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Vowel reduction in Modern Hebrew:
Traces of the past and current variation

Running title: Vowel reduction in Hebrew

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Abstract

The aim of this paper was to find out the scope and boundaries of *a*-reduction in Modern Hebrew. In Classical Hebrew, vowel reduction was a regular, obligatory process. In Modern Hebrew, it has restricted scope and operates under opaque conditions. The only reliable trace of the historical motivation for the rule is the Hebrew vocalization system (*nikud*). 100 participants in four age groups were asked to read aloud the same words under three conditions – twice without vocalization marks, and once more with vocalization marks. Results showed that all study groups read the non-vocalized words with poor adherence to the historical rules on the first two conditions. On the third condition, the two older groups improved, while the two younger groups did not. We conclude that *a*-deletion is no longer governed by prosodic and phonological context in Modern Hebrew. Older, more literate Hebrew users were better able to elicit phonological information from *nikud*, and also better able to handle forms which go counter the everyday, standard morphophonological representations.

1.0 Introduction

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. Its study provides us with a fascinating view of how native speakers deal with the remnants of ancient rules reflected in its current morphophonology and its writing system. The study presented here discusses to what extent native-speaking children, adolescents and adults regard vowel reduction in nouns as a current rule in Modern Hebrew, in what ways morphological categories affect their performance, and how processes of language change interact with linguistic literacy.

Modern Hebrew is a Semitic language deriving from older historical periods during which Classical Hebrew was a spoken, living language (Kutscher, 1982). Modern Hebrew was revived[1] 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. Though Modern Hebrew morphology remains essentially Biblical and its syntax mainly Mishnaic, Modern Hebrew phonology is very different from the Classical phonology represented in the traditional Masoretic reading of the Bible (Bolozky, 1997; Ravid, 1995a; Rosén, 1956). One of the acute domains of difference between Classical and Modern Hebrew phonology is that of vowels.

1.1 Vowel reduction

The focus of this paper is a morphophonological process of vowel reduction, whereby the vowel *a* deletes or reduces to schwa in Hebrew nouns in an open unstressed syllable. The domain of inquiry of this paper is thus the syllable, the

smallest major grouping of segments in language, a basic phonological unit in which

consonants group together in universally and language-specific predictable ways

around a vocalic segment, usually a vowel (Bernhardt & Stemberger, 1998). This

vowel is the sonority peak of the word, and it may be surrounded on both sides by

margin segments of lower sonority, which are usually consonants – the onset and the

coda. The syllable is the target domain where patterns of vowel insertion and deletion

occur. Syllables are necessary for defining the stress domain within which

phonological processes operate: A syllable may carry word accent (or stress), that is,

be pronounced in a manner that makes it perceptually more salient than the other

syllables (Kager, 1999). Though it is a particular syllable that is stressed, accent is a

property of the whole word, and it signifies the presence of one accentual domain, the

prosodic word (Goldsmith, 1990; van der Hulst, 1999). Within the word (and

sometimes crossing its boundaries), syllables are organized under a higher-order node,

the foot, which groups together (usually) two syllables, one of which is stressed

(Bernhardt & Stemberger, 1998). Patterns of word stress constitute an important part

of the present investigation, since Classical *a* reduction operated in relation to its

position vis à vis the accent syllable in the word and in the broader prosodic domain

of the compound (Nespor, 1999).

Vowel reduction and deletion in unstressed syllables is a well-known

phenomenon across the world's languages. It involves the substitution of a schwa or

zero for a vowel in unstressed syllables. The conditions for and actual implementation

of vowel reduction vary immensely across languages and are related to language

typology (syllable-timed vs. stress-timed) and to language-specific constraints (Roca,

1999). Vowel reduction processes span a continuum from acoustic reduction in

connected, spontaneous speech to regular morphophonological processes. Acoustic

reduction (van Bergem, 1994) is an optional, superficially phonetic process in casual speech, where speakers tend to enhance articulatory economy by shifting the formant frequencies of full vowels to schwa (Bolozky, 1985; Frid, 1998; Kager, 1989). Languages also display a whole range of higher-level phonological and morphophonological vowel reduction processes, all subject to the abstract shape of the accentual structure of word-prosodic systems (van der Hulst, 1999). These processes have been characterized using different theoretical linguistic frameworks, including, for example, the unique phonological representation of stress (the *grid*), grouping of stressed and unstressed syllables in the foot, and competition between prosodic well-formedness Optimality Theory constraints at the metrical and the syllabic levels (Bernhardt & Stemberger, 1998; Kager, 1999: 177-8). All models of vowel reduction relate vowels and consonants in syllabification processes to stress patterns in a given language.

According to Berg (1998), 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. Research into sound changes in the history of Indo-European languages shows that this is indeed the case (Berg, 1998: 202-204). In language change too, reduction processes of vowels almost always start in the unstressed syllable. This is because

unstressed syllables receive less activation than stressed ones during production

(Berg, 1998: 216-217).

Our concern here is with a Hebrew morphophonological alternation between

noun forms with the full vowel *a* and morphologically related noun forms with a

reduced or deleted vowel, e.g., *pakid / pkida* 'clerk / Fm'. In Classical Hebrew, vowel

reduction was a regular, obligatory process, which operated in two prosodic domains:

the word and the compound (Nespor, 1999; Visch, 1999). In Modern Hebrew, the

operation of vowel reduction has undergone linguistic change. It has restricted scope

and is subject to opaque conditions of operation. Our aim in this paper is to find out

the scope and boundaries of this change and their relation to Hebrew speakers' age

and literacy level.

1.2 Vowels and their representation in Tiberian Hebrew

Evidence on previous language periods always comes from written records. In

our case, these are Biblical Hebrew texts using the ancient Hebrew consonantal

alphabet with a more recent diacritic system indicating vocalization and other

features, a notational system developed in the city of Tiberias at some period between

the 7th and the 9th centuries. We base our comparison of the state of vowel reduction

in Modern vs. Classical Hebrew on the phonological system represented in Tiberian

Hebrew.

The major source of written records about Classical Hebrew is the Bible and

the Mishna, with some additional sources such as the Dead Sea scrolls and numerous

inscriptions. Classical Hebrew (1100 BCE- 250 CE) is usually identified with its

Biblical and Mishnaic periods (Kutscher, 1982; Rabin, 1972). To begin with, the

Hebrew orthography represented only consonants, but later on vowel representation

was added to record the official reading tradition of sacred texts. This was done in two

stages: First, the function of four letters (AHWY) was extended to representing both consonants and vowels. Later on, towards the end of the first millennium, a system of diacritics was developed by the Tiberian Masoretes (tradents), which represented vowels, consonantal spirantization and gemination, as well as the musical cantillation of the reading tradition (Khan, 1997; Rendburg, 1997). This notational system, known as the Tiberian vocalization system (*nikud*), is the major source of our knowledge about Classical Hebrew phonology. Scholars are not in a position to decide how accurately Masoretic text reading reflects the pronunciation of Biblical and Mishnaic Hebrew. On the one hand, it can be assumed that the Masoretic readers were extremely conservative in their Biblical reading tradition; but on the other hand, it is known that at that time, some Classical Hebrew consonantal distinctions had already merged, and that some vocalic allophones recorded in the Tiberian system may have developed after the Classical period. Moreover, there was also much local variation in the realization of the vowels in Tiberian Hebrew (Rendburg, 1997). This discrepancy between the actual Classical Hebrew phonological system and its representation in Masoretic Tiberian *nikud* should be taken into account when discussing the changes in the *a* reduction rule discussed in this paper.

