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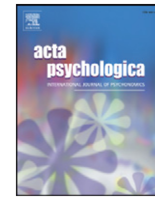

How verbs can activate things: Cross-language activation across word classes

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ABSTRACT

The present study explored whether language-nonselective access in bilinguals occurs across word classes in a sentence context. Dutch–English bilinguals were auditorily presented with English (L2) sentences while looking at a visual world. The sentences contained interlingual homophones from distinct lexical categories (e.g., the English verb *spoke*, which overlaps phonologically with the Dutch noun for ghost, *spook*). Eye movement recordings showed that depictions of referents of the Dutch (L1) nouns attracted more visual attention than unrelated distractor pictures in sentences containing homophones. This finding shows that native language objects are activated during second language verb processing despite the structural information provided by the sentence context.

1. Introduction

When processing information in a particular language, does a bilingual automatically activate knowledge of both languages? Many studies from the domain of word recognition suggest that this is the case. They have provided evidence for feature-based access to lexical information, rather than language-based access (e.g., Caramazza & Brones, 1979; de Groot, Delmaar, & Lupker, 2000; Grainger & Beauvillain, 1987; Schulpen, Dijkstra, Schriefers, & Hasper, 2003; von Studnitz & Green, 2002).

This feature-based approach, also referred to as language-nonselective lexical access, suggests that both languages are co-activated in a bilingual brain. In other words, this approach states that bilinguals cannot "switch off" their other language. For example, when listening to Russian sentences containing a target word like *marku* (*stamp*), Russian–English bilinguals looked at a competitor picture of a *marker* (which has phonological overlap with the nontarget language English) more often than at competitor pictures unrelated to the target (Marian & Spivey, 2003; Spivey & Marian, 1999). Furthermore, an English word like the homophone *note* (with a similar sound but different meaning in Dutch, meaning *nut*) generates longer lexical decision times in Dutch–English bilinguals than a word that does not have phonological overlap with the other language (Dijkstra, Grainger, & Van Heuven, 1999). This is thought to be the result of competition for recognition between the English *note* and the Dutch *noot*. These results show that the native language can create interference in second language processing. This notion is supported by recent neuroimaging data which show language conflict at a neuronal level during second language processing, demonstrating that bilinguals are unable to suppress their nontarget native language to avoid interference (van Heuven, Schriefers, Dijkstra, & Hagoort, 2008).

In contrast to the studies mentioned above, in real life words are almost never processed in isolation; they usually appear in a context. Although it is necessary to understand language processing at a word level, this is not sufficient for a rigorous understanding of the bilingual language system. The context in which a word is processed is an important factor to take into account to provide ecological validity to our findings (Graesser, Millis, & Zwaan, 1997; Grosjean, 1998). A sentence context, for example, can provide information on the language membership, syntactic category (word class), or meaning of a word.

Not much research has been performed so far on how a sentence context modulates cross-language activation in bilingual lexical processing. Several studies that assessed reading times have demonstrated co-activation of nontarget languages in a semantic sentence context when target words were preceded by or embedded in *low-constraint* sentences, in which the sentence frame did not bias toward the target word (Duyck, Van Assche, Drieghe, & Hartsuiker, 2007; Elston-Güttler, Gunter, & Kotz, 2005; Libben & Titone, 2009; Schwartz & Kroll, 2006; Van Assche, Duyck, Hartsuiker, & Diependaele, 2009; Van

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Hell & De Groot, 2008). For example, Van Assche et al. (2009) found that a cognate word like the Dutch–English *oven* (with a similar word form and meaning across languages) generated shorter reading times than a noncognate like *lade* (*drawer*) in a native language sentence context like "Ben found an old *oven*/*drawer* among the rubbish in the attic". Two studies that included *high-constraint* or predictive sentences (Schwartz & Kroll, 2006; Van Hell & De Groot, 2008) in which the sentence frame did bias toward the target word (e.g., "The best cabin of the ship belongs to the *captain*"), failed to find facilitative cognate effects, suggesting that a context with a strong semantic fit can restrict nonselectivity and eliminate effects of the nontarget language on item processing. This notion is supported by a naming study (Li & Yip, 1998) in which highly predictive sentences generated faster naming responses to homophones than to control words, demonstrating that prior sentence context can affect the disambiguation of different homophone meanings in a bilingual context.

