Research Note

second language research

Second Language Research
2016, Vol. 32(1) 109–122

DOI: 10.1177/0267658315608913
slr.sagepub.com
SAGE

Transfer of L1 visual word recognition strategies during early stages of L2 learning: Evidence from Hebrew learners whose first language is either Semitic or Indo-European

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Abstract

The present study examined visual word recognition processes in Hebrew (a Semitic language) among beginning learners whose first language (L1) was either Semitic (Arabic) or Indo-European (e.g. English). To examine if learners, like native Hebrew speakers, exhibit morphological sensitivity to root and word-pattern morphemes, learners made an off-line graded lexical decision task on unfamiliar letter strings. Critically, these letter strings were manipulated to include or exclude familiar Hebrew morphemes. The results demonstrate differential morphological sensitivity as a function of participants' language background. In particular, Indo-European-L1 learners exhibited increased sensitivity to word-pattern familiarity, with little effect of root familiarity. In contrast, Semitic-L1 learners exhibited non-additive sensitivity to both morphemes. Specifically, letter strings with a familiar root and a familiar word-pattern were the most likely to be judged as real words by this L1-Semitic group, whereas strings with a familiar root in the absence of a familiar word-pattern were the most likely to lead to a non-word decision. These findings show that both groups of learners activate their morphological knowledge in Hebrew in order to process unfamiliar Hebrew words. Critically, the findings further demonstrate transfer of L1 word recognition processes during the initial stages of second language (L2) learning.

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Keywords
Hebrew, L1 transfer, L2 learning, morphology, visual word recognition

I Introduction

Previous studies suggest that visual word recognition in Semitic languages may be different in nature from that in Indo-European languages (Frost et al., 2005; Velan and Frost, 2011). In Indo-European languages, many words are morphologically simple (base words that consist of only one morpheme, like ‘happy’ or ‘dark’). Morphologically complex words are formed by adding prefixes or suffixes to these base forms (e.g. ‘unhappy’ or ‘darkness’). This linear structure results in visual word recognition processes that are more tuned to the beginning or the end of the base word than to its internal structure (Perea and Lupker, 2003). In contrast, in Semitic languages most words are composed of two intertwined morphemes, a root and a word-pattern, which cannot stand by themselves as independent words. This complex non-linear morphological structure results in visual word recognition processes that are more tuned to the internal structure of the word (Frost et al., 2005; Velan and Frost, 2011). Given these differences, the current study aimed to examine the sublexical morphological sensitivity to the Hebrew root and word-pattern morphemes among Hebrew learners in the early stages of learning, and to determine whether reading processes in a second language (Semitic) in these early stages of learning are modulated by the morphological background of the first language (Semitic or Indo-European).

1 *Morphological decomposition in visual word recognition*

Although visual word recognition is normally conceptualized as being driven primarily by the analysis of orthography, it is now commonly accepted that letter strings are also analysed in terms of their constituent morphemes (Amenta and Crepaldi, 2012; Rastle and Davis, 2008; Rastle et al., 2004; Taft, 1981; Taft and Forster, 1975). For example, studies using the masked-priming paradigm (in which primes are masked and are not consciously perceived) show speeded recognition for base form targets (e.g. DARK / CORN) preceded by both genuinely affixed primes (e.g. darker–DARK) or pseudo affixed primes (e.g. corner–CORN), relative to non-morphological orthographic controls (e.g. brothel–BROTH) (Rastle et al., 2004). These masked priming effects reflect fast automatic activation of morphological representations shared by the prime and the target. Moreover, the fact that genuinely affixed primes (e.g. darker–DARK) and pseudo affixed primes (e.g. corner–CORN) yield equivalent priming effects indicates that morphological decomposition of words (e.g. corner = corn + er) arises in the early (pre-lexical) stages of visual word recognition (Rastle and Davis, 2008).

2 *The morphological structure of Semitic vs. Indo-European languages*

The importance of morphological structure during the early stages of visual word recognition is also evident in cross-linguistic research, as morphological complexity is created in different languages according to different principles (Frost and Grainger, 2000). As mentioned above, Indo-European languages, such as English or Spanish, have concatenated morphological systems in which morphologically complex words (e.g. *unhappy*, *darker*) are typically formed by concatenating morphological units in a linear manner. Prefixes (e.g. *un-*) or suffixes (e.g. *-er*) are added to base morphemes (e.g. *happy*, *dark*), which in most cases constitute word forms in their own right.

