, children’s ability to overcome voicing assimilation that masks root identity is almost perfect (Shany, Zeiger & Ravid, 2001).

Findings by different Israeli scholars clearly support the idea that morphological and orthographic knowledge in Hebrew are fundamentally related. Levin, Ravid & Rapaport (1999, 2001) tested 40 native Hebrew-speaking children in a longitudinal study from kindergarten to first grade on three late-emerging oral morphological constructions and on writing noun - adjective strings. They found a clear correlation between spoken morphology and writing ability: Spoken morphology

and writing were found to correlate concurrently in kindergarten and in first grade, and predictively from kindergarten to first grade. In addition, each domain made an additional unique contribution to the change in the other from kindergarten to first grade. From a different perspective, Schiff (2002) tested reading of non-vocalized nouns in which the final letter H ה served different functions in 2nd, 4th and 6th graders. In half of the words the letter H ה constituted part of the nominal pattern, as in *braxa* ‘blessing’ (pattern CcaCa), spelled BRKH ברכה; while in the other half it designated the bound possessive 3rd person feminine inflection, as in *znava* ‘her tail’, spelled ZNBH זנבה. Schiff found that the younger participants found the inflected words, where the H ה renders the word more morphologically complex, more difficult to read accurately than the words where the same letter designated an integral part of the word; while 6th graders were able to read both types of words with equal ease. In a related study Schiff (in press) tested 150 2nd, 4th and 6th graders on reading nouns with these two structures. She found morphological effects on reading latency and accuracy as well as different learning patterns for the two constructions. While reading accuracy increased with grade in both constructions, inflections took longer to read and elicited more correct responses than derivations, but with age latency became longer. In derivations, in contrast, latency became shorter with time. Ben-Dror, Bentin & Frost (1995) tested reading-disabled 5th graders together with an age-matched group and a vocabulary matched (3rd grade) group on phonological, semantic, and morphological skills. The reading-disabled children made the most mistakes and were the slowest to respond; and the most conspicuous difference between the groups was in the morphological test, most markedly in derivational morphology.

10. Spelling vowels

Beyond the problem of *nikud*, vowel spelling constitutes the most problematic area in Hebrew writing from the onset of literacy to adulthood. Recall that vowels are not only under-marked in graphemic format, they also map ambiguously and inconsistently onto the four *matres lectionis* אהוי AHWY (Tables 2 and 3). A number of studies showed repeatedly that consonants emerge earlier and are spelled more correctly than vowels in young children's writing (Haimowitz, 2003; Levin et al., 1999, 2001; Share & Levin, 1999). Vowel writing is inconsistent across the board in Hebrew spellers since it often requires formal linguistic and historical Hebrew knowledge that is beyond the abilities of 99% of Hebrew reader/writers (Ravid & Shlesinger, 2001; Schwarzwald, 2001). The most problematic of all are vowels which appear within the internal part of the word and mainly carry sparse phonological rather than morphological value. A subset of these are formally required in *plene* nonvocalized spelling and deleted in vocalized spelling, so that Hebrew users cannot form a consistent representation of the spelling of the word, e.g., Y ם in *siper* 'told' spelled both as SYPR סיפר and SPR ספר (Schiff & Ravid, submitted).

A series of studies indicate that representing internal vowels constitutes an area of instability for spellers of all ages. Ravid (2002) found that young gradeschoolers tend to overmark Y ם incorrectly (e.g., MYBHNYM מיבחנים rather than MBHNYM מבחנים). Alkaslassi (2003) found that adults systematically delete internal vowels incorrectly in nonvocalized writing (e.g., SPR ספר for *siper* 'told'). Ravid & Kubi (2003) elicited spelling errors from children, adolescents and adults in two conditions. First participants were given a dictation of a story. In the second condition, participants were given the same text and asked to write it using deliberate spelling errors. All spelling errors in the dictations were counted and classified using phonological (consonants and

vowels) and morphological (root and function letters) criteria. The most frequent ‘natural’ errors which lasted long into highschool were errors in internal vowel letters YW יו; whereas the overwhelming majority of the deliberate errors were consonantal root errors switching, for example, K כ for Q ק or T ת for F ט. Schiff & Ravid (submitted) presented vocalized and nonvocalized words in sentential context to Hebrew readers. Nonvocalized root-like strings with illegal spelling (e.g., MKR מִכַּר for *mukar* ‘familiar’) were identified faster than those with legal spelling (e.g., MWKR מוֹכַר) despite being inappropriate in the context.

