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Interlingual Homograph Recognition by Bilinguals: A New Paradigm

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In an exploratory study, bilingual individuals were presented with a list of English, French and interlingual homograph (IH) words that exist in both lexicons but differ in meaning (e.g., coin means "corner" in French). Participants were then shown pictorial representations of these stimuli (of both referents for interlingual homographs) and asked to decide whether each had appeared on the prior list. There was a main effect of word category for both accuracy and reaction times (RTs): English and French interlingual homograph items resulted in responses that were slower and less accurate than non-interlingual homograph items. This new paradigm provides an important advantage to researchers. Because recognition is not affected by surface features, it is a more accurate evaluation of conceptual representation. Results are discussed in light of bilingual processing models. It is important to note that the fluency in each language was not measured so it was not possible to ensure that the language-dominant groups differed significantly in their proficiency from the balanced bilingual group. Additional studies are needed to verify the findings reported herein.

Keywords: interlingual homograph, recognition, language dominance, pictures

In an attempt to overcome some of the shortcomings of past research paradigms (most notably the confound introduced from effects of repetition on memory), the present study uses a novel approach to assessing encoding in bilinguals: using pictures to elicit concepts, rather than re-presenting words. Research findings reported by Cummins (1977) and Landry (1974) have revealed a bilingual advantage (compared to monolinguals) in various tasks, including creativity and divergent thinking (the ability to "think outside the box"), and even performance on IQ tests. More recent evidence points to advantages in executive functioning tasks (Carlson & Meltzoff, 2008), recall (Kormi-Nouri et al., 2008) and metalinguistic awareness (Ransdell, Barbier, & Niit, 2006), and advantages appear to hold true cross-culturally (Baker, 2002). The finding that participants could recall words in their first language with greater accuracy than in their second (Service, Simola, Metsanheimo, & Maury, 2002) further suggests that a bilingual's language dominance (i.e., their relative proficiency in each language) has an effect on memory. Others, however, have found little to no differences between monolingual and bilingual memory performance (e.g., Abu-Rabia & Siegel, 2002; Amrhein & Sanchez, 1997; Bialystok, Martin, & Viswanathan, 2005), even as a function of language dominance (Insua, 2002), suggesting a less consistent influence of language on cognitive processes, especially memory. This inconsistency in the findings of studies examining bilingual processing has contributed to an upsurge of interest and research in the area of bilingualism in recent decades.

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The Organization of the Lexicon

An area that is especially important to explore is bilingual memory, including encoding, storage, and retrieval of information, because it can help to inform both monolingual and bilingual models of language processing. Many theories describe how word recognition occurs and, especially, how bilingual individuals process (encode and retrieve) word information. Paivio and Desrochers (1980) introduced the Bilingual Dual Coding Hypothesis, which purports that each bilingual person has two distinct language systems; these systems can interact or work independently from each other, depending on the context. Each of the language systems is related to what Paivio and Desrochers term the *image* (the meaning of the word or concept). There is also a relationship between each language by way of translation equivalents. According to this model, a presentation of the word *chair* also activates its translation equivalent "chaise" for a French-English bilingual. This model makes no claim as to the form taken by the representation (e.g., linguistic, imagistic, etc.), but literature suggests that the representations are abstract or conceptual in nature (Theios & Amrhein, 1989).

Beauvillain and Grainger (1987), and Schulpen, Dijkstra, Schriefers, and Hasper (2003) also offer compelling evidence in support of a system whereby both languages are linked by a shared conceptual store (Shared Store Hypothesis, discussed below) and recent neurobiological findings also support the idea that a single concept is linked to both languages (Martin, Dering, Thomas, & Thierry, 2009). The most convincing evidence for this comes from the phenomenon of cross-lingual priming. This occurs when the presentation of a word in one language primes the recognition of a related word in the bilingual person's other language. Results from many cross-lingual priming studies (Beauvillain & Grainger, 1987; Perea, Dunabeitia, & Carreiras, 2008; Schulpen, et al., 2003) have demonstrated cross-lingual priming, especially from native language (L1) to second language (L2). These findings are also consistent with a Shared Store Hypothesis (whereby both languages have access to shared concepts) because this priming suggests at least some semantic overlap between the two language-specific lexicons.