    1.2.1 Sources of Modern Hebrew *a*

    Tiberian Hebrew was a stress-timed language, with a number of rules sensitive to the main stress, including the vowel reduction rule discussed below (Baayen, 1985). Generally speaking, vowel length was probably not an independent contrastive feature of Tiberian Hebrew vowels: Meaningful contrasts between words were not made by differences in vowel length alone, and were almost always relatable to differences in syllable structure or stress placement (Khan, 1997: 91-92). Stress was final, and placed on a syllable containing a long vowel (e.g., *midbār* 'desert'), or else

penultimate (in the so-called *segolate* class), in which case it might fall on an open

syllable containing a short vowel (e.g., *mélex* 'king'). The Proto-Semitic vowel

system consisted of two sets of three basic vowels, short and long: /*i, u, a*/. Of these,

the long high vowels retained their identity in all environments in Tiberian Hebrew,

but long *a* had fluctuated. This is one of the sources of the present-day Hebrew vowel

a that is the focus of our study. By the time the Masoretic Tiberian notational system

was in place, there were, however, numerous allophones of the original short vowels,

based on a complex system of syllabification and accentuation (Baayen, 1985; Khan,

1997; Rendburg, 1997). The ones that are of concern here are the two manifestations

of the original Proto-Semitic *a.* In an accented syllable, or in an unaccented open

syllable immediately preceding the accent, Proto-Semitic *a* was realized as *ā,*

represented by the diacritic ָ (*qamac*). This was a so-called tone-long vowel, that is, a

short vowel that lengthened due to stress placement. In an unaccented closed syllable,

Proto-Semitic *a* was realized as a short *a*, represented by the diacritic ַ (termed *pataħ*)

(Rendburg, 1997: 77).

The two *nikud* diacritics *qamac* and *pataħ* thus represent vowels deriving from

two distinct historical sources: an original long *a* and a tone-lengthened *a* represented

by *qamac*; and a short *a* represented by *pataħ*[2]. A third diacritic, *ħataf pataħ* ֲ, a

composite sign of the schwa and the *pataħ*, represented a short *a*, related to schwa, in

a dependent syllabic CV (see 1.2.2 below). All of these have merged in Modern

Hebrew to the single vowel *a.* Table 1 depicts this information in graphic form.

INSERT TABLE 1 ABOUT HERE

1.3 Vowel reduction in Tiberian Hebrew

In the phonology represented in the Tiberian vocalization system, when any

short non-high vowel occurred in an open syllable before the accent, it was reduced to

schwa (Bolozky, 1997). According to medieval Masoretic grammarians, syllables with reduced vowels were "dependent" rather than "principal", meaning they could stand only in combination with the following principal syllable. This was directly reflected by the vocalization system, which represented the vowel nuclei of dependent syllables by different diacritics than those representing the nuclei of principal syllables (Khan, 1997: 94): The nucleus of a reduced syllable was noted in *nikud* by the mark for schwa ֶ or (subject to consonant type) by a composite sign of schwa and vowel (*ħataf*), representing an auxiliary vowel quantitatively equal to schwa and qualitatively assimilated to the following vowel, e.g., *ħataf pataħ* ֲ (Blau, 1971).

Our discussion concerns vowel reduction in the three vowels represented respectively by *qamac, pataħ* and *ħataf pataħ,* the sources of current-day *a.* Of the three, the tone-lengthened vowel represented by *qamac* reduced to schwa two syllables before the accent syllable, while *qamac* representing the historically long *a* (see above) was exempted. The short *a* represented by *pataħ* appeared in unaccented closed syllables, and therefore was also exempt from reduction. Vowel reduction was part of a re-syllabification process in the suffixed word. Note, for example, the shift from *zāhāv* 'gold' to *zɛhāvo* 'his gold' in (1) below[3] (schwa is represented by the symbol *ɛ*).

(1) *zā.hāv* ➔   *zā.hā.v+o* ➔ *zɛ/hā.vo*
     1 0   2 1 0   R 1 0

The accent syllable is marked by 0, and syllables preceding it by incrementing numbers. In *zāhāv* there is no environment for reduction, since the open syllable *zā* marked by 1 directly precedes the accent syllable *hāv* marked by 0. When the inflectional suffix *–o* indicating 3rd person masculine singular possessive is attached to *zāhāv*, a new final syllable is created and the accent moves to it. Now *hā* is an open syllable, but it directly precedes the accent syllable *vo* and so does not reduce.

However, the open syllable *zā* twice removed from the accent undergoes reduction to

schwa. This creates a dependent syllable *zɛ*/, affiliated to the next principal syllable

vo.

Unaccented syllables with *pataħ* do not reduce under these conditions in

nouns. For example, in the shift from *tabbāħ* 'cook' to *tabbāħo* 'his cook' the first

syllable does not reduce (2).

(2) *tab.bāħ* ➔   *tab.bā.ħ+o* ➔ *tab.bā.ħo*
    1   0   2 1 0   2 1 0

In *tabbaħ* there is no environment for reduction, since the closed syllable *tab* marked

by 1 directly preceding the accent syllable *bāħ* does not allow reduction. When the

inflectional suffix *–o* is attached to *tabbaħ*, a new final syllable is created and the

accent moves to it. Now *ba* is an open syllable but it directly precedes the accent

syllable *ħo* and so does not reduce. The first syllable *tab,* twice removed from the

accent, does not undergo reduction to schwa since it is closed due to gemination. The

result of the re-syllabification process is three principal syllables.

The *a* represented by *ħataf pataħ* (see above) was in itself a variant of schwa,

and therefore appeared too in a reduced syllable. For example, the word *ħamor*

'donkey' contains only one syllable according to Masoretic counts (*ħa/mor*), since the

vowel in *ħa* is a short *a* represented by *ħataf pataħ.*

The scope of the reduction rule described in this section refers mainly to

nouns. Historically, it encompassed not only the prosodic word, but also the broader

domain of the adjacency *smixut* N-N compound. Some types of compounds are

known in the general literature to constitute a single stress domain or a 'phonological

word' (Nespor, 1999). In Masoretic Tiberian Hebrew, the *smixut* (adjacency)

compound consisted of two members, the first of which (the head) was

phonologically dependent on the second (the modifier), and accordingly underwent

various morphophonological changes indicating its bound state, including *a* reduction,

under the same conditions specified above. The *smixut* compound was considered a

single 'phonological word' with one primary accent on the second member of the

compound. For example, see the shift in (3) from *šafan* 'rabbit' to *šefan^séla`*

'rabbit^rock = rock rabbit'.

> (3) *ša.fan* → *ša.fan^sé.la`* → *še/fan^sé.la`*
>   1 0   2 1 0   1 0

In this example, reduction occurs in *ša.fan^sé.la`* because the unaccented open

syllable *ša* is two syllables before the primary stress on the first syllable of *séla`,* the

second member of the compound.

   In the Tiberian reading tradition, the three diacritic signs *qamac, pataħ* and

ħataf pataħ thus represented phonological (quantitative and/or qualitative) differences

among vowels, and regularly participated in accentuation and syllabification

processes within the word and the compound, resulting in different outputs for

different vowels.

