



Meaning first: A case for language-independent access to word meaning in the bilingual brain

Shukhan Ng, Nicole Y.Y. Wicha*

University of Texas, San Antonio, TX 78249, United States

ARTICLE INFO

Article history:

Received 29 May 2012

Received in revised form

26 November 2012

Accepted 16 January 2013

Available online 31 January 2013

Keywords:

Bilingual lexical access

Event-related potentials

Language membership

Lexical access

Semantic categorisation

Word frequency

ABSTRACT

This study aimed to determine how deeply a word is processed in the bilingual brain before the word's language membership plays a role in lexical selection. In two ERP experiments, balanced Spanish–English bilinguals read lists of words and pseudowords in Spanish and English, and performed in each language (1) a language-specific lexical decision task, e.g., respond to real words in Spanish, and (2) a language-specific category decision tasks, e.g., respond to Spanish words that refer to a person. In Experiment 1, infrequent words elicited larger negativity between 350 and 650 ms post-stimulus onset for both target and non-target languages. This indicates that language membership did not block lexical access of non-target words, contrary to previous findings. In Experiment 2, we measured the onset of the target-category P300 as a way of determining if words from the non-target language were temporarily treated as targets. When Spanish was the target language, the ERP waveforms diverged early based on semantic category (people versus non-people), indicating that non-target 'English people' words were briefly treated as potential targets. This finding indicates that meaning was accessed prior to using language membership for lexical selection. However, when English was the target language, the waveforms diverged first based on language (Spanish versus English) then semantic category. We argue that the order in which meaning or language membership are accessed may be based on the frequency of use of a bilingual's languages: the more frequently a language is used (English was more frequently used herein), the faster the words are identified as members of the language, and the greater interference it causes when it is not the target language. In brief, these findings make the case for a moment in processing when language membership matters less than meaning.

© 2013 Elsevier Ltd. All rights reserved.

1. Introduction

A man living in Mexico City was at a full-service gas station with his family. When the Spanish-speaking station attendant walked up to the window and asked how much gas the man wanted, the man said he wanted a full tank plus an additive. The station attendant looked at him dumbfounded. The man repeated himself and said a bit more to clarify. The man finally realized why the attendant did not respond when his children said, "Dad you are speaking in English". The man laughed in disbelief and then switched to Spanish. This anecdote from one of the authors is an example of a surprisingly common bilingual phenomenon; a moment when we seem to be unaware of the language we are using. In this study we aimed to determine if a similar moment is quantifiable during comprehension. To do this,

we tested how deeply a word is processed in the bilingual brain before the word's language identity kicks in.

An issue of ongoing debate in bilingual word comprehension is whether lexical access occurs selectively in one language or not. By necessity, in order to access words selectively a bilingual must identify the language to which a word belongs (i.e., language membership), be it implicitly or explicitly. Language membership information can in theory be used to block the processing of non-target language words, including access to their semantic information, thus contributing to selective lexical access. Alternatively, language membership information may become available late in lexical processing, in which case it would not function as a filter for non-target words. The current study aims to determine at what stage in word processing language membership affects lexical access, or conversely, up to what stage language membership is ignored to allow for deeper word processing. We look at the automatic access of information during two comprehension tasks with mixed-language word lists, and record event-related potentials (ERPs) from proficient Spanish–English bilinguals. The continuous recording and temporal precision of ERPs allowed us to address two aims. First, we assessed whether balanced

* Corresponding author. Postal address: Department of Biology, University of Texas at San Antonio, One UTSA Circle, San Antonio, TX 78249, USA.
Tel.: +1 210 458 7013; fax: +1 210 458 5658.

E-mail addresses: shukhan.ng@utsa.edu (S. Ng),
nicole.wicha@utsa.edu (N.Y.Y. Wicha).

bilinguals use language membership to block processing of one language, as reflected by their sensitivity to the lexical frequency of words in the non-target language. Second, we employed a new paradigm to study the temporal dynamics of access to language membership information, and determine whether it is accessed before or after semantic information.

Early models of bilingual memory assume separate lexicons for the two languages (Kirsner, Smith, Lockhart, & King, 1984). Access to lexico-semantic information was thought to happen at a late processing stage, conditional on language selection at earlier stages, such that words of the context-irrelevant language did not reach the lexico-semantic level of processing. In support of this proposal, proficient bilinguals seemed able early on to discontinue processing of a written word in the task-irrelevant language (Gerard & Scarborough, 1989; Neumann, McCloskey, & Felio, 1999; Scarborough, Gerard, & Cortese, 1984). Later, Rodriguez-Fornells, Rotte, Heinze, Nösselt, and Münte (2002) provided the strongest evidence for language-specific word recognition, using ERPs and functional magnetic resonance imaging (fMRI) (though a subsequent production task showed strong cross-language interference, Rodriguez-Fornells et al. (2005)). Spanish/Catalan bilinguals were required to make a manual response to words in a list in one language and not to pseudo-words and words in the other language. The N400 frequency effect, which is usually larger in amplitude for low-frequency than high-frequency words (Rugg, 1990), was observed for words in the target language (either Spanish or Catalan), but not for words in the non-target language. In addition, there was no evidence of preparation of a motor response for words in the non-target language (based on the absence of lateralized readiness potentials), suggesting that the bilinguals were able to suppress the task-irrelevant language. In a parallel fMRI experiment, bilinguals and Spanish monolinguals exhibited similar brain activation for non-target Catalan words and pseudo-words. However, compared to monolinguals, bilinguals had greater activation of the posterior inferior frontal area in response to target Spanish words, and greater activation of the planum temporale for all words. Both brain regions have been related to phonological processing. Direct access from orthography to the lexicon, presumably used by monolingual Spanish speakers, may produce response competition from the non-target words. Thus the differential activation was attributed to the bilinguals' use of a "sublexical pathway, that is, activating only graphemic-phonological spelling rules of the Spanish language," (p. 1028). The inhibition of the direct access route was implicated in greater activation in an anterior prefrontal region by bilinguals than monolinguals, in response to the non-target words. Thus bilinguals may use a lexical retrieval pathway different from that of monolinguals, and achieve selective lexical access by inhibiting direct access from orthography to the lexicon.