Cross-linguistic priming has also been shown using pictures (Francis, Augustini & Sáenz, 2003). In the encoding phase, bilingual participants were first asked to name pictures in either English or Spanish (one block of images in each language). Then, during the test phase, they were asked to name these pictures again in one of their two languages. For some pictures, the naming occurred in the same language as in the encoding phase; other pictures were named in the other language. Results showed significant priming in the test phase regardless of language (i.e., both between and within language priming occurred), further supporting the idea that the bilingual cognitive system is integrative.

In a shared-store perspective (where two or more languages share a common conceptual store) language access in bilinguals is said to be non-selective, or language-independent (de Groot, Delmaar, & Lupker, 2000; Libben & Titone, 2009; Thierry & Wu, 2007), with both languages initially responding to the stimuli. This undifferentiated early-processing has been shown, for example, by Conklin and Mauner (2005, Experiment 1), using interlingual homographs (IHs). An IH is a letter string that exists in two or more languages but that has a different meaning in each of the languages. One such example is *lit* which in French means "bed," while in English it is the past tense of "to light." Conklin and Mauner (2005) reported longer response times (RTs) for words in a lexical decision task (where participants had to decide if the presented letter string was a real word or not) when the word followed a sentence containing an IH. When the IH followed a sentence containing a non-IH word, RTs were shorter. These results were replicated with auditory word presentation by Schulpen et al. (2003).

A significant amount of work has been done with bilingual populations using IHs and these studies have provided important information on the role of language context (Elston-Güttler & Gunter, 2008; Lemhöfer et al., 2008; Paulmann, Elston-Güttler, Gunter, & Kotz, 2006), sentence context (Conklin & Mauner, 2005; Duyck, Van Assche, Drieghe, & Hartsuiker, 2007; Schwartz & Kroll, 2006; van Hell & de Groot, 2008), and the written frequency of words (French & Ohnesorge, 1995; Gerard & Scarborough, 1989) in the processing of linguistic stimuli. For example, whether there is a single concept in the lexicon, which is shared by both languages, or whether each language has its own completely separate system. The Bilingual Interactive Activation and Bilingual Interactive Activation Plus (BIA and BIA+, respectively) are models which assume this type of non-selective access to a bilingual person's integrated lexicon (Brysbaert & Dijkstra, 2006; Thomas & Van Heuven, 2005).

Bilingual Models

The Bilingual Interactive Activation (BIA) model was the original computational model of bilingual word recognition developed by Dijkstra and van Heuven (2002) and included multiple levels of representation (features, letters, words); see Figure 1. The features which are encountered in the presented stimulus first activate letters that share those features and inhibit (or "block") the letters that do not possess the features. A feature might be, for example, a curved line, which would activate letters like R and P, but inhibit letters like L and M. The activated letters then allow access to words in both languages that contain those letters (and inhibit those which do not). The last level is a language node which inhibits words from the non-target language. Because of some important shortcomings (see Brysbaert & Dijkstra, 2006 for a discussion), the BIA+ was introduced.