   1.4 Vowels and their representation in Modern Hebrew

   In Modern Israeli Hebrew, Classical and Tiberian Hebrew phonological

categories and phenomena such as the emphatics class, consonant gemination, and the

motivation for stop/spirant alternation, have been obliterated. A new phonological

system with several consonant neutralizations and a weakened guttural-pharyngeal

class has emerged (Bolozky, 1997; Ravid, 1995a). The vowel system of Modern

Hebrew has five cardinal vowels *i, e, a, o, u* with no quantitative differences in vowel

length. Among the neutralized vowel distinctions are qualitative and quantitative

differences among the vowels represented by *qamac, pataħ*, and *ħataf pataħ.* Modern

Hebrew today has one low vowel *a* in all the environments depicted in Table 1. The

only possible source of knowledge for current Hebrew speakers about the differential

behavior of words containing *a* from the different sources could potentially be interaction with the diacritic system (*nikud*).

Nikud, however, is regarded as a supplementary, even redundant, notational system in contemporary Hebrew. Modern Hebrew officially employs two versions of the same orthography: *vocalized* orthography, representing both consonants and vowels (Shimron, 1993), using letters and diacritic marks; and *nonvocalized* orthography, representing mostly consonants and vowels (the latter, partially and ambiguously) by letters. In actual reality the vocalized version is marginally used in reading and writing instruction, in children's books, in texts for new immigrants, and in Biblical and poetic texts. Nonvocalized orthography is the default version of written Hebrew, used across the board for most purposes, including school instruction.

Native Hebrew speakers reading a vocalized text today disregard the three different diacritics (*qamac, pataħ, ħataf pataħ*) representing the vowel *a* to a greater degree that they disregard the fact that homophonic consonants are represented by different letters. This should be considered in view of the fact that each and every one of the other vowels in Modern Hebrew is also represented by at least two diacritics (Ravid, 1996). Vocalized texts with *nikud* are considered marked, juvenile, and even bizarre in everyday contexts. Young children do not use *nikud* in their written production, and by 4th grade they find it superfluous in reading (Ravid, 1996). In many cases, children at the end of gradeschool are not even sure about the names of the various diacritics and which vowels they stand for. As for producing written texts with correct *nikud,* following the specifications of the Tiberian Masoretes, this is beyond the capabilities of all adults except for those specially instructed in traditional Hebrew grammar[4]. Thus Israeli adults and children alike have little exposure to and

even less experience with correctly notated texts with *nikud.* This sets the stage for the current study of vowel reduction in Modern Hebrew.

1.4.1 Vowel reduction in Modern Hebrew

In general, processes of vowel reduction resulting from nominal suffixation continue to be governed in Modern Hebrew by the same context of syllabic structure and stress patterns. The particular conditions under which vowel reduction operates today, however, have changed, as will be shown in this section. Modern Hebrew has two stress patterns in native nouns and adjectives: Either final stress (e.g., *tmuná* 'picture'), or penultimate stress on the *segolate* class (e.g., *mélex* 'king'). Most nominal suffixes are stress-carrying, as in past historical periods, and create new accent syllables when affixed to stems (Bolozky, 1997). Note example (4) of vowel reduction in the adjective *sagur* 'closed' due to feminine inflection:

(4) *sa.gur* → *sa.gu.r+a* → *sgu.ra*
     1 0   2 1 0   1 0

As in Tiberian Hebrew, the *a* in the unaccented open syllable *sa* loses its vowel and its syllabic status when twice removed from the final accent syllable, created by the addition of feminine *–a* to the masculine adjective. Note, however, that "vowel reduction" essentially means now "vowel deletion", since Modern Hebrew has no schwa. Reduced vowels delete completely, as in (4), unless preceded by semi-vowels or sonorants, in which case, *a* is reduced to *e* to prevent a word-initial cluster (Bolozky, 1997) as in the example of pluralization of noun *naxaš* 'snake' in (5):

(5) *na.xaš* → *na.xa.š+im* → *ne.xa.šim*
     1 0   2 1 0   2 1 0

In the *nikud* notational system, both cases of reducing vowels in (4) and (5) are represented by *qamac* ֱbefore reduction and by the same diacritic schwa ֱafter reduction. We will thus continue to refer to "vowel reduction" in Modern Hebrew.

Despite the similarity in the prosodic context of Modern Hebrew vowel reduction and in its representation in *nikud*, it has lost its general prosodic motivation and is heavily morphologized (Bolozky & Schwarzwald, 1990). This is the result of opacity in the phonological category directly involved in reduction and in related phonological categories, as well as in the domain of application (Kiparsky, 1982). The most problematic issue is the merger of the three Tiberian Hebrew vowels represented by *qamac, pataħ,* and *ħataf pataħ* into a single *a*. But despite this phonological neutralization, the morphophonological behavior of words containing *a* continues to follow the differential paths dictated by their past identities. Note, for example, the behavior of the two (currently) homophonic words *davar* 'thing' and *davar* 'mailman' under pluralization in (6). Both words are accented on the last syllable. Orthographic representation (including vocalization) is given in Latin letters under the examples (schwa is marked by Σ).

> (6a) *davar* 'thing' / *dvarim* 'things'
>   DĀBĀR   DΣBĀRYM

> (6b) *davar* 'mailman' / *davarim* 'mailmen'
>   DAWWĀR   DAWWĀRYM

These two nouns sound exactly the same, but behave differently: In both words, the addition of the plural suffix *–im* creates a new accent syllable at the end of the word. In *davar* 'thing', vowel reduction takes part in a re-syllabification process, represented orthographically by the diacritic schwa. In *davar* 'mailman', despite the same suffixation, no vowel reduction takes place. An examination of the difference in spelling and *nikud* provides the historical explanation: In *davar* 'thing', the first vowel is *qamac* in an open unaccented syllable twice removed from the accent, and thus reduces. In *davar* 'mailman', the first vowel is *pataħ* in what is currently an open

syllable. However the *nikud* shows that this syllable is followed by a historically geminate consonant, which closes the syllable. Hence, no context for vowel reduction.

The problem with this analysis is that it provides a historical or phonologically abstract explanation for the occurrence and absence of vowel reduction. However, for native Israelis untutored in historical Hebrew grammar – practically the whole population – this difference in the morphophonological behavior of the two homophonic words is unmotivated. The two vowels sound the same, there is no phonological gemination in Hebrew, and in addition the two occurrences of *v* in the words sound the same, despite the difference in spelling (Bolozky & Schwarzwald, 1990).

The question is thus, how do Hebrew speakers know when and where to perform vowel reduction? The only difference in vowel representation is in the *nikud*, and as noted above, this notational system is marginal and virtually unfamiliar even to literate Hebrew speakers. There are three possible replies to this question. One, Hebrew speakers do not know when and where to perform vowel reduction. Two, they learn each related pair by associative memory. Three, they learn where to perform vowel reduction by morphological class. Our study set out to investigate these possibilities.

1.4.2 Psycholinguistic aspects of vowel reduction in Modern Hebrew

From a psycholinguistic point of view, speakers have to represent noun forms with both full and reduced forms as well as relate them to each other. *A*-reduction is one of the five possible morphophonological stem changes in Hebrew, including vowel and consonant insertion, change and deletion. For example, to shift from singular *iparon* 'pencil' to plural *efronot*, the stem has to undergo vowel change $i \rightarrow e$, *a*-deletion, and spirantization of $p \rightarrow f$ (Ravid, 1995b). Developmental studies indicate

that *a*-deletion is one of the earliest stem-change types to emerge in child Hebrew. Ravid (1995a, b) shows that vowel reduction errors occur in very young children and in general disappear early on. Most of these errors involve failure to implement vowel deletion, e.g., *gamalim* for *gmalim* 'camels' (cf. singular *gamal*), or *zakena* for *zkena* 'old,Fm' (cf. masculine *zaken*) – both examples of spontaneous speech by children under 3 years of age. These errors are described with a host of other morphological strategies in stem-changing forms that Hebrew-speaking preschoolers use to preserve the structure of the input form under morphological operation (Ravid, 1995a: 99-102). Acquisition is almost error-free in morphological categories with high semantic salience, such as the Hebrew color pattern *CaCoC* (Ravid, 1995a). Levin, Ravid & Rappaport (in press) report numerous examples of change-stem errors in preschoolers and first graders under experimental conditions, but very few errors involve failure to delete *a.* Thus *a*-reduction seems to be a robust and early part of morphophonological knowledge in Hebrew, and to be learnt by attending to salient and consistent morphological information.

