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The cognate facilitation effect in bilingual lexical decision is influenced by stimulus list composition

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ABSTRACT

Cognates share their form and meaning across languages: “winter” in English means the same as “winter” in Dutch. Research has shown that bilinguals process cognates more quickly than words that exist in one language only (e.g. “ant” in English). This finding is taken as strong evidence for the claim that bilinguals have one integrated lexicon and that lexical access is language non-selective. Two English lexical decision experiments with Dutch–English bilinguals investigated whether the cognate facilitation effect is influenced by stimulus list composition. In Experiment 1, the ‘standard’ version, which included only cognates, English control words and regular non-words, showed significant cognate facilitation (31 ms). In contrast, the ‘mixed’ version, which also included interlingual homographs, pseudohomophones (instead of regular non-words) and Dutch-only words, showed a significantly different profile: a non-significant disadvantage for the cognates (8 ms). Experiment 2 examined the specific impact of these three additional stimuli types and found that only the inclusion of Dutch words significantly reduced the cognate facilitation effect. Additional exploratory analyses revealed that, when the preceding trial was a Dutch word, cognates were recognised up to 50 ms more slowly than English controls. We suggest that when participants must respond ‘no’ to non-target language words, competition arises between the ‘yes’- and ‘no’-responses associated with the two interpretations of a cognate, which (partially) cancels out the facilitation that is a result of the cognate's shared form and meaning. We conclude that the cognate facilitation effect is a real effect that originates in the lexicon, but that cognates can be subject to competition effects outside the lexicon.

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1. Introduction

One of the most researched phenomena within the field of bilingualism is the *cognate facilitation effect*. Cognates are words that exist in an identical (or near identical) form in more than one language and carry the same meaning, like “winter” in Dutch and English. Many studies have shown that bilinguals process these words more quickly than words that exist in one language only (i.e. that do not share their form with their translation), like “ant” in English and it's translation “mier” in Dutch. This effect is at the heart of the Bilingual Interactive Activation plus (BIA+) model (Dijkstra & Van Heuven, 2002), the most commonly used model of the bilingual mental lexicon, and is taken as strong evidence for the claim that all the languages a bilingual speaks are stored in a single, integrated lexicon and that access to this lexicon is language non-selective.

The cognate facilitation effect has most commonly been observed in visual lexical decision experiments when the target words are presented in isolation (Cristoffanini, Kirsner, & Milech, 1986; De Groot & Nas, 1991; Dijkstra, Grainger, & Van Heuven, 1999; Dijkstra, Miwa, Brummelhuis, Sappelli, & Baayen, 2010; Dijkstra, Van Jaarsveld, & Ten Brinke, 1998; Font, 2001; Lemhöfer et al., 2008; Lemhöfer & Dijkstra, 2004; Peeters, Dijkstra, & Grainger, 2013; Sánchez-Casas, García-Albea, & Davis, 1992; Van Hell & Dijkstra, 2002), but also when they are embedded in sentences, although in the latter case the effect is often smaller (Duyck, Van Assche, Drieghe, & Hartsuiker, 2007; Libben & Titone, 2009; Schwartz & Kroll, 2006; Van Assche, Duyck, Hartsuiker, & Diependaele, 2009; Van Hell & De Groot, 2008). In addition, the cognate facilitation effect has been observed in word production: bilinguals are faster to name pictures of cognates (e.g. Costa, Caramazza, & Sebastian-Galles, 2000) and to read aloud cognate words (e.g. Schwartz, Kroll, & Diaz, 2007). It has been demonstrated most often in experiments in the bilinguals' second language, but it has also been observed in native-language only experiments (Van Hell & Dijkstra, 2002). Finally, the size of the effect is greater for

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cognates that are identical compared to non-identical cognates (e.g. “meloen” in Dutch and “melon” in English; Comesaña et al., 2015; Dijkstra et al., 2010; Duyck et al., 2007; Van Assche, Drieghe, Duyck, Welvaert, & Hartsuiker, 2011) and for cognates that exist in three languages compared to cognates that exist in only two languages (Lemhöfer, Dijkstra, & Michel, 2004; Van Hell & Dijkstra, 2002). This wealth of research suggests that the cognate facilitation effect is very robust and universal.

Research with interlingual homographs paints a more nuanced picture. Interlingual homographs are words that, like cognates, share their form in more than one language, but carry a different meaning, such that “angel” means “insect's sting” in Dutch. Also like cognates, bilinguals process interlingual homographs differently than single-language control words. In contrast to cognates, however, interlingual homographs are often processed more *slowly* than control words. This *interlingual homograph inhibition effect* has been reported in experiments examining bilinguals' visual word recognition (Dijkstra et al., 1998; Dijkstra et al., 1999; Lemhöfer & Dijkstra, 2004; Van Heuven, Schriefers, Dijkstra, & Hagoort, 2008), auditory word recognition (Lagrou, Hartsuiker, & Duyck, 2011; Schulpen, Dijkstra, Schriefers, & Hasper, 2003) and word production (Jared & Szucs, 2002; Smits, Martensen, Dijkstra, & Sandra, 2006). As with the cognate effect, this effect forms an important part of the BIA+ and is usually interpreted as evidence that both of the languages a bilingual speaks are stored in one integrated lexicon and that lexical access is language nonselective.