However, two recent studies have found evidence that a constraining context does not eliminate cross-linguistic effects, but merely reduces these effects. In a visual world study, Chambers and Cooke (2009) demonstrated cross-language lexical competition in both restrictive and nonrestrictive sentences, but found that fixations to a competitor picture (of a *pool*) dramatically reduced during and slightly after presentation of the noun (*poule*) in restrictive sentences (e.g., "Marie va nourrir la *poule*"/"Marie will feed the chicken") as compared to nonrestrictive sentences (e.g., "Marie va décrire la *poule*"/"Marie will describe the chicken"). In line with these findings, Libben and Titone (2009) found that strongly constraining contexts reduced the effects of interlingual competitors (and cognates) on reading times. Their findings suggest that between-language effects *can* occur, but are resolved rapidly. In their study, bilinguals read both high- and low-constraint sentences that contained cognates, homographs, or matched controls. Eye movement recordings showed cognate facilitation and homograph inhibition in *early*-stage comprehension measures (e.g., the duration of the first fixation of the target word) of high-constraint sentence reading. No such co-activation effects were found in late-stage comprehension measures (e.g., the total duration of all fixations to the target word). These findings suggest that co-activation of languages can occur during the initial comprehension of constraining sentences, but is rapidly resolved at later stages of comprehension.

However, a sentence context does not only provide semantic information on the content of a word. Because a sentence context provides a structural frame in which words are interpreted, it also provides information on a word's syntactic category. For example, the English verb *bake* is phonologically identical to the Dutch noun *beek*, meaning *creek*. The placement of a word class ambiguous word like *bake* in a sentence context might also constrain interlingual lexical ambiguities. In other words, when processing a sentence in which the verb meaning of bake is used (e.g., "the children bake cookies in the kitchen"), the inappropriate noun meaning (of creek) could become unavailable as a result of the word's placement at the verb position in the sentence. However, the few studies that have addressed how contextual constraints moderate lexical access in the bilingual language system, have all focused on co-activation of languages within a word class (nouns in particular). As a consequence, it is not clear whether the syntactic category information provided by a sentence context might affect bilingual lexical access across word classes.

The main objective of the present study was to explore whether language-nonselective access in bilinguals occurs across word classes despite the structural information provided by a sentence. Critical sentences contained word class ambiguous interlingual homophones at the verb location in English noun phrase–verb–noun phrase sentence structures. These homophones all constituted a verb in English (e.g., *step*) but a noun in Dutch (*step*, meaning *scooter*). It should be noted that a semantic ambiguity is inherently related to this syntactic ambiguity, in the sense that one needs to access the syntactic class of the word in order to access the meaning and vice versa.

To maximize the ecological validity of the experiment we presented the sentences a) auditorily, and b) in a situated visual world setting (Cooper, 1974). Because language often refers to objects in the world, eye fixations to relevant visual objects reflect the rapid mental processes involved in language, offering a measure of language processing as it unfolds over time (Tanenhaus, Spivey-Knowlton, Eberhard, & Sedivy, 1995). The visual world we used consisted of two pictures depicting both nouns from the sentences (for practical reasons referred to as the agent and the patient, in respectively the first noun phrase and the second noun phrase), one picture depicting the noun counterpart of the homophone verb (referred to as the between-language competitor), and an unrelated distractor picture. Hence, attention toward the competitor would have to compete with the sentences' actual meaning, which was depicted in both noun pictures of the agent and the patient. If nonselective access would occur across word classes despite the structural information provided by the sentence, this would be reflected by more visual attention toward between-language competitors relative to distractor pictures.