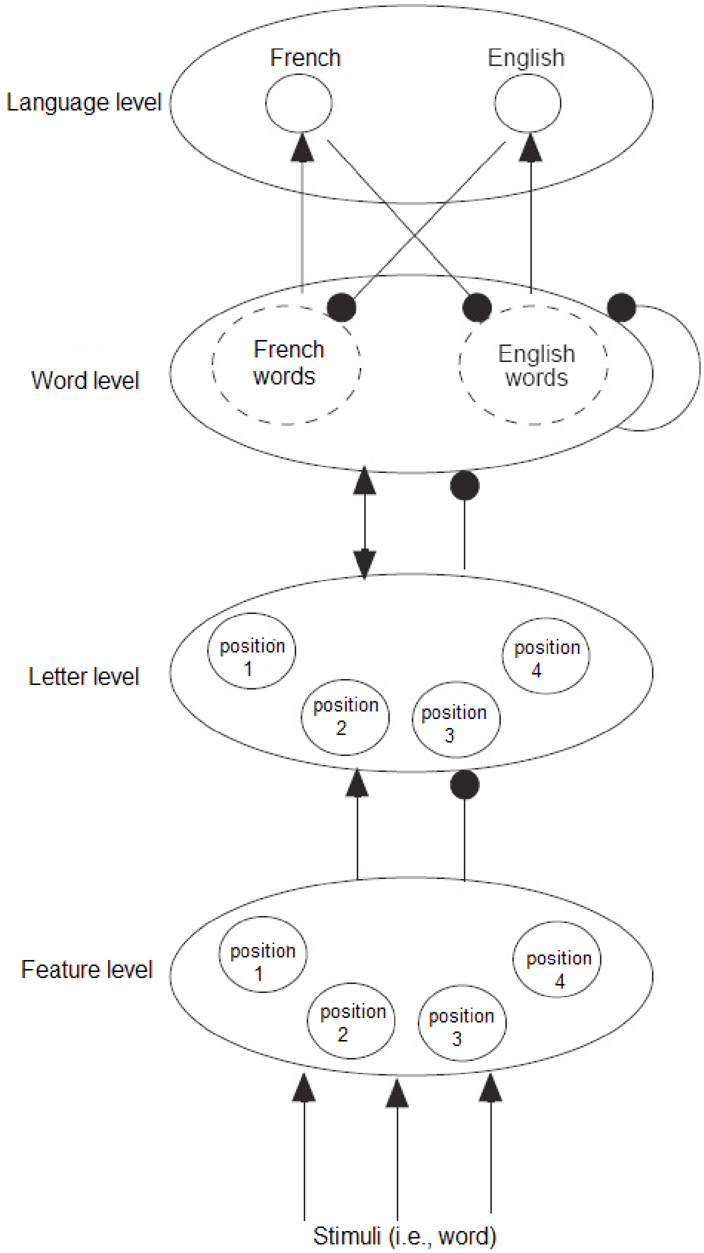
The BIA+ added phonological (sound) and semantic (meaning) levels and included two independent systems. The first of these systems is a word identification system, which is essentially the BIA model, with some slight modifications (most notably the language node or level, which will be briefly discussed below). The second system is a task schema system which incorporates effects from non-linguistic contexts such as task strategies (e.g., speed vs. accuracy), participant expectancies, and task demands or instructions (Brysbaert & Dijkstra, 2006). As mentioned, the language node has a very different role in the BIA+. Specifically, it no longer feeds back to the word level and simply tags the language to which a word belongs (recall that in the BIA, it could also inhibit words from the non-target language; Thomas & Van Heuven, 2005). This results in a competition between lexical codes as lateral connections allow for inhibition across languages (Thomas & Van Heuven, 2005). Yet this model makes no specific predictions about the influence of a bilingual person's proficiency in each language.

Language Proficiency

The influence of proficiency is addressed in Kroll and Stewart's (1994) Revised Hierarchical Model, which proposes that the mental lexicon is separate for each language, but that the two stores are related to one another by connections that vary in strength based on the individual's language dominance (Sharifian, 2002). In a revised version of this model, Heredia (1997) suggested that the labels L1 and L2 for the bilingual's two lexicons might be deceiving and that they should be replaced by *more dominant* and *less dominant* language, which is the school of thought adopted herein. There is strong evidence for memory differences based on proficiency and surrounding linguistic context in bilinguals. Language-dependent memory effects have been demonstrated by Marian and Fausey (2006), whereby memories encoded in one language are more easily retrieved in that same language than are those encoded in the bilingual person's other language (and vice versa). With high proficiency in both languages (i.e., balanced bilingualism), individuals were more susceptible to language-dependent memory, suggesting that language is increasingly used as a retrieval cue for memories. Bilingual autographical memory has also shown a similar encoding specificity effect, with facilitation for same-language encoding and retrieval contexts (Marian & Neisser, 2000). Clearly, memory is influenced by the linguistic context at the time of both encoding and retrieval.

