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Solely soles: Inter-lemma competition in inflected word recognition

Joe Xu, Marcus Taft *

School of Psychology, University of New South Wales, Australia

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ABSTRACT

It was found that the unmasked presentation of a complex form that corresponded to only one definition of a homograph (e.g., *solely*, which is related to the 'alone' meaning of *soles*) did not inhibit the subsequent recognition of a complex form that was related to the competing meaning (e.g., *SOLES*, which is related to the 'shoe' meaning). Further studies found that inhibitory priming only emerged when the unmasked prime was related to the subordinate meaning of the homograph (e.g., *fined*) and the target to the dominant meaning (e.g., *FINEST*), but not when the prime was dominant (e.g., *longer*) and the target subordinate (e.g., *LONGING*). These findings suggest that the relative dominance of the prime-target pair dictates whether inhibitory priming occurs. Implications for frameworks of morphological processing are discussed.

Introduction

One of the key questions in the domain of visual word recognition is how morphological structure is captured in the lexical processing system. Studies using the unmasked visual priming paradigm (e.g., Feldman & Soltano, 1999; Marslen-Wilson, Tyler, Waksler, & Older, 1994) have found that genuinely suffixed words (i.e., semantically transparent words such as *hunter*) facilitate the recognition of their stems (i.e., *hunt*), whereas pseudo-suffixed words (i.e., semantically opaque words such as *corner*) do not prime their pseudo-stem (i.e., *corn*). This has led to the assertion that morphological decomposition (i.e., the process in which a complex word activates the representations of its constituents) is semantically driven, where a complex word will only be decomposed if it is semantically transparent. Later studies (e.g., Longtin, Segui, & Halle, 2003; Rastle, Davis, & New, 2004), however, have demonstrated a priming effect for both transparent and opaque words when the prime is masked from consciousness, which cannot be attributed merely to orthographic overlap given that words that have no apparent suffix produce no priming (e.g., *turnip-TURN*[1]).

Based on these findings, many researchers (e.g., Diependaele, Sandra, & Grainger, 2009; Rastle & Davis, 2008; Rastle et al., 2004; Taft, 2006; Taft & Nguyen-Hoan, 2010) have adopted a two-stage perspective on morphological processing. During the early stage of recognition, there is the form-driven "morpho-orthographic" processing, which will decompose a letter-string as long as it is morphologically complex in its appearance. This is followed by "morpho-semantic" processing which will only treat a word as morphologically complex if it is semantically transparent.

Feldman, O'Connor, and del Prado Martín (2009) argue against the existence of early morpho-orthographic processing on the grounds that they find no opaque masked

* Corresponding author. Address: School of Psychology, University of New South Wales, Sydney, NSW 2052, Australia. Fax: +61 2 93853641.
E-mail address: m.taft@unsw.edu.au (M. Taft).

[1] As a convention, an in accordance with the way items are presented in experiments, primes will be illustrated in lower case and their targets in upper-case.

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priming in their experiment. However, that result appears to be an anomaly because so many other studies have found such priming (including Feldman, Kostic, Gvozdenovic, O'Connor, & del Prado Martín, 2012). While it might be true that the effect for opaque primes is weaker than that for transparent primes (as argued by Feldman et al., 2009, though see Rastle & Merkx, 2011), this does not preclude the existence of morpho-orthographic decomposition followed by a modulating semantic influence (e.g., Taft & Nguyen-Hoan, 2010).

There exist several theoretical accounts of morphological processing that incorporate morpho-orthographic processing (e.g., Crepaldi, Rastle, Coltheart, & Nickels, 2010; Diependaele et al., 2009; Taft, 2006; Taft & Nguyen-Hoan, 2010), which are similar in the sense that morphological relationships are defined by how the representations of complex words interact with their constituent morphemes. Whole words and their constituents that support one another (i.e., a transparent word and its stem) may be connected by an excitatory link where the increase of activation in one unit leads to the increase of activation in the connected unit. This means that the activation in the representation of the transparent stem will be retained, which gives rise to facilitatory priming. How then, does the system deal with entries in the lexicon that are morphologically related on the basis of form, but do not share that relationship in terms of meaning? An opaque word and its stem are an example of this. Based on the findings of the masked priming studies (e.g., Longtin et al., 2003; Rastle et al., 2004), the presentation of an opaque word (e.g., *corner*) will activate both of its constituents (i.e., *corn* and *-er*). The system would then need to suppress the activation in the opaque stem *corn* in order to avoid confusion with *corner*.