2. Method

2.1. Participants

Forty-one undergraduate students with Dutch as their native language (L1) and English as their second language (L2) took part in this study. Their proficiency in English was assessed by the Language Experience and Proficiency Questionnaire (LEAP-Q: Marian, Blumenfeld, & Kaushanskaya, 2007). The mean self-rated English skills were 7.4 (SD = 0.87) on a scale from 1 to 10. The mean age at which these unbalanced bilinguals acquired English was 9.1 (SD = 2.8). All received course credit for their participation.

2.2. Stimuli

Sixty-six English noun phrase–verb–noun phrase sentences were constructed for this experiment. The 22 homophone sentences contained a monosyllabic interlingual homophone at the verb position, e.g., "The boxers *step* into the ring" or "The police officer *spoke* to the child". The selected homophones were obtained from a pilot experiment.[1] The 22 matched control sentences were similar to the homophone sentences, the only difference being that the homophone verb was replaced by a "monolingual" verb, e.g., "The boxers *climb* into the ring" or "The police officer *talked* to the child". This was done in order to keep the semantic and syntactic sentential context the same. For an overview of the homophone and control verbs, see Appendix A. Furthermore, 22 filler sentences with an identical structure were created, e.g., "The janitor *walked* to the store". The visual world, consisting of four pictures in quadrants on the computer screen, was shown during each auditorily presented sentence. In the homophone condition the scene consisted of two noun pictures: The agent and the patient of the sentence (e.g., one of a boxer and one of a boxing ring), one between-language competitor picture (depicting the noun counterpart of the verb homophone, e.g., a scooter), and one unrelated distractor picture (e.g., of a traffic light), see Fig. 1. The control sentences were accompanied by the same set of pictures. The positioning of the pictures from quadrants 1 to 4 was randomized across trials and across participants. The experimental

[1] In this pilot experiment, Dutch–English unbalanced bilinguals performed a Dutch auditory lexical decision task. Besides Dutch words and nonwords, the participants were presented with the English counterpart of a Dutch–English homophone. The 22 words that were mostly perceived as being Dutch (>40% of the participants) were included in the experiment.

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Fig. 1. An example of the Visual World Paradigm as used in the present experiment.

sentences were counterbalanced between subjects so that each participant heard 11 homophone sentences, the 11 other control sentences, and all 22 filler sentences. The order of presentation was randomized within subjects. The sentences were recorded by a male native speaker of Dutch who had lived in the US for over 14 years, and sampled at 44.1 kHz. The sentences were rated by a native speaker of American English to ensure that they were pronounced correctly. The visual world was presented on the 21 inch display of the Tobii 2150 eye tracker, sampling at 50 Hz.

2.3. Procedure

The experiment consisted of three parts. First, participants performed the eye tracking experiment. They were seated with their eyes at approximately 60 cm from the display of the remote eye tracker. Participants were instructed in English. They received instructions for a so-called 'no-task task': They were not asked to perform any explicit task. Instead, the instructions were to listen carefully to the sentences while looking at the pictures displayed on the screen. This no-task task was chosen in order to avoid inducing unnatural processing strategies (see Altmann, 2004; Altmann & Kamide, 1999). Prior to each trial, a fixation point ("+") appeared on the screen for approximately 1 s. Next, the pictures were presented. After 3 s, the sentence was auditorily presented. The pictures remained on the display until 400 ms after the sentences' offset, after which the next trial started with a fixation point. After the last trial, participants were prompted to elaborate on whether they noticed anything particular about the relation between the sentences and the pictures.

The second part of the experiment consisted of a translation task. Forty-four English words were auditorily presented for the participants to translate into Dutch. Half of these words consisted of the homophones from the eye tracking experiment; the other half consisted of monosyllabic filler words. Again, the trials were randomized within subjects. This translation task made it possible to a) remove participants with a low proficiency in English and b) remove trials in which participants did not know the meaning of the English verb. The rationale behind this is that when English words are not known to a participant (either as a result of low proficiency of the participant or unfamiliarity with the word) these trials cannot properly reflect bilingual language processing; the participant would look at the competitor picture simply because he or she would not have the corresponding English word available. Therefore, the translation task was useful as a selection mechanism both at a participant and at an item level.

Finally, the participants filled out the LEAP-Questionnaire.