In contrast, Semitic languages, such as Hebrew and Arabic, have a non-concatenated morphological system, in which tri-consonantal root morphemes, which convey the core meaning of the word, and phonological word-pattern morphemes, which convey word class information, are superimposed upon each other in a non-linear manner. In Hebrew, for example, the root R.K.D, whose core semantic meaning includes things having to do with 'dance', and the word-pattern h_ _ _h (/haCCaCa/), are combined together to yield the word hRKDh (/harkada/) 'dancing'. Similarly, in Arabic, the root K.R.M, whose core semantic meaning includes things having to do with 'respect', is embedded in the word-pattern t_ _ee_ (/taCCeeC/) to create the word tKReeM (/takreem/) 'honoring' (Eviatar and Ibrahim, 2009). In such a system, most word forms are morphologically complex, as neither roots nor word-patterns can stand alone as an independent word. Note that the core morphological system in Hebrew is a non-linear one; however, morphologically simple non-Semitic borrowed words as well as linear morphology of prefixes and suffixes and of compound words also exist in Hebrew.

Cross-linguistic studies suggest that the morphological structure of a language modulates the way it is processed (Bick et al., 2011). In Indo-European languages, the base form is an independent word form with minimal internal structure. As a result, readers implement lexical mechanisms that are tuned to the word's linear orthographic structure (Forster, 1999), and are relatively insensitive to the internal ordering of letters within the word. This insensitivity to the internal structure of the word is evident in the so-called Transposed Letter (TL) effect, in which transposed-letter non-words (e.g. *anwser*) are misrecognized and misread as their base-word (e.g. *answer*). The TL effect was demonstrated across different Indo-European languages using different experimental procedures (Perea and Lupker, 2003; Schoonbaert and Grainger, 2004). By manipulating the transposed-letter position within words, it has been demonstrated that edge letters (the initial and final letters in a word) have a special status, and their position in the word is critical for lexical access and word recognition (Fischer-Baum et al., 2011; Perea and Lupker, 2003).

By contrast, base forms in Semitic languages, like Hebrew, are highly structured, having both a root morpheme and a word-pattern morpheme. As a result, readers of Semitic languages implement lexical processing mechanisms that are highly tuned to the word's internal structure. This sensitivity to the word's internal structure is reflected by the fact that Hebrew and Arabic readers do not demonstrate the TL effect (Perea et al., 2010; Velan and Frost, 2007, 2009, 2011).

Further evidence for the differences between the Semitic and the Indo-European mental lexicons comes from a series of experiments in which a robust form-orthographic priming effect was found in English (e.g. motel–model), but only a morphological root-priming effect was found in Hebrew (e.g. ריקוד - הרקדה, hRKDh–RiKuD, dancing–dance) and in Arabic (Frost et al., 2005).

Together, these findings suggest that in Indo-European languages visual word processing is sensitive to the linear orthographic structure of the word, where readers extract base forms that are morphologically simple. As a result, apart from the initial and the final letters that mark the boundaries of the word, readers are less sensitive to the order of the letters within the word. This process contrasts with that found in Semitic languages, where readers extract the root morpheme during the early stages of word recognition (Velan et al., 2013). Morphological decomposition into root and word-pattern morphemes is therefore a key aspect of proficient reading in Semitic languages (Bar-On and Ravid, 2011; Frost, 2012).

3 Morphological processing in second language (L2) visual word recognition

The present study capitalizes on these morphological differences between Indo-European and Semitic languages, to ask whether and how lexical mechanisms, which are tuned to the morphological structure of the first language (L1), modulate visual word recognition in early stages of second language (L2) learning. Is it generally the case that L2 reading is shaped solely by L2 morphological characteristics, or do L1's characteristics carry-over to modulate these L2 reading processes? In an fMRI study, Bick et al. (2011) found that processing of morphological information in the bilingual brain is modulated by language-specific structural properties, because within the same Hebrew–English bilinguals, semantic information modulated the activation of morphological neural correlates (areas in the brain recruited while processing morphological information) in English but not in Hebrew (Bick et al., 2011). This evidence is in line with the Script Dependence Hypothesis (Geva and Siegel, 2000), which suggests that the acquisition of reading skills in L2 is language dependent and is influenced by L2's linguistic characteristics.