However, there is also strong evidence for implicit interference effects from the non-target language even when processing only the target language. This implies that both languages may be active during language comprehension, regardless of a word's language membership. Evidence for non-selective lexical access has shown that interference arises at different levels of lexical access: semantic, lexical (homographs), and sublexical (neighborhood density), thereby implying bilinguals are not impervious to cross-language interference in visual word processing. At the semantic level, many studies have observed cross-language priming, for direct translations and semantically related words, often with more robust priming from the first language (*L1*) to the second (*L2*) than vice versa (see the summary by Altarriba and Basnight-Brown (2007)). Priming studies therefore seem to favor automatic processing of the meaning of words, which can facilitate the retrieval of semantically related words in both languages. At the lexical level, numerous studies have examined the

effect of cognates (words that share both form and meaning across languages) and interlingual homographs (words that share a same form but not meaning across languages) on lexical decision (e.g., de Bruijn, Dijkstra, Chwilla, & Schriefers, 2001; de Groot, Delmaar, & Lupker, 2000; Dijkstra, Timmermans, & Schriefers, 2000; Duyck, Van Assche, Drieghe, & Hartsuiker, 2007; Kerkhofs, Dijkstra, Chwilla, & de Bruijn, 2006; van Hell & Dijkstra, 2002; von Studnitz & Green, 2002) and found that cognate and homograph recognition was often affected by their meaning and frequency in the non-target language. At the sublexical level, Holcomb, Grainger, and O'Rourke (2002) have shown that words with more orthographic neighbors (words of the same length that differ in only one letter) within the same language had a larger N400¹ than those with fewer neighbors. Across languages, a target-language word that has many neighbors in the non-target language was found to evoke larger N400s than words with few neighbors (Midgley, Holcomb, van Heuven, & Grainger, 2008). Results of all these studies suggest that bilinguals are not able to completely turn off the non-target language when processing a target language.

In sum, there is experimental evidence supporting both selective and non-selective lexical access. The current study investigates whether the availability of language membership can serve to block processing of words in the non-target language. Language membership information must exist in some form in bilingual memory. Otherwise, bilinguals would not be capable of speaking one language at a time and making language-specific lexical decisions. But then, how is language membership information represented in a bilingual brain? It may be that the bilingual lexicons are functionally separate, even if they can be activated in parallel (e.g., Kroll, van Hell, Tokowicz, & Green, 2010), or they may be overlapping and highly interconnected, requiring an explicit or implicit way of determining language membership. Distributed connectionist models, for example, do not generally assume two separate lexicons for a bilingual. Instead, words are identified as members of a language by their specific orthographic and phonological features, and also by the language context (Dijkstra & Snoeren, 2004; Thomas & van Heuven, 2005). In contrast, localist connectionist models, exemplified by the Bilingual Interactive Activation Plus (BIA+) model (Dijkstra & van Heuven, 2002), postulate a separate language node. In the BIA+ model, the language node is like a label attached to a word, and does not function as a filter that can block the non-target words. It is representational but not functional within the word identification system, and can minimally affect individual word activation (Fig. 1) (van Heuven & Dijkstra, 2010). This assumption contrasts with an early version of the BIA model where language membership information can inhibit non-target language words (Dijkstra & van Heuven, 1998). Thus, language membership information may be realized as sublexical features, or as labels attached to words, or through co-activation of other words in a language context. The present study does not address directly the question of the form that language membership takes in bilingual memory. Instead, we assume that language membership information exists in some way and ask at what point in processing (when) does language membership information affect the course of lexical access?

1.1. Overview of the present study

We conducted 2 experiments with balanced Spanish-English bilinguals and measured ERPs to target and non-target language

¹ The N400 is an ERP component with a negative voltage deflection peaking around 400 ms post-stimulus onset, which is thought to reflect semantic processing (Kutas & Federmeier, 2011; Kutas & Hillyard, 1980).

Download English Version:

<https://daneshyari.com/en/article/10464864>

Download Persian Version:

<https://daneshyari.com/article/10464864>

[Daneshyari.com](https://daneshyari.com)