3. Results

The data from three participants were removed due software malfunction. Furthermore, data from one item ("dote") and two participants with many incorrect responses to homophones in the translation task (homophone accuracy $<.50$) were removed from further analyses. Next, all trials with erroneous responses in the translation task were removed by item and by participant (12.31% of the remaining homophone trials). Proportions of eye fixations to each picture were calculated for each participant in each condition (homophone versus control sentences) over successive time windows of 100 milliseconds, taking the verb onset as the reference point. The proportions of eye fixations across participants are presented in Fig. 2.

A significant Picture (agent vs. patient)*Time interaction (F (13,58) = 13.92, $p<.001$, $\eta^2=.76$) showed that early on in the sentence the agent received the highest proportion of fixations, whereas later on in the sentence the patient did; see the dashed lines in Fig. 2A and B. This viewing pattern demonstrates that the participants were attending to the meaning of the sentence (or at the very least the meaning of the individual nouns), given that the agent always was a depiction of the first noun phrase and the patient a depiction of the second noun phrase.

The main purpose of this study was to explore whether language-nonselective access in bilinguals occurs across word classes in a sentence context. Note that both competitor and distractor pictures are irrelevant to the sentence context, but could in principle attract fixations. Therefore, the proportion of looks to competitors compared to the proportion of looks to distractors serves as an index of the degree of L2 activation. Repeated measures analysis revealed a significantly higher proportion of fixations to competitor pictures than to distractor pictures in the homophone condition (F (1,35) = 17.55, $p<.001$, $\eta^2=.33$). These results show that, when processing a sentence like "The boxers step into the ring", the picture of a scooter (/step/ in Dutch) received more visual attention than the distractor picture (depicting a traffic light). In other words, the bilingual participants activated the L1 noun counterparts of L2 homophone verbs during L2 sentence processing, reflecting co-activation of languages *across word classes*. Additional analyses showed that this effect could not have been the result of participants' possible awareness of the manipulation.[2]

Given the finding that the homophone verb activated the native language in an L2 setting, we would only expect such an effect in homophone sentences as opposed to the control sentences. Indeed, similar analysis of the control condition showed no significant differences between competitor and distractor fixations (F (1,35) = 1.25, $p>.25$). When participants heard a sentence like "The boxers

[2] In the post experiment session questioning the participants on the purpose of the experiment, seven participants indicated that they were aware of the presence of homophones in the stimuli. This subset of seven participants showed a significant difference in fixations to competitor and distractor pictures (F (1,6) = 14.64, $p<.01$, $\eta^2=.71$). These data show a strong effect, which possibly reflects a conscious search for a picture with phonological overlap across languages rather than first-pass lexical access to both languages, and which might have affected the overall analysis. However, after exclusion of this subset the significant difference in fixations to competitor and distractor pictures persisted (F (1,28) = 11.29, $p<.005$, $\eta^2=.29$). Furthermore, when including the order of the trials as a factor (first two trials versus last two trials), this effect did not differ across trials (Picture*Trial interaction F (1,28) = 0.96, $p>.3$). These results indicate that the remaining participants indeed were not aware of the manipulation and suggest that the no-task task did not evoke a particular processing strategy of looking for a possible match between the pictures in these participants. Therefore, we conclude that the results reflect cross-language activation rather than a conscious search to the homophone counterpart.