Conversely, other evidence suggests that the neural network of L1 reading, which is modulated by the L1 orthographic system, determines the recruited neural network for L2 reading (Tan et al., 2003). For example, in an fMRI study, Tan et al. (2003) found that Chinese–English bilinguals apply their L1 reading strategies of Chinese characters, whose phonology is defined at the monosyllabic level, to L2 reading of alphabetic English words, whose phonology is defined at the phonemic level by letter-to-sound conversion rules. In this study, bilinguals recruited the same neural network while phonologically processing alphabetic written words in English (L2) and while processing Chinese characters (L1).

According to the Linguistic and Orthographic Proximity Hypothesis (Kahn Horwitz et al., 2011), specific characteristics of L1's linguistic and orthographic structure affect L2 literacy acquisition, due to cross-linguistic transfer. Thus, shared linguistic knowledge between L1 and L2 will facilitate L2 literacy acquisition. In contrast, when the new writing system requires additional procedures, accommodation is required (Perfetti et al., 2007). For example, there is evidence that during L2 reading learners of Chinese whose L1 is English recruit additional neural resources that are not recruited during L1 reading (Nelson et al., 2009).

Previous research demonstrated differences in L1 visual word recognition processes between Indo-European and Semitic languages due to different morphological structure (Frost et al., 2005; Velan and Frost, 2011) and explored the nature of morphological

Table 1. Condition structure.

Condition	Familiar root	Non-existent root
Familiar word-pattern	+R+P	–R+P
Non-existent word-pattern	+R–P	–R–P

processing during visual word recognition in L2 (Dipendaele et al., 2011; Silva and Clahsen, 2008). Critically, studies to date have mainly focused on L2 reading strategies among relatively proficient bilinguals. The current study extends the investigation to examine L1 transfer of word recognition strategies in the early stages of L2 learning. Specifically, it examines whether L1's visual word recognition processes, which are modulated by L1's morphological properties, affect visual word recognition strategies in L2, during the early stages of L2 acquisition.

II The present study

Differences between beginning L2 learners of Hebrew as a function of their L1 background are predicted if one assumes that readers carry over word processing strategies from L1 to L2 (Tan et al., 2003). As mentioned above, L1-Semitic learners are tuned to non-concatenated morphological principles, and are therefore expected to attempt to decompose an unfamiliar Hebrew (Semitic) word into its root and word-pattern morpheme. In contrast, L1-Indo-European learners are sensitive to the overall word form with special sensitivity to the word's edges. These learners are therefore expected to be less sensitive to the internal Semitic word structure. In particular, because in most cases Semitic Hebrew words begin and end with pattern letters, L1-Indo-European learners are expected to be more sensitive to the word-pattern morpheme of unfamiliar Hebrew words, often including the word's initial and final letters, than to the root morpheme, often including only internal letters.

To examine these issues, beginning Hebrew learners were asked to make a graded lexical decision task on Hebrew letter strings that were unfamiliar to them (half real words and half non-words). Critically, letter strings were manipulated to include or exclude familiar root (R) and word-pattern (P) morphemes. Specifically, although learners were unfamiliar with the letter string as a whole, in all cases, they could be familiar with one or both of its constituent morphemes. As shown in Table 1, orthogonally crossing the two factors resulted in four item types. In the +R+P condition, learners were familiar with both the root and the word-pattern, but were not familiar with the word that resulted from intertwining the two known morphemes. In the +R–P condition, the letter string was a non-word that included a familiar root combined with a non-existent word-pattern. In the –R+P condition, the letter string was a non-word that included a familiar word-pattern combined with a non-existent root. Finally, the –R–P condition consisted of non-Semitic, morphologically simple, unfamiliar, borrowed words, which do not include a root or a word-pattern.