But despite the early emergence of *a* reduction, there are numerous examples of what would count from the perspective of Tiberian Hebrew as reduction and retention errors in older children and even among adults, e.g., *masofim* 'terminals' for *mesofim* from singular *masof*; *mesokim* 'helicopters' for *masokim* from singular *masok*. Observation shows such deviation from Tiberian norms to be strongest in compounds, e.g., *matos^nos'im* 'airplane^passengers = passenger airplane' for *metos^nos'im*, free noun form *matos*. Such deviant or "erroneous" forms occupy different positions on the "kyriolexia" scale defined in Householder (1983: 2) as "a form regarded by most speakers as the basic variant…the normal or correct pronunciation, the in-group form". To our native-speaking (though grammatically

tutored) ears, some of these deviations sound incorrect, others possible, and still others the only possible form.

One more problem is the existence of numerous homophonous forms with similar semantic content but with different morphophonological behavior and different *nikud* patterns. Note the pairs of homophonous nouns and adjectives with *a* in the first syllable in Table 2.

INSERT TABLE 2 ABOUT HERE

The first member of each pair has *qamac* in the first syllable, which reduces under suffixation. The second member has *pataħ* in a Tiberian closed syllable, marked in *nikud* by the diacritic for geminate (*dageš*) in the next consonant, and it does not reduce under suffixation. In many cases, such pairs are joined by a third identical form, which has *ħataf pataħ* in the first syllable and accordingly does not reduce either. Moreover, the forms with different *nikud* patterns often carry the same semantic content, e.g., both *CaCuC* templates denote adjectives, and both *CaCiC* templates denote agent nouns and adjectives. Given this similarity, these morphological classes seem to be particularly subject to deviations from the Masoretic Tiberian tradition.

2.0 The study

The current study examined how native-speaking children, adolescents and adults perceive *a*-reduction and deletion in Modern Hebrew. The experimental design was based on Ravid (1996), and involved manipulating the degree of phonological information provided to Hebrew speakers in a reading task of non-vocalized and vocalized items with reducing and non-reducing *a*.

2.1 Population

100 Hebrew speakers participated in this study, divided into 5 groups of 20 each: 5th, 7th, 9th and 11th graders, and adults, half male and half female in each group. All participants were monolingual speakers of Hebrew from a medium to high SES (Socio-Economic Status) background. The youngest study group consisted of 5th graders in order to assure adequate reading competence with and without vocalization marks. Gradeschoolers and highschoolers were selected randomly from the class register, after ensuring that they did not suffer from any learning, language, or emotional problems. Adults were students in a military academy.

2.2 Materials

The materials for this study consisted of a reading task with 30 inflected items: 7 plural nouns and adjectives[5], and 23 noun compounds, 9 with singular heads and 12 with plural heads. All test items belonged to morphophonological categories susceptible to deviations from *a-* reduction or retention (see 1.4.2 above). Of the 30 test items, 16 originated in free forms vocalized by *qamac* and thus were supposed to undergo vowel reduction; 14 of the items originated in free forms vocalized by *pataħ* and by (historically) long, non-reducing *qamac* (see 1.2.1 above), and thus were not supposed to undergo vowel reduction. All test items were randomized and embedded in sentences so as to make the reading task meaningful and authentic, and in order to conceal the true aim of the study. Test items were presented to the study participants in their bound forms (i.e., after vowel reduction had [not] operated). Appendix I presents the test items and their classification. Appendix II gives examples of the sentences as they were administered to the study participants.

2.3 Procedure

The study design followed the concept underlying Ravid's language change and literacy studies (1995c, 1996). The idea was to stimulate incremental levels of language awareness in language users through text manipulation in order to see how different age groups approach tasks involving categories susceptible to language change. Language awareness is defined as the ability to think about language as a formal problem space, focusing consciously and analytically on linguistic components that blend together naturally in normal language usage (Gombert, 1992; Karmiloff-Smith 1986, 1992). Language awareness involves an enhanced degree of control and reflection about language form separated from its semantic content.

In the current study, participants had to read aloud the same test sentences three times, termed here "conditions", within the period of a week, with increasing degrees of linguistic control. The same test sentences were presented in a different random order each time. The order of the conditions was however fixed and invariable. In the first condition, the test sentences were presented in non-vocalized script, i.e., without the *nikud* diacritics. Participants were asked to read the study sentences aloud, and to raise their hand after each sentence whose content concerned the land of Israel. This was a distractor strategy planned in cooperation with the teachers whose students we tested. After piloting and discarding a number of other distractor ideas, this was found the most successful in diverting participants' minds away from linguistic structure, the true aim of the study. Thus the level of linguistic awareness and control in the first condition was the lowest.

In the second condition, participants were again presented with the same test materials in non-vocalized script, i.e., without the *nikud* diacritics, and asked to read the sentences aloud. This time, however, they were asked to read the text "in correct

Hebrew". There was no further explanation of what "correct Hebrew" involved, but it is the usual practice in Israeli schools to treat morphophonology and *nikud* as belonging to the realm of "correct Hebrew" (Ravid, 1995a). Level of linguistic control was thus increased in the second condition by directing participants' attention to language form and specifically to its morphophonological components. In the third condition, participants were again presented with the same test materials and asked to read the text aloud "in correct Hebrew". This time, however, the text was vocalized, i.e., with correct *nikud* diacritics specifying all historical vowels, including correctly occurring and absent *qamac* and *pataħ* in target sites. In items that had undergone vowel reduction, the reduced syllable was vocalized by the schwa ֶ. In items that resisted vowel reduction, the target syllable was vocalized by *pataħ* ַ or by *qamac* ָ. Making this phonological information available to our study participants should have resulted in correct vowel pronunciation. Since vocalized Hebrew texts specify vowel signs and are considered marked, we assumed readers' attention would be drawn to the specific morphophonological composition of the test items. This would increase participants' degree of linguistic awareness and control, enhancing their ability to pay attention to the specific vowels they were reading. Test conditions are summed up in Table 3 below.

<div align="center">INSERT TABLE 3 ABOUT HERE</div>

Participants' task thus consisted of reading aloud the sentences with the test items, and the aim of the reading task was to assess how close their reading was to the prescribed Tiberian Hebrew forms with and without the vowel *a* in the target sites. The research question was, to what extent participants in the different study groups would be able to reconstruct the correct pronunciation of the target words in the three conditions.

Each participant was tested separately by two investigators in a quiet room at school or at university, and was asked to read aloud the test sentences to one of the investigators. Each reading session was recorded by the second investigator, who also noted down at the same time the occurrence or non-occurrence of *a* in the target sites. Recordings were transcribed on the same day, with particular attention to the target vowel. 25% of the transcriptions were selected randomly and compared to the recorded tapes to ensure reliability.

2.3 Predictions

We predicted adults and highschoolers to achieve higher correct scores than the younger age groups. Correct scores were predicted to increase from the first to the third condition. We also predicted more success in retaining the vowel *a* than in its deletion (Ravid, 1995a,b).