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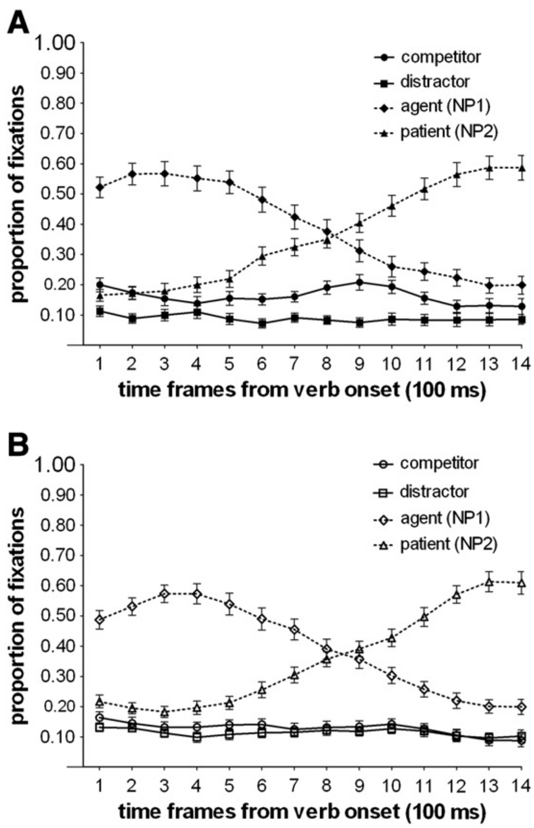

Fig. 2. Mean proportions and standard errors of eye movements to each picture from the onset of the verb to 1400 ms after verb onset, for (A) the homophone condition and (B) the control condition. An example of the accompanying sentences is (A) "The boxers *step* into the ring" and (B) "The boxers *climb* into the ring".

climb into the ring", the picture of a scooter did not receive more visual attention than the picture of the traffic light. This finding further indicates that the effect in the homophone condition cannot be the result of a difference in valence between the competitor and distractor pictures. Given that the identical visual scene evoked a different viewing behavior in different conditions, the difference in viewing patterns can only be attributed to the difference in linguistic input.

When looking into the homophone condition again, the difference in visual attention to competitor and distractor pictures changed over time (Picture (competitor vs. distractor) * Time interaction F (13,23) = 2.18, $p<.05$, $\eta^2=.55$). To establish the time course of co-activation, a series of consecutive *t*-tests were performed to compare the proportion of fixations to competitor and distractor pictures per time window (see the uninterrupted lines in Fig. 2A). Results of the two-tailed paired-samples *t*-tests at participant level showed that the proportions of looks to between-language competitors were significantly higher than the proportions of looks to distractor pictures (t_1 (35) > 2.12, $p<.05$) from 400 to 1100 ms after the onset of the homophone verb.[3] Item analyses showed a similar pattern in a slightly shorter time window (time frames 6, 8, and 9 t_2 (20) > 2.32, $p<.05$, time frames 7 and 10 t_2 (20) > 1.80, $p<.09$).

[3] Consecutive *t*-tests showed significant *p* values for the competitor–distractor comparison in time frames 1–2 and 5–11. An effect in proportions of looks was defined as the point at which five of more consecutive *t*-tests showed a significant difference ($p<.05$). This is a methodology frequently used in ERP research (e.g., Dehaene et al., 1998; van Schie, Mars, Coles, & Bekkering, 2004). The only time window in which (more than) five time frames were significant is that from 5 to 11, reflecting 400 to 1100 ms after the onset of the verb.

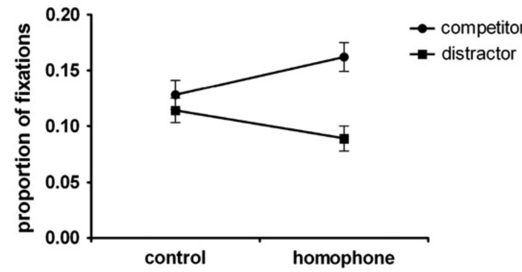

Fig. 3. Mean proportions and standard errors of eye movements to competitor and distractor pictures for the control and the homophone condition.

The increased visual attention to the between language competitor in homophone sentences must inherently have gone at the expense of attention to other pictures in the visual world. Analyses showed a significant difference in viewing behavior to both competitor and distractor pictures depending on the condition (homophone versus control sentences), as reflected by a significant Picture * Condition interaction (F (1,70) = 7.58, $p<.01$, $\eta^2=.10$), see Fig. 3. Furthermore, agent and patient fixations showed no such condition effects (Picture * Condition F (1,70) = 0.03, $p>.86$). These results suggest that between-language activation might have gone at the expense of attention to distractor pictures.