Due to the similar morphological word structure in all Semitic languages and to the existing evidence indicating a crucial role for the root morpheme during lexical access in both Hebrew and Arabic, we expect L1-Semitic learners to recognize and activate knowledge regarding familiar root morphemes when processing unfamiliar Hebrew letter strings. Due to the existence of linear morphology of affixes in Indo-European languages and the existence of word-pattern morphemes in Arabic, we expect both types of Hebrew learners to recognize and activate knowledge regarding familiar affixes when processing unfamiliar letter strings, and thus show sensitivity to the word-pattern morpheme. As is characteristic of Hebrew in general, the vast majority (13/15) of the word-patterns that were used in the experimental stimuli included the initial and final letters of the letter string. Therefore, we hypothesize that L1-Indo-European learners, which are especially sensitive to words' boundaries in L1, will be more sensitive to words' boundaries in L2-Hebrew, and thus will be influenced by a familiar word-pattern, which includes prefixes and/or suffixes, within unfamiliar Hebrew letter strings.

III Method

1 Participants

Participants were 40 Hebrew learners (age 18–41, 23 females), enrolled in beginner level intensive Hebrew courses in Israel. All participants were high school graduates and above, and were divided into two groups according to their L1 background. The *L1-Indo-European* group included 20 participants (ages 18–41, 11 females) whose L1 was an Indo-European language (12 native speakers of English, 3 native speakers of Spanish, 2 native speakers of French, 2 native speakers of Danish, and 1 native speaker of German), with no previous knowledge of Semitic languages. They were all foreign students who came to Israel to learn Hebrew during a seven-week summer course at Tel-Aviv University. The *L1-Semitic* group consisted of 20 participants (ages 18–35, 12 females) whose L1 was a Semitic-language (Arabic). These participants were Arabs living in the Arab villages of East-Jerusalem and participating in an eight-month intensive Hebrew course at the Hebrew University of Jerusalem. Despite their geographical proximity to Hebrew speakers, they all lived in an Arab environment, where life is conducted completely and exclusively in Arabic, and they did not formally learn Hebrew at school.

Importantly, learners in both L1 groups rated themselves as having minimal and insignificant knowledge of Hebrew, and were placed in the beginner level Hebrew class. However, both L1 groups may have had a certain amount of minimal exposure to Hebrew. Indo-European participants, who were mostly Jewish, may have had limited exposure to biblical Hebrew or cultural link to Hebrew speakers. Arabic participants may have had limited exposure to spoken Hebrew because they live in proximity to Hebrew speakers.

At the time of testing, participants from both groups had been learning Hebrew for six weeks, five days a week, five hours a day, using the same textbook. Thus, learners from both L1 groups were predicted to have had similar exposure to Hebrew vocabulary in general, and to Hebrew orthography and grammar instruction in particular.

Because we were interested in examining morphological processing during visual word recognition, it was mainly important to make sure that participants could orthographically recognize letters and written words, and activate their corresponding semantic representations. To verify this knowledge, participants completed a written vocabulary test at the end of the experiment. Note that it could be the case that participants had only partial phonological knowledge regarding these words due to the non-pointed writing system in Hebrew. However, the critical dimension is participants' orthographic–lexical knowledge which was tested via the vocabulary post-test. Reported participants had 4 mistakes or less on this vocabulary post-test.[1]

2 Stimuli

Stimuli consisted of 60 Hebrew letter strings (written in the non-pointed script system, which conveys only partial phonological information regarding the word's vowels). All items were 4–6 letters ($M = 5.2$ in each condition). Four different conditions with 15 letter strings each were created by orthogonally manipulating the existence or absence of a familiar root or a familiar word-pattern in the unfamiliar letter string. The +R+P condition consisted of unfamiliar real words with Semitic structure, constructed of a familiar root and a familiar word-pattern. The +R–P condition consisted of non-word letter strings constructed of a familiar root and a non-existent word-pattern. The –R+P condition consisted of non-word letter strings constructed of a familiar word-pattern and a non-existent root. Finally, the –R–P condition consisted of unfamiliar borrowed words that did not consist of any root or word-pattern. Note that all critical stimuli were non-cognates between Arabic and Hebrew and did not share any root or word-pattern, in order to prevent direct lexical or morphological transfer.

