Morphological activation during spoken word recognition: beyond sound and meaning?
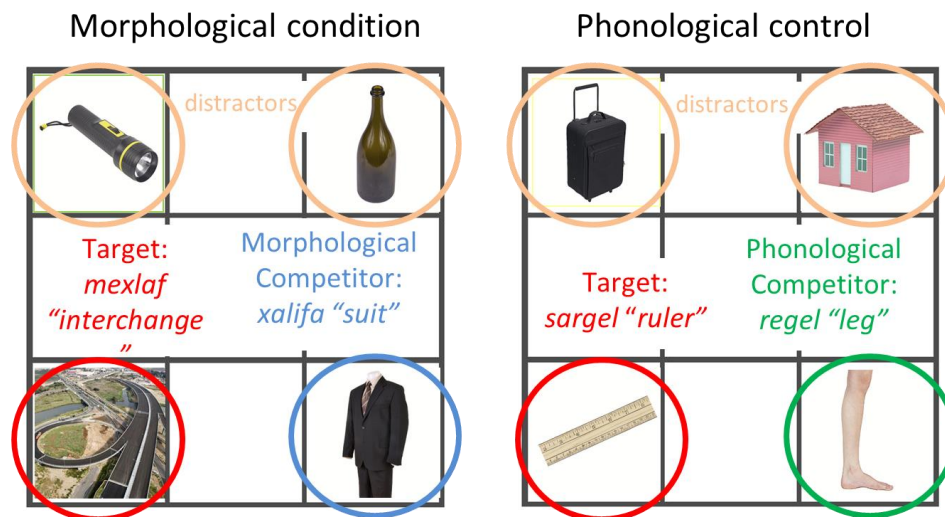
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Introduction. The lexicon of Semitic languages has received much attention because of the nature of morphemes in these languages. Unlike Indo-European languages where morphemes are concatenated, in language like Arabic and Hebrew, (most) words are constructed by *interweaving* a consonantal root (e.g., *x,l,f*) into the vocalic pattern (e.g., *meXXaX*, yielding *me**x**la**f*** "interchange"). In theoretical linguistics, some have argued that the lexicon consists of consonantal roots and vocalic patterns, and these two types of morphemes combine to form words (e.g., McCarthy 1979, 1981), while other argue that the lexicon only lists whole words (e.g., Bat-El 1994, 2003; Ussishkin 1999, 2005). Here we investigate the status of consonantal roots experimentally, by examining their status during lexical access; specifically, during *spoken word recognition*.

Background. There has been extensive research using *written* words, and this research has provided much evidence about the activation of consonantal roots during lexical access. The methodology used in these experiment is priming: participants see a written word briefly (the "prime") and then have to respond to a second word (the "target") either with lexical decision (i.e., determining if it is a word; filler items include non-words) or naming (i.e., reading it out loud). When the target shared the same root as the prime, both lexical decision and naming were facilitated, as compared with priming with a control word that shared three letters that were not the root (e.g., Frost et al., 1997 for Hebrew; Boudala & Marslen-Wilson 2005 for Arabic). Importantly, root priming was observed even when the semantic relationship between the morphologically-related words was opaque. We note that the effect observed with written words could potentially arise from the consonantal nature of the writing systems in Semitic languages, where consonant information is highly salient because most vowels are not orthographically marked.

The current study. To examine the status of roots during spoken word recognition, we conducted two visual world eye-tracking paradigm experiments in Hebrew. On each trial, participants saw an array of four pictures and heard a single word. Participants were instructed to click on the picture that corresponded to the spoken word and their eye movements to the four pictures were recorded. Critical trials contained the target picture (red), a competitor picture that was related to the target (blue or green), and two distractor pictures (orange) that were unrelated in sound or meaning.

Morphological condition

Phonological control

distractors

Target: *mexlaf* "interchange"

Morphological Competitor: *xalifa* "suit"

distractors

Target: *sargel* "ruler"

Phonological Competitor: *regel* "leg"

Experiment 1 (n=16) examined morphological activation using displays where a "morphological competitor" shared the root with the target word, but the semantic relationship between them was opaque (e.g. target: *me**xlaf*** "highway interchange", competitor: ***xal**ifa* "suit"). As a baseline for activation that is due to sound-based similarity, we used displays where a "phonological competitor" shared three consonants with the target, but these consonants were not the root of the target (e.g. target: *sa**rgel*** "ruler", competitor: ***regel*** "leg"). In both conditions, target and competitor pairs did not have overlapping initial sounds and did not rhyme (the Hebrew lexicon forced a between-item design). Results showed that during the processing of the whole word, a morphological competitor – but not a phonological competitor – received more visual attention than the unrelated distractors, potentially suggesting that morphological activation goes beyond effects based on sound similarity.

However, when we conducted a post-hoc rating experiment (n=34) where participants were presented with pairs of written words (target + competitor), and were asked to rate them for semantic relatedness, we found that the morphologically-related pairs were rated as significantly more related than the phonologically-related pairs (2.76 vs. 1.72 on a five-point scale), even though both were rated low on the scale.

Experiment 2 (n=20) aimed to examine whether the morphological effect will be retained when morphological and phonological pairs are equated on semantic relatedness. We first conducted a (second) rating experiment (n=41), which allowed us to choose pairs of words that were judged similarly for semantic relatedness (morphological condition: 1.68; phonological condition: 1.49).

When we used these newly normed pairs in the visual-world eye tracking experiment, we did not find a difference between the phonological and the morphological conditions. That is, in this case the morphological competition effect was not observed.

Conclusions. Taken together, these results raise the question of whether morphological activation exists independently from the activation that is due to sound and meaning similarity (see e.g., Gonnerman & Seidenberg, 2000). Given the contrast between these results in spoken word recognition and the well-established morphological effects in the visual modality, this raises the question of whether the linear unfolding nature of spoken words shift the importance of morphological information during lexical access.

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