4. Discussion

In a second language context, do bilinguals access knowledge of their native language across word classes despite being at verb position in a sentence structure? The results of the present study suggest that they do. Second language sentences containing a homophone verb shifted visual attention toward the depictable noun counterpart in the native language, as was reflected in higher fixation proportions to competitor pictures than to unrelated distractor pictures. This activation across languages and word classes manifested *despite* a) the word being embedded in an L2 sentence frame that did not only provide information on the appropriate word's language membership and meaning, but also on its syntactic category, and b) competition of the homophone depiction with relevant agent and patient pictures. These findings provide additional evidence that bilinguals are unable to "switch off" the native language when processing the second language.

The present study is, to our knowledge, the first to investigate whether word class information in a sentence context eliminates intrusion of the nontarget language during bilingual language processing. The only study explicitly investigating co-activation of languages across syntactic classes is that by Sunderman and Kroll (2006). In that study, English–Spanish bilinguals performed a translation recognition task on word pairs that either did or did not belong to the same syntactic category (e.g., *cara-card*, consisting of two nouns, versus *cara-care*, consisting of a noun and a verb). Results demonstrated cross-language lexical interference in same-class word pairs, but not in different-class word pairs. These results suggest that the influence of the other language was eliminated when crossing word classes. However, the present study does demonstrate cross-language effects across word classes. Both types of findings (selective versus nonselective lexical access across syntactic classes) do not necessarily contradict. It should first be noted that there are several differences between both studies, thereby compromising a direct comparison of the results. Compared to Sunderman and Kroll (2006), the present study used different stimulus contexts (sentences vs. word pairs), modalities (hearing vs. reading), and paradigms (eye movements vs. accuracy and response times). Importantly, also the timing of the measurements (during vs. after processing) differed. Therefore, it is possible that both studies were tapping different points in lexical access. It could be the case that the results by Sunderman and Kroll (2006) lacked the sensitivity to detect co-activation of languages due to measuring a single behavioral response *after* processing of the word pair. In contrast, the eye fixations in the present study provided more continuous measures *during* processing of the words in the sentence.

The notion of tapping into different levels of lexical access can also explain the seemingly contradicting results from the few cross-language studies on constraining contexts. As explained earlier, two studies on language-nonselectiveness in a sentence context suggested that a constraining context can restrict nonselectivity (Schwartz & Kroll, 2006; Van Hell & De Groot, 2008). On the other hand, two studies have demonstrated nonselective lexical access in constraining sentences, but only dramatically reduced (Chambers & Cooke, 2009) or during early stages of comprehension (Libben & Titone, 2009). The present study also demonstrated nonselective lexical access in a sentence context, and extended these findings across word classes. It should be noted that the type and extent of sentence constraints in the present study were different than those of the previously mentioned studies, given that the previous studies provided semantic cues on the appropriate meaning of the word in the preceding sentence context, whereas the present study mainly cued the syntactic category of the word by its placement in the sentence context. Again, both the findings of selective versus nonselective lexical access in a sentence context do not necessarily exclude one another. The studies supporting co-activation of languages (the present study; Chambers & Cooke, 2009; Libben & Titone, 2009) provided measurements during sentence processing, whereas the studies supporting language selectivity (Schwartz & Kroll, 2006; Van Hell & De Groot, 2008) provided a single measurement after sentence processing. Again, these findings indicate that the more fine-grained comprehension measures were sufficiently sensitive to reveal evidence of co-activation of languages.

Furthermore, the results from the present study suggest that only *irrelevant* visual information suffered from native language activation. Attention to between-language competitor pictures did not seem to occur at the expense of attention to the relevant noun phrase referents (agent and patient). In other words, the present data do show language nonselectivity but do not show impairment in processing the explicit meaning of the sentences. This finding can reconcile both viewpoints of evidence for co-activation during processing on the one hand and no evidence for co-activation at a decision level on the other hand: L1 activation might not exert sufficient influence to hinder L2 processing and, therefore, co-activation is not detected at a decision level.