Familiarity with the relevant Hebrew morphemes (roots and word-patterns) composing the critical letter strings was confirmed using the vocabulary post-test. Specifically, rather than testing their explicit knowledge of these morphemes as independent constituents, we verified that learners have had the opportunity to implicitly acquire these morphemes based on their familiarity and knowledge of words containing these morphemes. Items including unknown morphemes, which were embedded in unknown words in the post-test, were excluded on a participant-by-participant basis (7% of the data). Example stimuli are presented in Table 2.

3 Procedure

Participants completed an off-line questionnaire in which they rated all 60 items on a six-level word certainty rating scale (for example, see Table 3). In this task, they were to decide whether each letter string was a real word in Hebrew or not according to their level of certainty, such that 1 indicated they were certain it is not a real word, and 6 indicated they were certain it was a real word in Hebrew. If they decided it was not a real word, they were to choose 1–3 on the scale based on their certainty level, whereas if they decided the letter string was a real word in Hebrew they were to choose 4–6 on the scale according to their level of certainty. Importantly, to prevent ratings based on lexical word knowledge participants were instructed specifically to skip items they recognized as familiar words with known meanings. These items were excluded as missing data in the analysis (less than 2% of the data). Order of strings was initially randomized across conditions, and then presented in a fixed order for all learners. Instructions were presented in English to the Indo-European group and in Arabic to the Semitic group.

Table 2. Example stimuli.

Condition	+R +P unfamiliar Semitic words	+R–P Non-word	–R+P Non-word	–R–P Unfamiliar non-Semitic (borrowed) words
Hebrew	מאהבת	אהבדע	מאהשת	צפרדע
Phonological transliteration	/meahevet/	–	–	/t͡sfarde/
Orthographic transliteration	mʔHVt	ʔHVdʕ*	mʔHʃt*	CFRDʔ**
Familiar root	ʔ.H.V	ʔ.H.V	–	–
Familiar word pattern	m__ __ __t	–	m__ __ __ t	–
Meaning	lover	–	–	frog

Notes. * non-existent morphemes (_ _ _dʕ; ʔ.H.ʃ); ** morphologically simple (borrowed) Hebrew words.

Table 3. Example of the six-level word certainty rating scale.

Not a word			Real word			Letter strings	
1	2	3	4	5	6		
1	2	3	4	5	6	מאהבת	1
1	2	3	4	5	6	אהבדע	2
1	2	3	4	5	6	מאהשת	3
1	2	3	4	5	6	צפרדע	4

Following the rating scale, participants completed the vocabulary post-test. In this task they were presented with 15 verbs derived from the critical roots included in the main experiment, and 10 nouns consisting of the critical word-patterns, and were asked to circle one of four pictures depicting the correct meaning of the word. Note that we did not directly examine familiarity with the morphemes as independent constituents. Instead, we deduce that the participants have been exposed to them by testing their knowledge of vocabulary that uses these same morphemes. This was done to verify that they have had the opportunity to learn these morphemes implicitly in the past.

IV Results

Analyses were conducted on a categorical yes/no measure derived from the continuous word certainty rating scale, such that ratings of 1–3 were treated as non-words and ratings of 4–6 were treated as real words. The pattern of results remained unchanged, however, when the full scale was used. For the analysis by participants (reported as F_1), the proportion of real word responses was computed for each participant in each condition and subjected to a repeated measures ANOVA with two fully-crossed within-participant factors of *Root Familiarity* (+R vs. –R) and *Pattern Familiarity* (+P vs. –P) and *Language*

Background (L1-Indo-European vs. L1-Semitc) as a between-participant factor. Conversely, for the analysis by items (reported as F_2), the proportion of real word responses was computed for each item in each language background, such that *Language Background* was treated as a within-item factor and *Root Familiarity* and *Pattern Familiarity* were treated as between-item factors.