Beauvillain and Grainger (1987) used a priming paradigm and IHs to assess access in French-English and English-French bilinguals. In Experiment 1, they examined the question of language-selective access in bilingual people. They found that interlingual priming occurred with IH words whereby IHs like *coin* (presented in an all-English word list) facilitated responses

Figure 1. *An example of a computational model (adapted from Dijkstra & van Heuven's (2002) BIA+ model)*



related to the non-target French meaning of the IH (i.e., "corner"). They concluded that, at least initially, IH access is non-selective. In fact, not only are both languages initially activated by the presented stimulus, but this access also appears to be automatic (Beauvillain & Grainger, 1987; Jared & Kroll, (2001). This automatic, exhaustive activation has even been found when bilingual participants are explicitly instructed not to pay attention to the other language or when they are performing a monolingual task (Kandil & Jiang, 2004).

Given the research discussed thus far regarding the relationship between memory and language, it is possible that briefly activating a concept in the non-target language will result in a lasting memory trace for that same grapheme in the target language. However, until this point, very little research has been done on this topic. It may be the case that such activation affects (i.e., slows) lexical decision or naming responses but does not affect memory processes. This is one of the issues addressed in the present paper: What effect does presenting an IH in a bilingual word list have on bilingual memory?

Additionally, much of the research examining the influence of reading an IH in the non-target language on task performance has used lexical decision or naming paradigms. Thus, a further aim of this paper is to see if IH activation leaves a more long-term memory trace, using a delayed recognition paradigm. There are also grounds to suspect differences between the traditionally used word-level tasks and the presently used conceptual-level picture task. Recently, Francis and Sáenz (2007) showed that picture-naming performance is a result of two processes—picture identification and word retrieval. They were able to tease apart these two processes and showed that it is actually the picture identification processes that contribute to the long-lasting repetition priming effects.

The present, study seeks to further investigate how the two languages of a bilingual person are represented and accessed during word reading, and more specifically whether there is a long-lasting memory trace from the presentation of an IH word in both languages. The majority of past research has used IHs in both the learning phase (initial presentation) and test phase (recognition phase), introducing a confound to this body of research. Using images during the recognition phase will eliminate this confound.

The present study will address the question of whether there exists a single conceptual store or two separate stores in the lexicon, which is a fundamental question in both monolingual research and bilingual research. Adding to this growing body of research by using pictures rather than words in the test phase allows us to examine memory traces without the responses being influenced by the surface characteristics of the targets.

What can we learn about the way bilingual individuals encode, store or retrieve linguistic information by examining how they process IHs? The present, exploratory study attempted to explain, resolve, or contribute to the following questions: 1) Are the representations in both languages activated when an IH is presented?; 2) Do differences exist in performance between the frequently-used word recognition paradigms and the presently-used conceptual picture recognition paradigm; and 3) Can the initial brief activation of both of the IH's meanings (i.e., in both languages) result in long-lasting memories for both of those concepts, or does language dominance affect this process?

Method

Participants

Individuals who are bilingual in French and English were recruited from a large university participant pool in Southwestern Ontario, Canada and through solicitation in the Department of Languages, Literatures and Cultures' French classes. Participants ranged in age from 18 to 58 years (M = 26.2). Forty-three individuals participated, some French-dominant (n = 12), some English-dominant (n = 20), and others considered Balanced, with equal comfort in both languages (n = 11). Participants were categorized into these dominance categories based self-reported responses to a question within the language assessment questionnaire. All participants were compensated either with bonus points to be used towards a psychology class or an entry into a drawing for a cash prize.

Materials and Procedures

A mixed list of English, French and IH words were presented to participants. Following a distraction task, participants were asked to indicate whether the meaning of each of these words (and distracters) had been present in the mixed list of words. These responses were elicited using pictures rather than repeating the written homographs.