These findings indicate to what extent Hebrew speaker/writers regard the consonantal root as a unified entity across phonology, semantics, and orthography. Root representation in writing is the consistent, stable, consensual facet of Hebrew orthography, and violating it is considered a real ‘spelling error’ typical of children and illiterate persons. In contrast, internal vowel letters carry little if any morphological value since none of the meaning-carrying Hebrew affixes is word-internal. Internal vowels may carry phonological information alone, as in loan words (e.g., *minimali* ‘minimal’). In most cases, internal vowels constitute part of the word pattern, e.g. *CiCeC* or *CiCuC*, but in such cases it is not the individual vowel that carries meaning but rather the full pattern. At any rate, pattern meaning is categorial rather than lexical and is less coherent semantically than that of roots (Ravid, 1990, 2003). Moreover, Hebrew speakers often accept two *spoken* versions of the same word with differing vocalic patterns (e.g., both *madad* and *médéd* for ‘index’), another indication of the relative instability of vowels compared with consonants in Hebrew. Consequently, the status of internal vowel representation is unstable and a range of alternative spellings is acceptable to mature and literate speaker/writers. In fact, while consonantal errors

disappear from the spelling of the majority of normally-developing children by the end of gradeschool, vowel errors linger on in the writing of adolescents and adults and are not regarded as real ‘spelling errors’ (Ravid & Kubi, 2003). In a recent academic paper written by a native Hebrew graduate who had never been diagnosed with any language problems I found 24 vowel letter errors, including spelling the loan word *minimal* ‘minimal’ as MNMLY מנמלי instead of MYNYMLY מינימלי, and deleting the vowel root letter W ו in *lavo* ‘to come’, spelled LBA לבא instead of LBWA לבוא.

Consonant and vowel spelling patterns testify to the strong and constant links between Classical Hebrew and Modern Hebrew, two versions of a Semitic language with a rich morphology and a mainly consonantal orthography.

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Classical Hebrew consonant	Modern Hebrew consonant	Hebrew Grapheme	Corresponding Latin Grapheme
<i>w</i>	<i>v</i>	ו	W
<i>v</i>	<i>v</i>	ב	B
<i>b</i>	<i>b</i>	ב	B
<i>q</i>	<i>k</i>	ק	Q
<i>k</i>	<i>k</i>	כ	K
<i>ħ</i>	<i>x</i>	ח	H
<i>x</i>	<i>x</i>	כ	K
<i>t</i>	<i>t</i>	ט	T
<i>t</i>	<i>t</i>	ת	T
<i>h</i>	<i>h / ? / 0</i>	ה	H
<i>ʔ</i>	<i>? / 0</i>	א	A
<i>ʕ</i>	<i>? / 0</i>	ע	9

Table 1. Consonantal neutralizations and resulting homophony in Hebrew, with corresponding graphemic values.

Classical Hebrew vowel	Modern Hebrew vowel	Hebrew Diacritic Sign	Hebrew Diacritic Name	Hebrew <i>matres lectionis</i> Grapheme Denoting Vowel
ā	a	ָ	<i>qamats</i>	ָ, ֶ, א, ה
a	a	ֶ	<i>pattah</i>	
ă	a	ֶּ	<i>hataf-pattah</i>	
e	e	ֵ	<i>serey</i>	ֵ, ֶ, א, ה
ε	e	ֶ	<i>segol</i>	ֶ, ֶּ, א, ה
ě	e	ֶּ	<i>hataf-segol</i>	
i	i	ִ, ֵ	<i>hiriq</i>	ִ, י
o	o	ֹ, ֺ	<i>holam</i>	ֹ, ו
ă	o	ֶ	<i>qamats qatan</i>	ו
u	u	ֹ	<i>qubuts</i>	ו
u	u	ֹ	<i>shuruq</i>	ו
∅	e / 0	ְ	<i>schwa</i>	

Table 2. Vowel neutralizations and resulting homophony in Hebrew, with corresponding graphemic values in diacritics (using the letters G ָ and A ֶ To demonstrate diacritic values), and in the four graphemes denoting vowels.