The results show a significant main effect of language background by items only, $F_1(1,38) = 2.552$, $MSE = .073$, $p = .118$, $\eta p^2 = 0.63$; $F_2(1,54) = 9.082$, $MSE = 0.014$, $p = 0.004$, $\eta p^2 = .144$. The effect of root familiarity was significant, $F_1(1,38) = 20.356$, $MSE = 0.016$, $p < 0.001$, $\eta p^2 = .349$; $F_2(1,54) = 5.582$, $MSE = .042$, $p = 0.022$, $\eta p^2 = .094$, as was the effect of pattern familiarity, $F_1(1,38) = 55.849$, $MSE = 0.023$, $p < 0.001$, $\eta p^2 = .595$; $F_2(1,54) = 19.101$, $MSE = .042$, $p < 0.001$, $\eta p^2 = .261$. The two-way interaction between root familiarity and pattern familiarity was significant, $F_1(1,38) = 16.274$, $MSE = 0.019$, $p < 0.001$, $\eta p^2 = .300$; $F_2(1,54) = 4.586$, $MSE = .042$, $p = 0.037$, $\eta p^2 = .078$. The two-way interactions between root familiarity and language background as well as between pattern familiarity and language background were not significant, $F_1(1,38) = 3.251$, $MSE = .016$, $p = .079$, $\eta p^2 = 0.079$; $F_2(1,54) = 2.679$, $MSE = 0.014$, $p = .107$, $\eta p^2 = .047$ and $F_1(1,38) = 1.057$, $MSE = .023$, $p = .310$, $\eta p^2 = 0.27$; $F_2(1,54) = 1.595$, $MSE = 0.014$, $p = .212$, $\eta p^2 = .029$. Critically, however, the three-way interaction among language background, root familiarity and pattern familiarity was significant, $F_1(1,38) = 13.469$, $MSE = .019$, $p = 0.001$, $\eta p^2 = .262$; $F_2(1,54) = 13.698$, $MSE = .014$, $p = .001$, $\eta p^2 = .202$ (see Figure 1). This suggests that the two groups were differentially affected by root and pattern familiarities.

To examine the source of this interaction, we examined the effects of root familiarity and pattern familiarity for each L1 group separately. For the L1-Indo-European group, there was a significant effect of root familiarity by participants only, $F_1(1,19) = 4.417$, $MSE = .013$, $p = .049$, $\eta p^2 = .189$; $F_2(1,57) = 1.363$, $MSE = .032$, $p = .248$, $\eta p^2 = .025$, but a significant effect of pattern familiarity, $F_1(1,19) = 17.439$, $MSE = .027$, $p = .001$, $\eta p^2 = .479$; $F_2(1,57) = 8.845$, $MSE = .032$, $p = .004$, $\eta p^2 = .141$, and no interaction between them, $F_1 < 1$; $F_2 < 1$. Indeed, planned paired *t*-tests show that all conditions differed from each other, $p < .05$, except for the +R+P and –R+P conditions ($p = .138$) and the +R–P and –R–P conditions ($p = .302$); for details, see Table 4. This indicates that for L1-Indo-European participants the presence of a familiar pattern led to a word response irrespective of root familiarity, and conversely that the absence of a familiar pattern led to a non-word response irrespective of root familiarity. For the L1-Semitic group, there was a significant effect of root familiarity, $F_1(1,19) = 17.050$, $MSE = .019$, $p = .001$, $\eta p^2 = .473$; $F_2(1,57) = 9.557$, $MSE = .024$, $p = .003$, $\eta p^2 = .150$, and a significant effect of pattern familiarity, $F_1(1,19) = 44.668$, $MSE = .018$, $p < .001$, $\eta p^2 = .702$; $F_2(1,57) = 22.838$, $MSE = .024$, $p < .001$, $\eta p^2 = .297$. Interestingly, there was a significant interaction between root familiarity and pattern familiarity for this group, $F_1(1,19) = 34.702$, $MSE = .016$, $p < .001$, $\eta p^2 = .646$; $F_2(1,57) = 15.868$, $MSE = .024$, $p < .001$, $\eta p^2 = .227$. Planned paired *t*-tests show that all conditions differed from each other, $p < .05$, except for the –R+P and –R–P condition ($p = .207$) and the +R–P and the –R–P conditions ($p = .389$). This finding indicates that for L1-Semitic learners only the joint presence of a familiar root and a familiar pattern led to a word response. In the absence of a familiar root, a non-word response was given irrespective of pattern familiarity and, conversely, in the absence of a familiar pattern, a non-word response was given irrespective of root

