Phonological "Roots": Consonant priming in auditory presentation in Hebrew, without semantic and orthographic effects

Si Berrebi

August 6, 2016

Introduction. Languages with non-concatenative morphology (Hebrew included) were claimed to include Roots in their lexicon. On the other hand, lexicalist theories argue that in all languages, words or stems are the basic formatives. Previous psycholinguistic experiments have supported the Root hypothesis, showing that in visual presentation, consonant graphemes of a word in Hebrew facilitate targets sharing these consonant graphemes, whether the prime constitutes a word or not, and with semantic relations playing only a limited role (Frost et al. 1997 and onward). However, previous work has not taken into account the perceptual consonant-bias of languages in general (Nespor et al., 2003) and the consonants-bias of the Hebrew writing system in particular. The current work used two (overt) auditory lexical decision tasks to test the influence of phonological, orthographic and semantic similarities using separate conditions, in the auditory modality. The results of experiment 1 present a similar consonant facilitation effect in every condition which included identical stem consonants: words which share meaning and 3 identical graphemes (+Semantics, +Orthography), words which do not share meaning but share all three consonant graphemes (-S,+O), and words which share 2 graphemes or less (-S,-O). Experiment 2, using a longer SOA and primes, again showed a similar pattern in all relation types ([+S,+O], [-S,+O], and [-S,-O]), only this time the effect was for the most part inhibitory. Some subjects, however, still showed a facilitatory effect, as in experiment 1. A correlation analysis revealed that facilitation was highly correlated with the average RT of the subject, such that slow reactions were correlated with a strong inhibitory effect and fast reactions maintained the facilitatory pattern.

Goal. Most psycholinguistic data which were taken to support the root hypothesis were obtained using the visual modality, and furthermore, no experiment (to the best of my knowledge) distinguished between phonological and orthographic representations. Results obtained in the visual modality were attributed to morphology, while they might be due to orthography. Phonology was also not controlled for in an orderly manner. The object of the current work was to effectively tease apart between orthography, phonology and semantics, hoping that some morphological insight could arise from the data.

In Experiment 1 ($N = 48$), critical items were prime-target pairs with one of three possible relations: (i) share all three consonants, but only two graphemes (3 in Table 1); (ii) share all three consonants and all graphemes, but have distant meanings (2 in the table); (iii) share all three consonants and graphemes and have related meanings (1). In the first condition, the third remaining grapheme is of a homophonous consonant, such that the words sound as if they share a root. For example, the words 'ʃataf' *wash* and 'hiʃtatef' *participate* sound as if they share a root, but as evident in the orthographic forms, in one word the consonant *t* is represented by the grapheme ת (in *hiʃtatef* השתתף); and in the other by ט (in *ʃataf* שטף). An example of the second relation is that between the words 'rigel' *spied* and 'hitragel' *got used to*, which share all three stem consonants and all three graphemes (ריגל and התרגל), but have distant meanings (see Table 1 for 2 more examples). The baseline trials included words which were not semantically or phonologically related to targets (no more than 1 consonant in common). In half of the trials, the target was a non-word (compatible

Table 1: Conditions of the Experiment

		Prime			Target		
1.	[+S, +O]	sovev	סובב	'turned trans.'	histovev	הסתובב	'turned *reflexive*'
2.	[-S, +O]	ʃalal	שלל	'negated'	hiʃtolel	השתולל	'gone wild'
3.	[-S, -O]	*nikeʃ*	ניכש	'washed'	*hitnakeʃ*	התנקש	'assasinated'

with the phonology of Hebrew verbs). Primes appeared in a different voice, were compressed to 75% their original length and their volume was lowered by 15 decibels compared with targets. 4 lists were used in a latin square design, such that every participant was exposed to a target word only once (prime-target in one of two orders, or the baseline condition for either word). A significant facilitation effect obtained in all relation types, without interaction between relation type and the size of the effect.

Experiment 2 (*N=32*) aimed to reveal possible later effects of the same primes on their related targets, hoping to find more interactions. The experimental items were the same, only this time primes were not compressed and were presented at the same volume as targets; and the SOA was lengthened by 150ms, to 300 ms. The effect was for the most part inhibitory, with the exception of very fast subjects, who showed the facilitatory pattern of experiment 1.

Conclusion. The results support a model of lexical retrieval in which consonants play a prominent role in auditory lexical retrieval – a result which had previously been obtained for French and English as well (Delle Luche et al., 2014). Comparing Hebrew with French and English is actually quite bold, because as mentioned above, the consonant bias of Hebrew received mostly morphological accounts designed especially for Semitic languages. Following Bat El (1994, 2003), I claim that the facts about Hebrew can be better accounted for within a universal framework of a phonological consonant-oriented lexical storage and retrieval model. The current experiments follow the predictions of such a model, in yielding a similar phonological facilitation effect for words "sharing a root" ((1) and arguable (2) in Table 1) and words "not sharing a root" ((2) and arguably (3) in the Table). In addition, a question arises regarding the access to orthography during auditory word recognition. The current results reveal no orthographic effect whatsoever, in contrast with English, for example, where orthographic effects were observed in auditory tasks (e.g., Ziegler and Ferrand, 2004). These differing results may be a side effect of the tasks, a property of the language or of the writing system. I would like to explore these possibilities but cannot commit to either. Last, the time course of phonologically-based lexical retrieval can benefit from comparing the reversed effects of experiments 1 and 2: facilitatory effects are faster and obligatory, while inhibition effects occur later and might be context-dependent.

References Bat-El, O. 1994. Stem Modification and Cluster Transfer in Modern Hebrew. Natural Language and Natural Linguistic Theory 12:ʃ571–96.

Bat-El, O. 2003. Semitic verb structure within a universal perspective. J. Shimron, ed., Language Processing and Acquisition in Languages of Semitic, Root-based, Morphology. John Benjamins: Amsterdam/Philadelphia, 29-59.

Delle Luche, C., Poltrock, S., Goslin, J., New, B., Floccia, C., & Nazzi, T. (2014). Differential processing of consonants and vowels in the auditory modality: A cross-linguistic study. Journal of Memory and Language, 72, 1–15.

Frost, R., Deutsch, A., Gilboa O., Tannenbaum M. & Marslen-Wilson, W. 2000. Morphological priming: Dissociation of phonological, semantic, and morphological factors. Memory & Cognition 2000, 28 (8), 1277- 1288.

Nespor, M., Pena, M. & Mehler, Jacques. 2003. On the different roles of vowels and consonants in speech processing and language acquisition. Lingue e linguaggio 2.2: 203-230.

Ziegler, J. C., Ferrand, L., & Montant, M. 2004. Visual phonology: The effects of orthographic consistency on different auditory word recognition tasks. Memory & Cognition, 32, 732-741.