Grapheme	Hebrew form	Consonant	Vowel	Constraints on occurrence as vowel designator
A <i>Alef</i>	א	ʔ	<i>a,e</i>	Word final only (unless root letter)
H <i>He</i>	ה	<i>h</i>	<i>a,e</i>	Word final only
W <i>Vav</i>	ו	<i>v</i> (historically, <i>w</i>)	<i>o,u</i>	Word internal and word final
Y <i>Yod</i>	י	<i>y</i>	<i>i</i>	Word internal and word final

Table 3. AHWY (Hebrew אהוי) in their dual function as consonant and vowel designators

Word	Gloss	Hebrew written form	Written form
Root <i>q-r-n</i>	'shine'	קר"ן	QRN
<i>karanta</i>	you,Sg shone	קרנת	QRNT
<i>hikrinu</i>	they screened	הקרינו	HQRYNW
<i>kéren</i>	beam, N	קרן	QRN
<i>makrena</i>	projector	מקרנה	MQRNH
<i>hakrana</i>	screening	הקרנה	HQRNH
<i>krina</i>	emission	קרינה	QRYNH
<i>karnit</i>	cornea	קרנית	QRNYT
Root <i>m-s-r</i>	'hand over'	מס"ר	MSR
<i>masarti</i>	I handed over	מסרתי	MSRTY
<i>nimsera</i>	she was handed over	נמסרה	NMSRH
<i>hitmaser</i>	devoted himself	התמסר	HTMSR
<i>méser</i>	message	מסר	MSR
<i>timsóret</i>	transmission	תמסורת	TMSWRT
<i>hitmasrut</i>	self-devotion	התמסרות	HTMSRWT
<i>tamsir</i>	hand-out, N	תמסיר	TMSYR
<i>mimsar</i>	relay, N	ממסר	MMSR

Table 4. Root letters and function letters in the written Hebrew word.

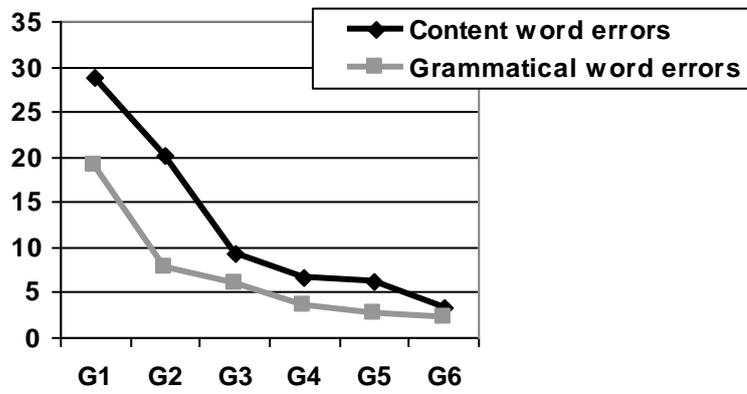


Figure 1. Percentages of erroneously spelled content words and grammatical words in gradeschoolers' compositions, by grade (data from Ravid, 2001)

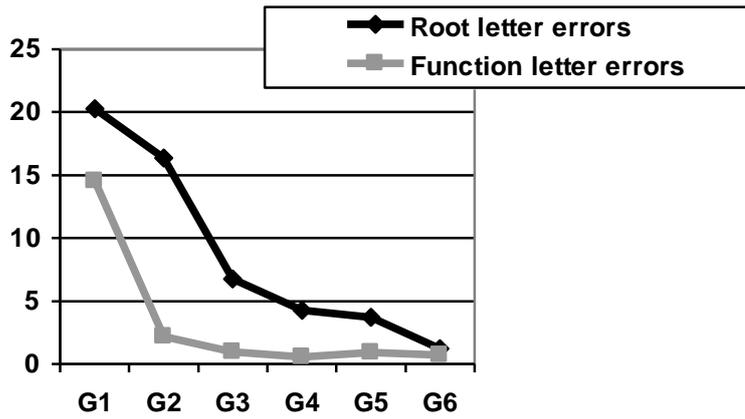


Figure 2(i). Percentages of erroneously spelled root letters and function letters, by grade (data from study 1, Ravid 2001).

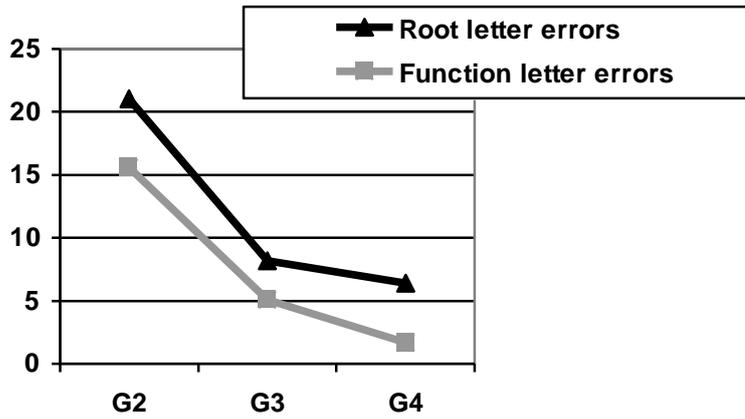


Figure 2(ii). Percentages of erroneously spelled root letters and function letters, by grade (data from study 2, Ravid 2001).