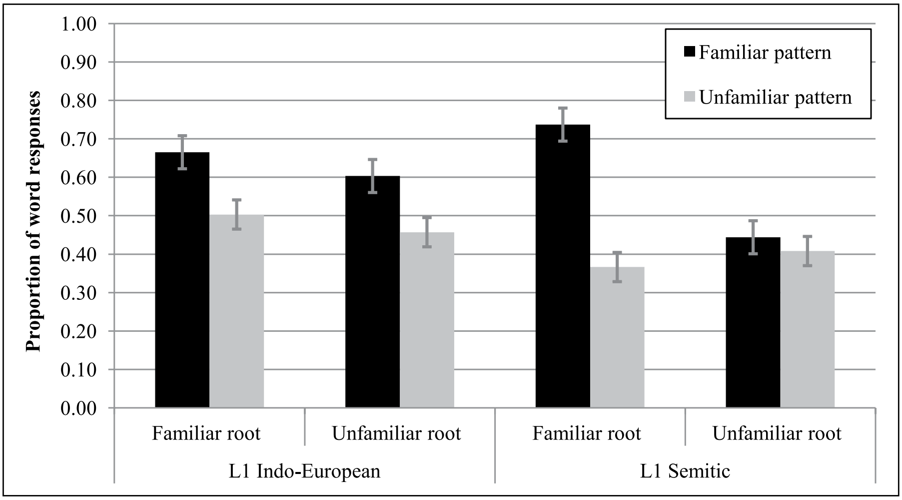

Figure 1. Proportion of word responses as a function of language background and root and pattern familiarities.
Note. Error bars reflect standard errors.

Table 4. Proportion of word responses in each condition by language background.

	Condition			
	+R+P	+R–P	–R+P	–R–P
L1-Indo-European	$.67\ (.17)_a$	$.50\ (.16)_b$	$.60\ (.14)_a$	$.46\ (.19)_b$
L1-Semitic	$.74\ (.21)_a$	$.37\ (.16)_b$	$.44\ (2.3)_c$	$.41\ (.17)_{b,c}$

Note. Means in the same row that do not share an alphabetic subscript differ at the $p < .05$ level based on planned paired t-tests between conditions. Standard deviations (SDs) are shown in parentheses.

familiarity. These learners seek a combination of familiar root and a familiar pattern for a word response.

V General discussion

The present study explored morphological sensitivity among early learners of Hebrew who differ in their L1 background. According to the Script Dependence Hypothesis (Geva and Siegel, 2000), the acquisition of reading skills in L2 is language dependent and is influenced by L2's characteristics. Conversely, according to the Linguistic and Orthographic Proximity Hypothesis (Kahn Horwitz et al., 2011), specific characteristics of L1's linguistic structure affect L2 literacy acquisition, due to cross-linguistic transfer. In accordance with the latter proposal we show that, at least in the early stages of learning, reading processes in a second language (Semitic) are modulated by first-language morphological background (Semitic or Indo-European). In particular, the influence of familiar root and familiar word-pattern morphemes intertwined within unfamiliar Hebrew letter strings was examined using a graded lexical decision task. As predicted by the Linguistic and Orthographic Proximity Hypothesis (Kahn Horwitz et al., 2011), the presence or absence of familiar Hebrew morphemes differentially affected lexical decisions for the two groups of learners.

Specifically, L1-Indo-European beginning learners showed increased sensitivity to the word-pattern, such that a familiar word-pattern led to a word-response and an unfamiliar word-pattern led to a non-word response, irrespective of root familiarity. This increased sensitivity to the overall orthographic contour of the word, conveyed by the Hebrew word-patterns, is consistent with learners' L1 morphological strategies. Because Indo-European languages use concatenated morphology, readers of these languages put an emphasis on word's edges and are less sensitive to the internal structure and the order of letters within the word (Perea and Lupker, 2003). Accordingly, L1-Indo-European learners were less affected by the presence or absence of a familiar root morpheme when judging the lexicality of unfamiliar letter strings in Hebrew.