Words were identified for use by cross-referencing two frequency databases, one in French (Baudot, 1992) and one in English (Kucera & Francis, 1967). Words that were present in both these lists were further assessed by the primary researcher to ensure that they were familiar in both languages and that they had different meanings in each language. For example, the word *table* exists in both French and English, but was discarded because it refers to the same object in both languages. Words that could not be represented by a picture in one or both languages were also rejected. An example is *lit* because it would be difficult to represent the past tense of "to light" without eliciting the present tense, which is not an IH. Finally, words that were unfamiliar or uncommon in one or both languages were also discarded (i.e., words with which the primary investigator, who is fluent in both English and French, did not know and words that did not appear in the frequency database). Filler items, which were pure French and pure English words, were selected from an online dictionary (Internet Picture Dictionary, 2001) because they could be easily represented in picture form. The final list of stimuli consisted of 20 French words, 20 English words and 33 IHs (Appendix A). Stimuli were comparable across conditions using the available data (frequency, familiarity and length) from the online version of the MRC Psycholinguistic Database (Coltheart, 1981). There was no difference in frequency, $F(3,96) = .941$, $p = .424$, and although there was a significant difference in familiarity, $F(3,75) = 2.754$, $p < .05$, no pairwise post hoc comparisons (Bonferroni) were significant ($p > .05$). There was a difference in word length, $F(3,101) = 6.253$, $p < .05$. Paired comparisons with Bonferroni corrections showed that French words were the longest ($M = 5.95$) and different from both IH groups ($M = 4.64$; $p < .05$). This will be addressed in the discussion of the relevant results below.

Table 1
The Effect of Word Category on Response Times (ms)

	French words	English words	IH English Picture	IH French Picture
RT	2017_a	2257_b	2736_c	2793_c
Standard Error	90.1	108.05	129.45	152.44

**RTs with different subscripts are significantly different

For each word, a graphic representation was selected by the primary researcher for both the English and French meanings. To ensure that the pictures selected were an accurate representation of the desired meanings and would consistently elicit the target, 10 French-speaking and 10 English-speaking colleagues were asked to indicate the word they thought best represented the picture being shown (in French and English, respectively). The pictures that did not elicit the desired meaning were replaced by different pictures and the procedure was repeated until all of the pictures elicited the target word with at least 80% agreement.

Participants were asked to complete a language assessment questionnaire before being brought into the testing room. Items included a 7-point Likert-scale self-rating of bilingual proficiency in each of French and English (anchors were 1 for *Not Very Proficient* and 7 for *Very Proficient*), a brief personal history of French and English exposure, demographic questions and a self-classification question in which participants were asked which of the three proficiency groups (French-dominant, English-dominant, or Balanced bilingual) they felt best described their language abilities. Participants were grouped according to the self-classification they provided unless their Likert proficiency ratings contradicted this (e.g., if they rated themselves as much more proficient in English, but classified themselves as French-dominant or balanced). When such discrepancies occurred, the entire questionnaire was evaluated by the primary researcher and the participant was assigned to a group based on their answers to all the questions on the questionnaire. Generally, French-dominant bilinguals rated themselves higher on French proficiency than on English proficiency and had learned French first as a child. English-dominant bilinguals obtained a lower French proficiency score than English proficiency and self-classified themselves as English-dominant. Balanced bilingual individuals had similar or identical self-reported proficiency (moderate to high proficiency) in both languages. We assessed dominance using a proficiency-based evaluation where participants rated themselves on a number of linguistic variables (rather than examining age of acquisition, for example) because research has shown this to be a more accurate predictor of actual language performance (Ferré, Sanchez-Casas, & Guasch, 2006; Heredia, 1997).

Before entering the testing room, participants were told that they would be encountering French and English words. Once in the testing room, all instructions were given in both French and English to further establish a bilingual context. Participants were instructed to remember the mixed list of words for future recognition. The presence of IHs was not revealed to participants until the debriefing.

Participants viewed words displayed on a 17" computer screen. The words were presented by Direct RT (Jarvis, 2000) in random order. Each word was presented only once, at 600-ms intervals, in teal-coloured uppercase letters on a black background. Words appeared on the screen for 2000 ms.

Following the completion of a maze distracter task, participants read bilingual instructions for the recognition task that followed. Participants were asked to indicate, by pressing the appropriate

Table 2
The Effect of Word Category on Proportion of Correct Recognition

	French words	English words	IH English Picture	IH French Picture
Proportion of Correct Recognition	$.61_a$	$.51_b$	$.44_c$	0.45_c
Standard Error	0.031	0.029	0.027	0.03

**values with different subscripts are significantly different

response key, whether the word elicited by the picture had been present on the list they had viewed moments earlier. Participants were instructed to answer as quickly and as accurately as possible.