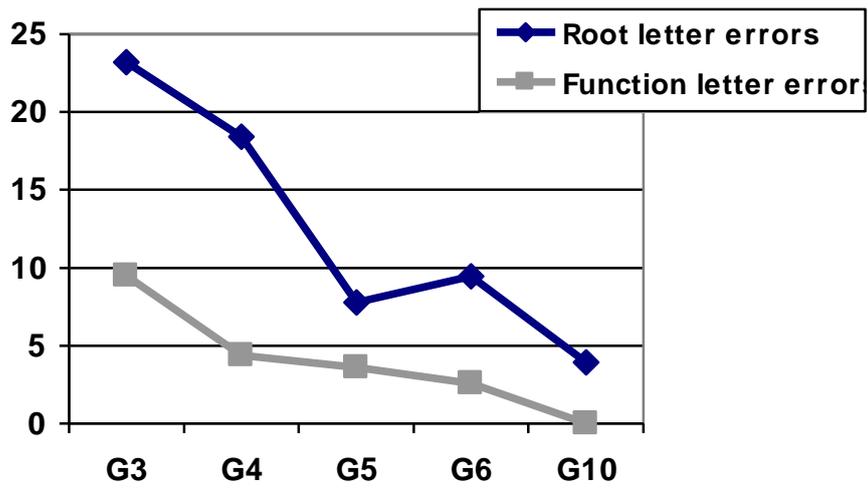


Figure 3. Percentages of erroneously spelled root letters and function letters, by grade (data from Ravid & Bar-On, 2001).

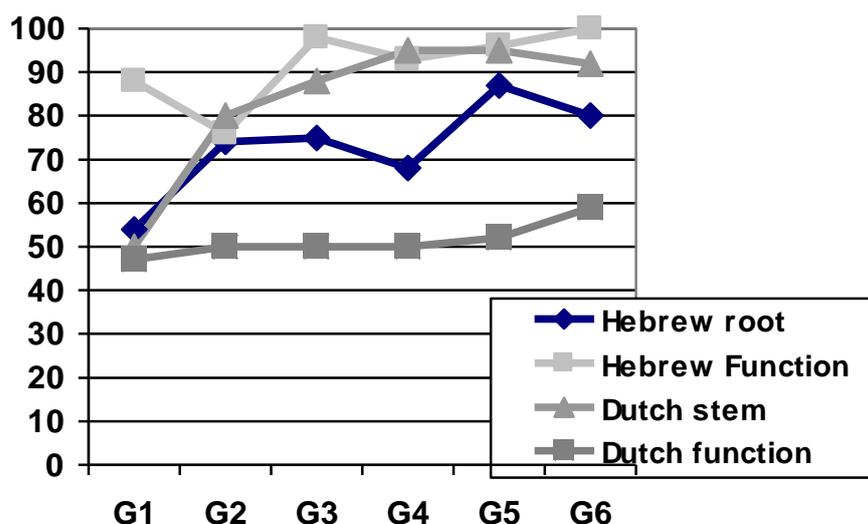


Figure 4. Percentages of correctly spelled root letters and function letters in Hebrew and stem and function letters in Dutch, by age group (data from Gillis & Ravid, 2001).

¹ Spoken Hebrew (broad phonemic transcription) appears in italics with gloss following between apostrophes.

² To make Hebrew script more accessible to non-Hebrew speakers, I use Latin capitals to transcribe Hebrew characters. The digit 9 is used to designate the letter ν , standing for the voiced pharyngeal fricative.

³ Except in loan words and in strings not considered established 'words', e.g. *ma'am* 'VAT' spelled M9M מע"מ rather than מע"ם.

⁴ The following linguistic conventions are used in this chapter: -s stands for the English plural marker; Pl. = Plural; Fm. = Feminine.

⁵ The link between attached function letters and the next word is not only orthographic: all of them, except for *she-* 'that', spelled Š, have morphophonological allomorphs depending on their environment (e.g., *ve-* 'and' also has the forms *vi-* and *u-*). The spelling (e.g., W) does not change since the difference is in the accompanying vowel which is not represented in non-vocalized spelling. Mastery of all possible allomorphs is part of literate language knowledge in Hebrew (Ravid, 1996).