3.0 Results

Only target sites with reduced or retained vowel *a* were counted and analyzed. Target sites were marked as either correct or incorrect. A correct response consisted of vowel reduction or vowel retention in accordance with the historical Masoretic Tiberian grammatical stipulations.

3.1 General results

Table 4 presents the overall correct mean percentage scores for each of the study groups in the three conditions.

INSERT TABLE 4 ABOUT HERE

To test our predictions, we conducted a two-way ANOVA of age (5 study groups) x condition (3 conditions). An effect for age was found ($F(4,95)=21.51$, $p<.001$): Overall, correct scores increased with age. However the Scheffé Post-Hoc Procedure, designed to detect differences between pairs of study categories, could not

find differences between any two of the test groups in conditions 1 and 2. In the third

condition, the two oldest groups differed significantly from the three younger groups.

There was an effect for condition ($F(2,190)=272.39$, $p<.001$): Condition 3 ("Correct

Hebrew", vocalized) had overall higher scores (M=58.87) than Condition 1 ("The

Land of Israel", non-vocalized) (M=37.55) and Condition 2 ("Correct Hebrew", non-

vocalized) (M=38.41). A significant interaction of age x condition was found

($F(8,190)=21.81$, $p<.001$), showing exactly how the scores of the study groups

differed across the three conditions. This interaction is depicted in Figure 1.

<div align="center">INSERT FIGURE 1 ABOUT HERE</div>

Figure 1 shows that conditions 1 and 2 have the same pattern of correct responses, and

moreover the study groups do not differ from each other: Their correct scores range

between 30-40%. However in the 3rd condition all groups have higher scores, and the

two oldest groups show a dramatic increase in correct responses.

Thus, under this analysis, our predictions were only partially confirmed. We

had predicted correct scores to increase from the first to the third condition, and also

for adults and highschoolers to achieve higher correct scores than the younger age

groups. In fact, all study groups did the same on the first two conditions, reading the

non-vocalized words with poor adherence to the historical stipulations. The third

condition with the vocalized words brought out a difference: the three younger groups

did slightly better than in the first two conditions, yet did not cross the 50% line in

reading the vocalized words, while the two older groups read the vocalized words

much more accurately, with ¾ correct scores.

3.2 Vowel reduction and vowel retention

We next examined the results in depth to see if participants performed better

on vowel reduction or on retention. Table 5 presents the breakdown of results for

items containing *qamac* in their free forms (vowel should reduce), and for items

containing *pataħ* or long Proto-Semitic *a* represented by *qamac* (vowel should be

retained). Results showed that averaging the *qamac* and *pataħ* responses had obscured

the true picture.

<div align="center">INSERT TABLE 5 ABOUT HERE</div>

We analyzed the data in Table 5 using a 3-way ANOVA of age (5) x condition (3) x

vowel type (2 – reduced or retained). Results showed an effect for age ($F(4,94)=12.7$,

$p<.001$): The study groups differed from each other. There was also an effect for

condition ($F(2,188)=272.78$, $p<.001$), showing different score patterns for the three

conditions. There was also an effect for vowel type ($F(1,94)=414.27$, $p<.001$),

showing that there were different patterns for test items derived from free forms with

qamac or with *pataħ*. The precise nature of these effects is clarified by the three-way

close-to significant interaction[6] between the study variables depicted in Figure 2.

<div align="center">INSERT FIGURE 2 ABOUT HERE</div>

Figure 2 shows three variables: Age, vowel type, and condition. Age of the

study group is in numbers representing grade level, e.g., 5 = 5th grade. Vowel type is

marked for each study group by either q (*qamac*) or p (*pataħ*). The scores for each

study group thus appear twice, once for reducing *a* (*qamac*), and once for non-

reducing *a* (*pataħ*). For example, 5q represent the scores for reducing *a* in 5th grade,

and 5p represent the scores for non-reducing *a* in the same study group.

On the whole, the first two conditions are almost identical. In both of them,

test items originating in non-reducing *a* (*pataħ,* represented by p) scores are always

relatively high, and decline slowly with age of the study group from over 60% in 5th

and 7th grade to less than 50% in adults. Separate Scheffé procedures for these two

conditions show that the youngest groups (5th and 7th graders) differ significantly from

the older groups by having HIGHER correct scores. The third condition starts higher than the other two, over 70%, and the previous trend is reversed in the 9th grade: The scores of older age groups increase to over 80% in the adults. Test items originating in reducing *a* (*qamac*) have a different pattern. Again, the first two conditions are almost identical. The three younger study groups have very low *qamac* scores, around 20%, and the two older age groups do significantly better by 13-15%, as shown by a separate Scheffé analysis. Still, all age groups have very poor scores on reducing *a*. The third condition shows a similar pattern, though with increased success: The reducing *a* scores of the younger groups range between 30-35%, but those of the 11th graders and adults reach the same level as their non-reducing scores.

From this perspective, our predictions again were only partially confirmed. We had predicted adults and highschoolers to achieve higher correct scores than the younger age groups. This was true only for reducing *a*, and for non-reducing *a* only in the third condition. In the first two conditions, scores for non-reducing *a* DECLINED. Correct scores had been predicted to increase from the first to the third condition. This was not confirmed in the shift from first to second condition. In the third condition, it was only the 11th graders and adults who really benefited from the vocalized text. We had also predicted more success in retaining the vowel *a* than in its deletion. This prediction was generally confirmed, but in the first two conditions the older age groups surprisingly performed less well on vowel retention than the younger groups, while the reverse was true for vowel reduction.

4.0 Discussion

This study investigated the ability of native Hebrew-speaking children, adolescents and adults to follow the historical Hebrew vowel reduction rule, while manipulating the degree of phonological information provided to them in vocalized

vs. non-vocalized texts. Study participants were asked to read the same target words (inflected nouns and adjectives, and nominal compounds) three times – twice without vocalization, and once more with vocalization marks. In the first condition, participants' attention was diverted away from language structure to the content of the sentences. In the second condition, while vocalization was still missing, participants were asked to read the text in "correct Hebrew", thus raising their consciousness of linguistic form. In the third condition, vocalization was provided, and participants were again explicitly told to read the text in "correct Hebrew". The combination of vowel signs and attention to language structure was supposed to bring reading closer to Tiberian Hebrew norms.

There were two types of test items in this study: One class consisted of target items deriving from free forms with historically tone-lengthened *a*, which should therefore undergo vowel reduction, e.g., *gada* 'bank / *gdat^ha-naxal* 'the river bank''. In the vocalized condition, these items were marked by the schwa sign in the target syllable. Another class consisted of items deriving from free forms with non-reducing *a*, e.g., *takif* 'firm' / *takifim* 'firm,Pl'. In the vocalized condition, these were marked by either the *pataħ* or *qamac* diacritic signs.

Literate Hebrew speakers read and understand non-vocalized texts as a matter of course (Shimron, 1993), and this is the norm towards the end of gradeschool, grades 5-6 (Ravid, 1995c). This means that a process of retrieval is taking place, matching non-vocalized orthographic forms with full phonological and semantic representations. It was precisely those phonological representations that we wished to tap by manipulating language awareness level and text vocalization.

4.1 First and second conditions: the domain of language change

The three conditions differed in the effect they had on participants' performance. In the first condition participants were provided with a non-vocalized text, and moreover were not told the real goal of the reading session. Thus, crucial phonological information about vowels was not represented in written form, and moreover participants' attention was diverted away from language structure towards the emotional-laden topic of the land of Israel. This presumably means that target items were retrieved and vocalized in their habitual spoken form, testifying to a general departure from Tiberian Hebrew norms at least in the items or morphological categories represented in the study.