Another example in which lexical entities could potentially be confused are ambiguous words (i.e., homographs) where there are individual lexical representations corresponding to each meaning. For example, the word *sole* possesses a representation related to the 'shoe' meaning and another related to the 'alone' meaning. If there is morpho-orthographic decomposition when the word *soles* is presented, the units related to both definitions of its stem would be activated, even though only the 'shoe' version is relevant. As such, the activation in the unit associated with the 'alone' meaning must be suppressed so that the appropriate lexical entry (i.e., the one related to 'shoe') would achieve recognition. One way in which the suppression of the stem could be accomplished is by means of an inhibitory mechanism, where the activation in the *sole* unit that is related to 'alone' is actively inhibited by the system (Allen & Badecker, 1999; Taft & Nguyen-Hoan, 2010). The alternative to such active suppression would be for the activation in the inappropriate unit to simply fall to a baseline level (i.e., its activation is not maintained within the system).

Evidence to support a mechanism of active suppression comes from a series of studies by Allen and Badecker (1999, 2002) conducted in Spanish. An inflected word was presented as an unmasked prime corresponding to one meaning of a homograph, followed by an inflected target word that was exclusive to a different meaning of the same homograph. For example, the prime *cerrar* (i.e., 'to close', with the bound stem *cerr-* and the suffix *-ar*) was paired with the target *CERRO* (i.e., 'hill', with the homographic bound stem *cerr-*), and it was found that the response times to the target were longer than when preceded by an unrelated prime *pasear* (i.e., 'to walk'). This inhibitory priming effect suggests that the incompatible prime *cerrar* suppressed the activation in *CERRO*, so that the target had to overcome the inhibition from the competing prime before its level of activation could be raised to the threshold for recognition.

The possibility exists, however, that the inhibitory priming effect for *cerrar-CERRO* could have arisen entirely from overlap in orthography since there is evidence to suggest that unmasked primes inhibit the subsequent recognition of orthographically similar targets (e.g., Colombo, 1986). Allen and Badecker (1999) dismissed this possibility by showing that the magnitude of inhibition from *cerrar* to *CERRO* was greater than that found between orthographically similar prime-target pairs that did not share a stem (e.g., *cerdo-CERRO*, where *cerdo* means 'pig'). Additional experiments using orthographically dissimilar allomorphs of the competing prime (e.g., *cierrar*, 'he closes') also produced an inhibitory priming effect on *CERRO* that was greater in magnitude than an orthographic control (*cierto-CERRO*, where *cierto* means 'certain'). Given that allomorphs do not have sufficient form overlap to elicit inhibition between orthographic units, the authors argued that the inhibitory priming effect cannot be attributed to overlap in orthographic form, but to a level that is sensitive to genuine morphological relationships (i.e., similar to a morpho-semantic stage). The inhibition could not have arisen purely from a semantic level, given that a prime that was semantically associated with the competing stem homograph (e.g., *puerta-cerro*, where *puerta* means 'door' which is related to *cerrar*) did not produce inhibition (Allen & Badecker, 2002). Therefore, the inhibitory priming effects between competing stem homographs were attributed to the competition between lexical representations and not feedback from the semantic level.

An Italian study by Laudanna, Badecker, and Caramazza (1989) obtained similar results using a 'double lexical decision task' in which two letter-strings were presented on screen simultaneously and participants had to decide whether both were real-words or not. It was found that competing letter-strings (i.e., those that corresponded to different meanings of a homograph) showed an inhibitory effect, while pairings that were inflected forms referring to the same homograph showed a facilitatory effect. For example, the response to *portare* ('to carry') and *porte* ('doors') was slower than the response to unrelated word pairs (e.g., *causa* and *ponte*, 'cause' and 'bridge'), while the response to two morphologically related words *voltare* ('to turn') and *voltavo* ('I was turning') was faster than the response to an unrelated word pair.

On the whole, this body of research provides strong evidence in support of an inhibitory mechanism. However, there is a potential issue with the way in which Allen and Badecker (1999) controlled for orthographic overlap between the prime and the target. Orthographic similarity between the incompatible homographs and their orthographically similar primes was controlled by matching the number of letters shared with the target (e.g., *cerrar*, the