Importantly, most experiments that have focused on the interlingual homograph inhibition effect used single-language visual lexical decision tasks, during which participants have to decide whether letter strings are words in a specific language (usually the bilingual's second language). Further research has shown that when using such tasks, interlingual homographs are more likely to be recognised more slowly than control words when the experiment also includes words from the bilingual's other language (the non-target language, usually the bilingual's first language) that require a ‘no’-response (De Groot, Delmaar, & Lupker, 2000; Dijkstra et al., 1998; Dijkstra, De Bruijn, Schriefers, & Ten Brinke, 2000; Von Studnitz & Green, 2002). For example, in Experiment 1 of their study, Dijkstra et al. (1998) asked Dutch–English bilinguals to complete an English lexical decision task which included cognates, interlingual homographs, English controls and regular non-words, but no words from the bilinguals' native language, Dutch. In this experiment, they observed no significant difference in average reaction times for the interlingual homographs and the English controls (cf. Van Heuven et al., 2008, who did find evidence for an inhibition effect under the same conditions). In Experiment 2, the English lexical decision task also included a number of Dutch words which the participants were told required a ‘no’-response. This time, the analysis did reveal a significant difference between the interlingual homographs and the English (but not the Dutch) control words: the participants were slower to respond to the interlingual homographs than the English controls.

This pattern of results is interpreted within the framework of the BIA+ model (Dijkstra & Van Heuven, 2002) by assuming that there are two points at which language conflict can arise for an interlingual homograph. According to this model, there are two components to the (bilingual) word recognition system: the word identification system and the task/decision system (inspired by Green's, 1998 Inhibitory Control model). In the word identification system, the visual input of a string of letters first activates letter features, which in turn activate the letters that contain these features and inhibit those that do not. The activated letters then activate words that contain those letters in both languages the bilingual speaks. These activated words inhibit each other through lateral inhibition, irrespective of the language to which they belong. The task/decision system continuously reads out the activation in the word identification system and weighs the different levels of activation to arrive at a response relevant to the task at hand. In this system, *stimulus-based* conflict can arise in the lexicon due to competition (lateral inhibition) between the two (orthographic) representations of the interlingual homograph (Van Heuven et al., 2008). *Response-based* conflict arises outside the lexicon at the level of decision making (i.e. in the task/decision system) and is the result of one of those two lexical representations being linked to the ‘yes’-response, while the other is linked to the ‘no’-response (Van Heuven et al., 2008).

In short, in Experiment 1 of the Dijkstra et al. (1998) study, the interlingual homographs most likely only elicited stimulus-based language conflict, which it appears does not always translate to an observable effect in lexical decision reaction times. In contrast, in Experiment 2 the interlingual homographs elicited both stimulus-based and response-based conflict, as the participants linked the Dutch reading of the interlingual homographs to the ‘no’-response, due to the presence of the Dutch words that required a ‘no’-response. This response-based conflict resulted in a clear inhibition effect. In other words, in Experiment 1, the participants could base their decisions on a sense of familiarity with each stimulus (essentially reinterpreting the instructions as ‘Is this a word in *general*?’), whereas in Experiment 2, they were forced to be very specific (adhering to the instructions ‘Is this a word in *English*?’).

Recent work indicates that the cognate facilitation effect may also be influenced by the composition of the experiment's stimulus list. Poort, Warren, and Rodd (2016) designed an experiment to investigate whether recent experience with a cognate or interlingual homograph in one's native language (e.g. Dutch) affects subsequent processing of those words in one's second language (e.g. English). They asked their participants to read sentences in Dutch that contained cognates or interlingual homographs. After an unrelated filler task that lasted approximately 16 minutes, the participants completed a lexical decision task in English. Some of the words included in the lexical decision task were the same cognates and interlingual homographs the participants had seen before in Dutch. The analysis revealed that their recent experience with these words in Dutch affected how quickly they were able to recognise them in English and, crucially, that this depended on whether the Dutch and English meaning were shared: recent experience with a cognate in Dutch was shown to speed up recognition in English (by 28 ms), while recent experience with an interlingual homograph slowed the participants down (by 49 ms). In contrast to the studies mentioned previously, however, they found that the (unprimed) cognates in their experiment were recognised 35 ms more *slowly* than the English controls (see panel A of Figure 1 of their article), although a subsequent re-analysis of their data revealed this difference to be non-significant.

Notably, in contrast to those previous lexical decision experiments, Poort et al. (2016) also included some non-target language (Dutch) words (e.g. “vijand”, meaning “enemy”) in their English lexical decision task as non-English words which required a ‘no’-response. They furthermore included both cognates and interlingual homographs in the same experiment and used pseudohomophones—non-words designed to sound like existing words, like “mistaik”—instead of ‘regular’ non-words—non-words derived from existing words by changing one or two letters, like “grousp”. As far as we are aware, no research has systematically investigated whether the cognate facilitation effect, like the interlingual homograph inhibition effect, could be affected by the composition of the stimulus list. However, given the significance of the cognate facilitation effect to theories of the bilingual lexicon, it is important to determine whether the unusual composition of Poort et al.'s (2016) stimulus list is the reason behind this apparent inconsistency with the studies mentioned previously.

Indeed, there are good reasons to suspect that any (or all) of the ‘extra’ stimuli types Poort et al. (2016) included—the interlingual homographs, pseudohomophones and Dutch words—might have affected the size and/or direction of the cognate effect. As discussed previously, the presence of non-target language words in a single-language lexical decision has notable consequences for how bilinguals