Generally speaking, most target items from both classes were read with the vowel *a* in the first condition. This is because vowel reduction items were mostly incorrect – that is, *a* was retained; while non-reduction items were mostly correct – that is, *a* was again retained. But note that even in this first condition, with attention focused on language content and with no conscious control over morphophonology, older age groups did slightly better on vowel reduction and slightly worse on vowel retention. We interpret this as older speakers' recognition of the existence of a process of vowel reduction, despite their poor performance.

In the second condition, the text was still non-vocalized, so that information about specific vowels was still formally absent. However, participants' attention was drawn to language structure by requiring that they read the text in "correct Hebrew". This was a manipulation intended to enhance participants' linguistic control and awareness, and perhaps to make them concentrate on applying the Tiberian Hebrew rule or retrieving the precisely vocalized forms – if the rule or the representations were there. However, the results of this condition closely resembled the first with no

improvement in terms of correct scores. Vowel reduction again slightly improved with age and literacy, while vowel retention again slightly deteriorated.

Our conclusion is that older speakers are trying to perform more vowel reduction than younger ones, hence these results. But none of the study groups really knows WHERE to perform reduction. This is because, as noted above, all types of *a* deriving from any historical source now sound exactly the same, making it impossible to identify the domain of application of vowel reduction on the basis of phonology alone. Even when told explicitly to watch out and read aloud in "correct Hebrew" – which means for Hebrew speakers watch out for vowels and stops / spirants – our study participants were not able to identify what exactly it was that could make the target items "correct Hebrew".

Vowel reduction is a good candidate for making one's Hebrew sound more literate and correct, and all target words were candidates for reduction. However a processing problem interfered here: Almost every target item in the test was a member of a morphophonological pair (and sometimes a triplet) of the type presented in Table 2 – one with reducing *a*, another with non-reducing *a.* Whenever one representation was stimulated, another, almost identical except for vowel behavior, was also stimulated, resulting in confusion. This is exemplified by one of the target items, *šakul* 'bereaved', which is not supposed to reduce under inflection, yet forms a minimal pair with *šakul* 'level-headed', where reduction does occur under inflection. Since vowels are perceived continuously rather than dichotomously (Berg, 1998), Hebrew speakers are better able to tolerate the presence or absence of vowels in border-line cases. Indeed, Ravid (1995a) shows that word-internal vowels are highly unstable in certain Hebrew templates, and speakers tolerate a number of parallel lexemes with differing vowels, all signifying the same lemma and lexical concept

(Bock & Levelt, 1994). This blurs the distinctions between forms of the type represented in this study.

4.1.1 Domains of application

The *smixut* compound used to constitute a prosodic domain for *a* reduction since the accent syllable in the modifier motivated the process. Our study had both plural forms (e.g., *pgazim* 'shells' from singular *pagaz*) and nominal compounds (e.g., *mucrey crixa* 'consumption products' from plural *mucarim* 'products'). Since these two categories contained an unequal number of the two vowel types, we could not perform a statistical comparison. However, Figure 3 gives an idea of the trends involved in the interface of vowel type and study group in the first two conditions. Since scores were very similar, we present the average of the two conditions.

INSERT FIGURE 3 ABOUT HERE

Figure 3 elaborates the findings presented so far. Within the single words chosen as test items for this study, participants were producing higher scores with age and literacy for *qamac,* although the processing problem described in 4.1 above prevented the correct application of the old rule. Plural words with *pataħ* stay around 40%. Compounds with non-reducing *a*, however, had very high scores in the three younger groups, which then declined with age and literacy. Our tentative interpretation is that this reflects speakers' developing perception of the domain of application of *a* reduction in Modern Hebrew. In the young age groups, compound heads were viewed as discrete words, and thus retained their vowel. Older age groups were able to construe the whole compound as a single morphophonological domain, and therefore reduced the vowel. This part of the study requires further examination in future research.

4.2 Third condition: Where literacy comes in

The third condition involved reading the same items in vocalized Hebrew, with *nikud* providing the phonological information about where to pronounce *a* and where not to. This condition had different effects on younger and older participants. The three gradeschool and junior highschool groups did not gain much from the orthographic information supplied to them. Their correct scores somewhat improved, but still patterned exactly like the first two conditions. The scores of the adults and highschoolers, in contrast, improved dramatically in items with both reducing and non-reducing *a*.

These results resemble closely the phenomenon revealed in Ravid (1996). In that study, 4th graders and adults read aloud target items whose normative morphophonological structure shown by vocalization marks clashed with their standard spoken representation. For example, the compound normally pronounced *gader ha-báyit* 'fence the-house = the house fence' was vocalized according to historical norms as *géder ha-báyit*. Non-vocalized scores were similar across the age groups, but adults read the vocalized items much more accurately than the gradeschoolers. The latter ignored vocalization marks and superimposed their standard spoken version of the test items, which differed from the one represented by the vocalization marks.

Results of the 1996 as well as the current study testify to the differential status of consonants and vowels in spoken and written Hebrew. The central role of the Semitic root is related to the fact that consonants (though not stop / spirant alternation) carry highly informative lexical content, and are highly stable. Vowels classify Hebrew words into categories and tolerate much more variability. While a Hebrew speaker would not dream of substituting one consonant for another and still

refer to the same lexical concept, it is possible to vary the vocalic pattern of the word (and to a certain extent, also stop / spirant segments) while retaining the same lexical identity (Ravid, 1995a, 1996). This overrepresentation of consonants at the expense of vowels is reflected in the spelling system (Ravid, in press): Vowels are either represented fully in small diacritics under, above and inside letters in the vocalized version, or else are represented partially and ambiguously by letters.

Our conclusion is that phonological information presented in the form of *nikud* is not processed by Hebrew users in the same way as information presented in letters. The fact that vocalization marks were available was more or less ignored by children and adolescent participants in this study up to 9th grade. Instead, they provided their own version of word-internal vocalization, retrieving the phonological form of the word in the usual process as if they were reading a non-vocalized text. Older, more literate Hebrew users were better able to elicit phonological information from *nikud*, and also better able to handle those lexemic forms which go counter the everyday, standard morphophonological representation (Bock & Levelt, 1994). While none of the study groups was able to follow the path stipulated by Tiberian Hebrew scholars re *a*-reduction (as shown by results of the first two conditions), it was impossible to draw the attention of children and young adolescents to forms with the historical vocalization patterns. Having focused in highschool on formal Hebrew morphophonemics and their reflection in *nikud*, the older study groups were better able to process the vocalized text.

5.0 Conclusions

Do the results of this study mean that *a* reduction no longer operates in Modern Hebrew? Not at all. *A* is the most frequent vowel in Modern Hebrew, and *a* reduction is an extremely wide-spread and early-occurring phenomenon (Bolozky,

1997; Ravid, 1995a,b). What this means is that its conditions of operation are no longer governed by prosodic and phonological context, as they were in Tiberian Hebrew. We agree with Bolozky (1997) and Bolozky & Schwarzwald (1990) that vowel reduction is heavily morphologized in Modern Hebrew, as are other previously-phonological phenomena such as spirantization and vowel lowering (Ravid, 1995a). We claim, however, that *a*-retention is the unmarked morphophonological behavior in Modern Hebrew, following the Optimality Theory notion of *faithfulness* to lexical contrasts, where output forms are completely congruent with their lexical inputs with respect to some featural opposition – in this case, the presence of the vowel *a* (Kager, 1999:5). In order to reduce *a*, a morphological class has to be well-defined from as many perspectives as possible, given that vowel retention is always easier and more regular than vowel reduction. This is especially valid in semantically distinct morphological categories. For example, in the highly salient agent pattern *CaCaC* (e.g., *nagar* 'carpenter', *balaš* 'detective'), *a* is always retained. In the highly salient color category *CaCoC*, *a* is always deleted. In past and future tense verbs, other vowels delete in pre-tonic position with no exception from very early child language. However, in most nominal categories with reducing *a*, overshadowed by similar templates with a retained vowel, speakers have problems deciding whether to reduce or retain the vowel.