Rather than reporting continued observations of language-nonselectivity, the status quo of bilingual research asks for specification of the factors under which nonselectivity is attenuated or reduced, in order to gain more insight in the bilingual language systems and improve models of bilingual language processing. The results of this single experiment are, of course, not conclusive about the role of syntactic information in language-nonselectivity and do not rule out that syntactic information can constrain initial consideration of the irrelevant language. Because the present study did not manipulate high versus low syntactic constraints, we cannot pinpoint whether the elevated visual attention for competitors demonstrate that initial lexical access is either not affected by word class information or whether it is attenuated despite modulation by word class information. The next step could be to present participants with low and high syntactic constraint sentences (in convergence with studies on low and high semantic constraints, e.g., Chambers & Cooke, 2009; Libben & Titone, 2009), in order to investigate this issue. Another step in specifying the hierarchy of the factors that affect language-nonselectivity could be to present both within-word class homophones and across-word class homophones within an experiment, or to manipulate both the syntactic and the semantic constraints of preceding sentences.

Despite the need for more studies, the present study has made a first step to investigate the role of word class information in a linguistic context on consideration of the nontarget language. The present results suggest that the constraining effect of syntactic category is late rather than early in cross-language processing. The influence of the native language materialized 400 ms after the onset of the ambiguous verb and lasted 700 ms. The planning of an eye movement usually takes approximately 200 (Hallet, 1986) to 300 ms (Matin, Shao, & Boff, 1993) after the onset of the referent's name. Given the processing constraints of the auditory referent in the present study, for example with respect to its meaning and language membership, a 100 ms delay compared to referents without these constraints is remarkably early. Furthermore, the 700 ms duration of the homophone effect is striking given competition with the pictures of the first and second relevant noun competitor.

Mapping of these results onto present word recognition models can only occur indirectly, because such models do not yet explicitly include information on the syntactic category of a word or specify exactly how linguistic and nonlinguistic context affect word recognition. However, models as the extended Bilingual Interactive Activation (BIA+) model by Dijkstra and Van Heuven (2002) can provide a theoretical framework to carefully start interpreting the present findings. The BIA+ model specifies a bottom-up system for word identification that contains linguistic context information at a lower level, and a top-down system that regulates control and contains nonlinguistic context information at a higher level. It is assumed that the phonological overlap of the interlingual homophones in the present study induced competition between lexical candidates from both languages in the lower level word identification system. Next, word class information could become activated in the word identification system as a cue on the meaning of the different lexical candidates. In other words, analogously to the interpretation of Sunderman and Kroll (2006) the word identification system could initially be 'blind' to syntactic category. Sunderman and Kroll furthermore suggested that top-down demands from the task/decision system would use the syntactic information that is activated at a later stage to decide on the appropriate meaning of the lexical candidates.

As opposed to the study by Sunderman and Kroll (2006), the present study did not require explicit decision making, reducing the need to resolve lexical ambiguities top-down. However, it could be that the presence of a visual world with relevant and irrelevant referents might have invoked decision-making strategies, imposing a (somewhat less explicit) task demand as compared to explicit decision making requirements. This interpretation of the results in light of the BIA+ model is in line with the previous claim that L1 activation might not exert sufficient influence to hinder L2 processing at a decision level. However, the exact function of both systems in the BIA+ model with regard to syntactic category, linguistic context, and nonlinguistic context are still underspecified and in need of a broader empirical basis.

To conclude, this study demonstrated that sentences containing a lexically ambiguous verb (the interlingual homophone) resulted in visual attention to the inappropriate noun counterpart from the other language. Verbs in second language sentence processing activated irrelevant native language objects, demonstrating that language-nonselectivity persists across word classes in a sentence context.

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Appendix A

Critical verb	Control verb
Ate	Eats
Bake	Make
Based	Inspired
Beat	Hit
Bet	Wait
Bill	Charge
Bow	Kneel
Build	Find
Court	Seek
Dose	Prescribe
Dote	Cherish
Float	Hover
Hack	Cut
Mail	Send
Mess	Play
Pet	Stroke
Snoop	Investigate
Snore	Sleep
Spin	Rotate
Spoke	Talked
Stain	Pollute
Step	Climb

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