L1-Semitic learners, in contrast, showed increased non-additive sensitivity to both root and word-pattern morphemes such that they indicated a letter string was a real word only when both the root morpheme and the word-pattern morpheme were familiar (+R+P). If however, they recognized a root morpheme without a familiar word-pattern (+R–P) or a word-pattern without a familiar root (–R+P), they were less likely to judge the letter string as a real word. This is probably because their experience with a Semitic language has taught them that a root must be accompanied by a word-pattern, as these morphemes typically do not stand alone in Semitic languages. The high sensitivity of L1-Semitic learners to the joint presence of the two morphemes indicates that they employ a decomposition strategy, breaking down an unfamiliar letter string into its root and word-pattern morphemes, as is characteristic of proficient reading in Semitic languages (Frost, 2012). Thus, as other cross-linguistic transfer studies have previously demonstrated (Miller, 2011; Pasquarella et al., 2011; Schiff and Calif, 2007; Wang et al., 2003; Zhang, 2013), the results of the present study suggest that L1 transfer of visual word recognition strategies occurs during L2 reading. Moreover, it suggests that reading processes in L2, at least at the early stages of learning, are modulated by L1 morphological background.

Notably, although both the root morpheme and the word-pattern morpheme significantly affected L1-Semitic learners' performance, their effect seems to be different. Specifically, because there are more potential roots than word-pattern in Hebrew (Frost et al., 2013) learners are likely to trust their knowledge and familiarity of word-patterns more than their knowledge of roots. Consequently, when they recognize a familiar root they expect to recognize a familiar word-pattern. If they do, they are relatively certain the letter string is a real word (M = 0.74 word responses), and if they do not recognize a familiar word-pattern, they are relatively certain the letter string is not a real word (M = .37 word responses). In contrast, when they recognize a familiar word-pattern, they are uncertain that the unfamiliar root does not exist, and are thus closer to chance level responses (M = .44 word responses).

The distributional properties of roots vs. word-patterns in Hebrew can also explain why the word-pattern morpheme is more salient, and is picked up in the early stages of learning even by learners with non-Semitic L1. Sensitivity to the root morpheme in Hebrew is likely to develop with proficiency (for individual differences in this process, see Frost et al., 2013), such that even L1-non-Semitic learners will eventually develop morphological decomposition strategies that are essential for proficient reading in Semitic languages (Frost, 2012).

These results clearly demonstrate transfer of L1 word recognition processes during the initial stages of L2 learning. Nonetheless, one may suggest that other linguistic or non-linguistic differences between our two groups of participants have contributed to these results. For example, it could be the case that one of the groups had more experience with Hebrew (or more exposure to Hebrew), and therefore was more sensitive to the root and word-pattern structure than the other group. Nevertheless, we believe that the different behavioral patterns obtained for the two groups derive mainly from fundamental morphological differences between these two types of L1s (Semitic vs. Indo-European). First, although exposure to spoken Hebrew was not explicitly measured, we estimate that both groups have had similar experience with Hebrew (all participants rated themselves as having minimal and insignificant knowledge in Hebrew, and were all placed in the beginner level Hebrew class). Second, given the nature of the stimuli (all unfamiliar letter strings) and the nature of the task (a simple lexical decision task), it is unlikely that non-linguistic differences (e.g. non-verbal intelligence), if they existed, could explain the subtle morphological differences mentioned above.

To conclude, the present study demonstrates differences between word recognition strategies in Semitic languages vs. Indo-European languages as reflected when reading an L2. Specifically, our results are in line with previous studies demonstrating increased sensitivity of Indo-European readers to words' edges and of Semitic readers to the internal structure of the word. Further, our findings show that at least in the early stages of learning, reading processes in L2 (Semitic) are modulated by L1 morphological background (Semitic or Indo-European). The challenge for further studies is to investigate whether these L1 morphological strategies continue to play a role as proficiency in the L2 increases.

Declaration of conflicting interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

During the writing of this manuscript, TD was supported by EU-FP7 grant CIG-322016.

Note

1. An additional 35 L1-Indo-European participants and 28 L1-Semitic participants were excluded from the analysis because they had more than 4 mistakes on the post-test, or because they skipped 4 or more items on the questionnaire (either inadvertently or because they were familiar with the word). To equate the number of participants in the two groups, 35 additional L1-Semitic participants were excluded.

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