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Historical source	Syllable type in Tiberian Hebrew	Diacritic name	Diacritic sign	Modern Hebrew vowel
Proto-Semitic long *a*	Open	*qamac*	ָ	[*a*]
Short tone-lengthened *a*	Closed accented *or* Open unaccented, preceding accent	*qamac*	ָ	[*a*]
Short *a*	Closed unaccented	*pataħ*	ַ	[*a*]
Auxiliary *a*	Dependent	*ħataf pataħ*	ֲ	[*a*]

Table 1. Historical sources of contemporary Hebrew *a*.

Surface Template	*qamac*		*patah*	
	Free form	Suffixed form	Free form	Suffixed form
CaCaC	*davar* 'thing'	*dvarim* 'things'	*davar* 'mailman'	*davarim* 'mailmen'
CaCuC	*šakul* 'level-headed'	*škula* 'level-headed, Fm'	*šakul* 'bereaved'	*šakula* 'bereaved,Fm'
CaCiC	*pakid* 'clerk'	*pkidim* 'clerks'	*cadik* 'righteous'	*cadikim* 'righteous, Pl'
maCoC	*masof* 'terminal'	*mesofo* 'his terminal'	*masor* 'saw'	*masoro* 'his saw'

Table 2. Identical surface templates with *qamac* and *patah*.

Condition	Label	Degree of linguistic control	Vocalization
First condition	"The Land of Israel"	Low	-
Second condition	"Correct Hebrew"	Medium	-
Third condition	"Correct Hebrew"	High	+

Table 3. Schematization of the test conditions.

Condition →	First Condition "The Land of Israel" No vocalization		Second Condition "Correct Hebrew" No vocalization		Third Condition "Correct Hebrew" With vocalization	
Study Group	Mean %	SD	Mean %	SD	Mean %	SD
5th grade	36.29	4.33	35.86	4.96	47.88	11.65
7th grade	37.02	5.92	37.74	7.54	44.73	11.73
9th grade	33.92	8.51	35.02	7.03	49.72	11.38
11th grade	40.5	7.03	41.91	7.24	76.67	11.75
Adults	40	8.52	41.5	9.82	75.33	12.29

Table 4. Mean percentages of correct scores, by study group and by condition.

Condition →	First Condition "The Land of Israel" No vocalization		Second Condition "Correct Hebrew" No vocalization		Third Condition "Correct Hebrew" With vocalization	
Study Group	Mean %	SD	Mean %	SD	Mean %	SD
5th grade *qamac*	18.01	6.35	17.11	6.16	33.82	16.27
5th grade *pataħ*	64.23	7.46	63.6	10.39	71.7	8.09
7th grade *qamac*	18.88	7.71	19.92	9.19	31.12	14.97
7th grade *pataħ*	64.77	12.56	64.58	14.42	65.53	17.0
9th grade *qamac*	17.9	9.76	19.23	11.49	35.72	18.96
9th grade *pataħ*	58.73	12.57	59.32	12.58	71.14	12.14
11th grade *qamac*	32.22	11.05	32.91	12.74	75.83	12.78
11th grade *pataħ*	52.92	13.32	55.42	14.28	77.92	14.38
Adults *qamac*	33.06	12.02	37.22	12.89	71.38	15.74
Adults *pataħ*	50.42	11.93	47.92	14.28	81.25	15.5

Table 5. Mean percentages of correct scores, by study group, by condition, and by adherence to vowel reduction (*qamac*) and vowel retention (*pataħ*). Note that *pataħ* refers to the category of retained vowels marked by both *pataħ* and long Proto-Semitic *a* signified by *qamac*.
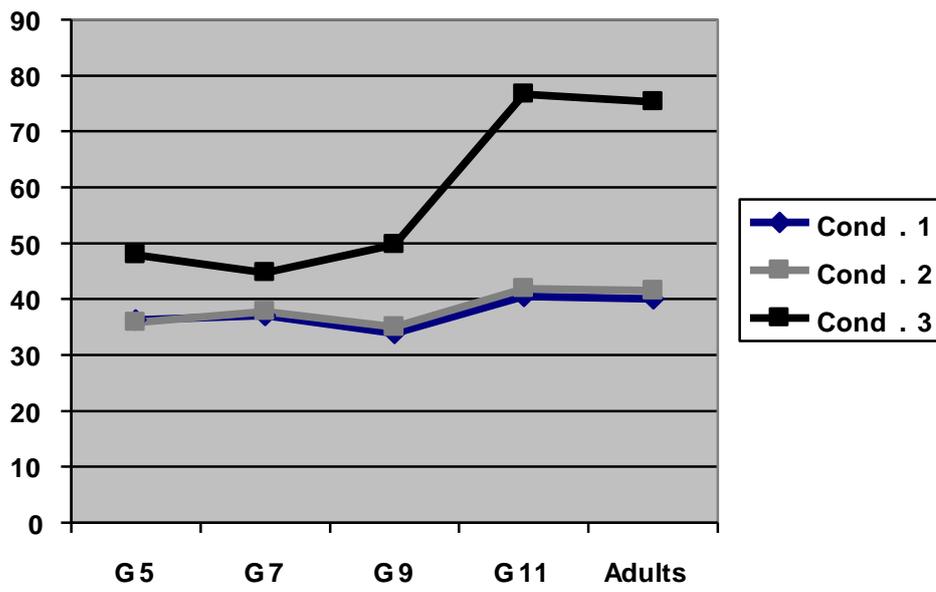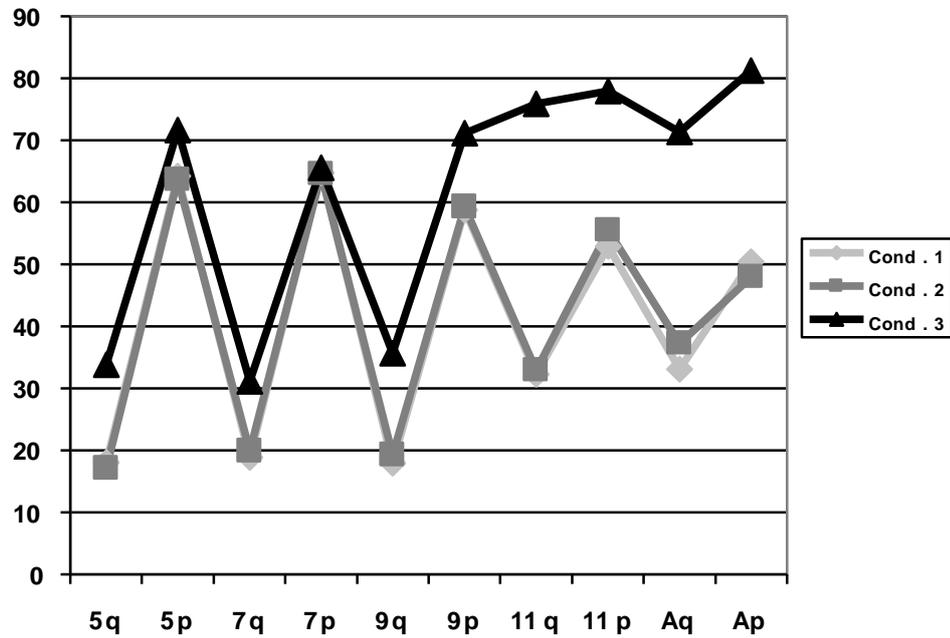
Figure 1. Interaction of age and condition.

Figure 2. Interaction of study group (numbers represent grade level), by vowel type (q = reducing *qamac,* p= non-reducing *pataħ* and *qamac*), and by condition (three different lines).
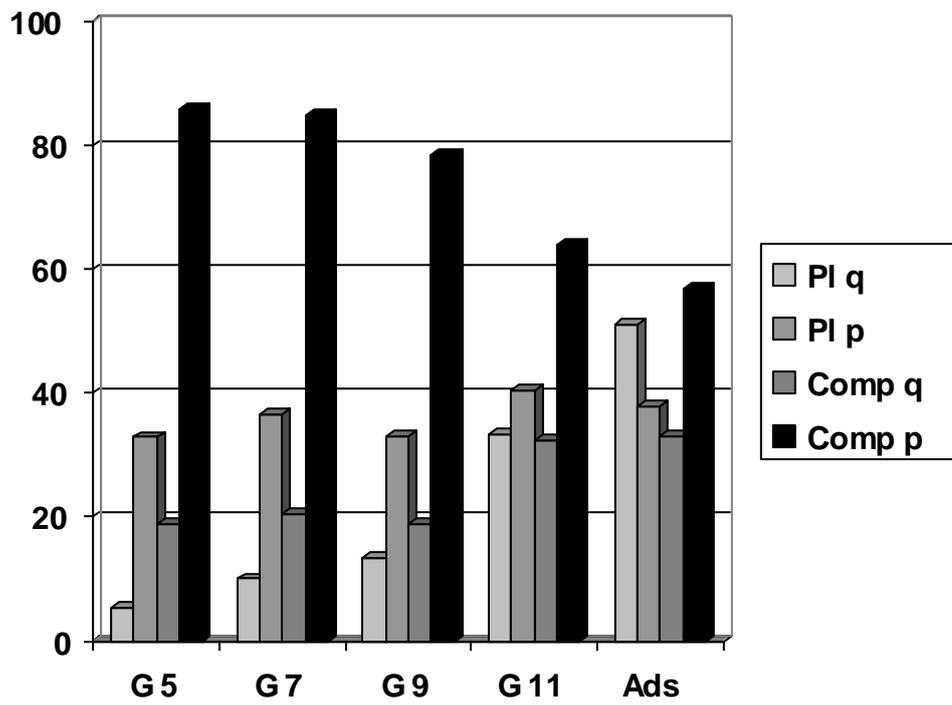
Figure 3. Conditions 1 & 2: Plural and compound test items with reducing (q = *qamac*) and non-reducing (p= *pataħ* and long *qamac*), by study group

Appendix I: Test items and their categories: Plural and compound. The free form of each test item is given below it.

Structure	Plural	Compound with singular head	Compound with plural
Reducing *a* *qamac*	*mesofim* 'terminals' *masof* 'terminal'	*ge'on ha-maxševim* 'the computer genius' *ga'on* 'genius'	*mosdot mexkar* 'research institutes' *mosadot* 'institutes'
	pgazim 'shells' *pagaz* 'shell'	*metos krav* 'fighter plane' *matos* 'plane'	*mošvot ha-cafon* 'northern settlements' *mošavot* 'settlements'
		še'on yad 'wrist watch' *ša'on* 'watch'	*pisgot he-harim* 'mountain peaks' *psagot* 'peaks'
		medor ha-tašlumim 'payment division' *mador* 'division'	*yaldot ha-kibuc* 'kibbutz girls' *yeldaot* 'girls'
		šitfon meyda 'information flood' *šitafon* 'flood'	*merkezey ha-pituax* 'development centers' *merkazim* 'centers'
		sdin ximum 'heating (electrical) sheet' *sadin* 'sheet'	*ma'avrey ha-yarden* 'Jordan crossings' *ma'avarim* 'crossings'
		gdat ha-naxal 'river bank' *gada* 'bank'	*mucrey crixa* 'consumption products' *mucarim* 'products'
		brak or 'light flash' *barak* 'flash'	*dgey zahav* 'goldfish' *dagim* 'fish,Pl'
Non-reducing *a* *pataħ,* long *qamac*	*masokim* 'helicopters' *masok* 'helicopter'	*cavar ha-bakbuk* 'bottleneck' *cavar* 'neck'	*dakot hamisxak* 'minutes of the game' *dakot* 'minutes'
	lakoxot 'customers' *lakoax* 'customer'		*sakanot ha-milxama* 'war dangers' *sakanot* 'dangers'
	yacivim 'stable,Pl' *yaciv* 'stable'		*bakašot ha-mištatfim* 'participants' requests' *bakašot* 'requests'
	takifim 'firm,Pl' *takif* 'firm'		*pratey ha-hacba'ot* 'voting details' *pratim* 'details'
	šakulim 'bereaved, Pl' *šakul* 'bereaved'		*ktaney emuna* 'of little f *ktanim* 'small,Pl'
			prasey roš ha-memšala 'prime minister's prizes *prasim* 'prizes'

Appendix II: Examples of test sentences (test items are underlined)

1) *šlošet ha-<u>mesofim</u> ba-bank mexubarim li-<u>mdor ha-tašlumim</u> be-<u>merkezey</u>*

    <u>*ha-pituax*</u> *šel ha-iriya*

    'The three <u>terminals</u> in the bank are connected to the <u>payment division</u> in the

    <u>development centers</u> of the city council'

2) *<u>cavar ha-bakbuk</u> be-tel aviv nocar be-<u>dakot ha-misxak</u> ha-axaronot biglal*

    nehirat <u>lakoxot</u> li-kniyat <u>mucrey crixa</u>

    'The <u>bottleneck</u> in Tel Aviv was created during the last <u>game minutes</u> due to

    <u>customers</u> streaming to buy <u>consumption goods</u>'

3) *<u>ktaney ha-emuna</u> hutsu be-<u>masokim</u> el <u>pisgot he-harim</u> u-le-<u>ma'avrey ha-</u>*

    <u>*yarden*</u>

    'Those <u>of little faith</u> were flown in <u>helicopters</u> to the <u>mountain peaks</u> and to

    the <u>Jordan crossings</u>'

Notes

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[1] Terminology is problematic here: It is controversial whether Modern Hebrew was "revived", implying it had been dead or dormant before; or whether it is a continuation of previous entities (Wexler, 1990). We have chosen to use the term "revival".

[2] . The actual pronunciation of *qamac* and *pataħ* is not our concern here, and is discussed in length in Khan (1997) and in Rendburg (1997).

[3] Vowels in the Hebrew examples are transcribed in the current Israeli Hebrew pronunciation, which is native to both authors.

[4] Compare, in contrast, the fact that by grade 6 the overwhelming majority of gradeschoolers are excellent spellers (Ravid, in press).

[5] Hebrew adjectives are morphophonologically similar to nouns (Blau, 1971).

[6] In fact, there were three highly significant interactions: Age by condition (see Figure 1); age by vowel type ($F(4,94)=20.7$, $p<.001$); and condition by vowel type ($F(2,188)=18.45$, $p<.001$). But their exact meaning is less fragmented when presented in the three-way interaction.