For this second stimulus set, approximately half of the pictures represented the words on the original list (including both meanings of the IH) and the remainder consisted of filler items (i.e., pictorial representations of words that were not on the original list). The order of presentation was randomized by the computer and reaction times were measured in milliseconds (ms) through Direct RT (Jarvis, 2000). Once participants had completed the recognition task, they were given a written debriefing and thanked for their time. This study was conducted in accordance with the most recent American Psychological Association and Canadian Psychological Association guidelines.

Results

Both reaction times and errors were analyzed using both subject and item analyses. Two items (the French IH *bras* and *roman*) were removed due to very low accuracy. Speculations about why this might have occurred for these words will be included in the Discussion section.

Reaction Times

No differences were found for the between subject effect of language dominance, $F1(2,41) = .082$, $p = .912$, or the interaction between word category and language dominance by subject, $F1(8,41) = .76$, $p = .476$, or by item, $F2(6,295) = .419$, $p = .866$.

A mixed repeated measures design was used to analyze the data. There was a main effect of word category ($F(4,41) = 37.963$, $p < .001$). Paired sample *t*-tests with Bonferroni correction comparing response times between the word categories showed fastest response times for pictures of pure French words, being faster than all other categories. Results were as follows: English, $t(41) = 4.10$, $p < .001$; IH English: $t(41) = -9.48$, $p < .001$; IH French: $t(41) = -8.23$, $p < .001$. Pictures of pure English words resulted in faster response times than pictures of IH English words, $t(41) = -7.00$, $p < .001$, and pictures of IH French words, $t(41) = -6.00$, $p < .001$, while no difference was found in response times between pictures representing IH English and IH French words, $t(41) = -.96$, $p = .343$. See Figure 2 and Table 1 for means and standard errors. The same results were found in the item analysis, $F2(4,189) = 11.85$, $p < .001$.

Accuracy

As with the RT data, there was no between-subjects main effect of language dominance, $F1(2,41) = .43$, $p = .657$, or word category-language dominance interaction by subject, $F1(8,41) = .69$, $p = .682$, or by item, $F2(6,295) = 1.33$, $p = .242$.

A mixed repeated measures design was used to analyze the data. There was a within-subjects main effect of word category, $F1(4,41) = 29.73$, $p < .001$. Paired sample *t*-tests with Bonferroni correction comparing accuracy between the word categories indicated better accuracy for pictures of French words as compared to English words, $t(41) = -3.73$, $p < .01$, as well as both pictures of English IH words, $t(41) = 5.55$, $p < .001$ and French IH words, $t(41) = 5.27$, $p < .001$. Pictures of pure English words produced better accuracy than those of English IH words, $t(41) = 2.41$, $p < .02$ and marginally better accuracy than those of French IH words, $t(41) = 1.99$, $p = .053$. There were no differences in accuracy between pictures of English IH and French IH words. Refer to Table 2 for means and standard errors. An item analysis revealed no difference for accuracy $F2(4,189) = 1.00$, $p = .407$, suggesting that this effect may not be as robust as the results found with the RT data.

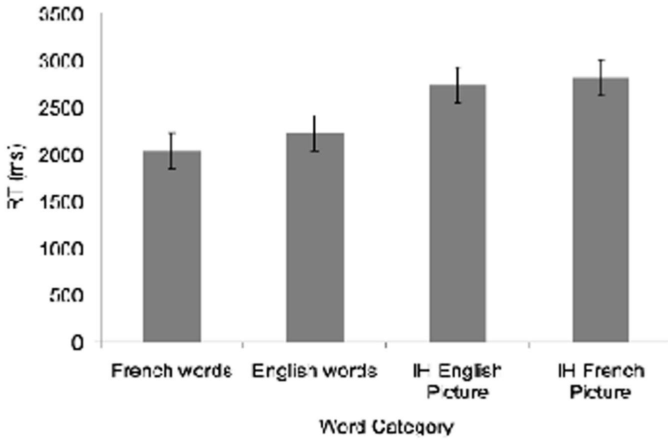
Discussion

Using a new picture paradigm, the present research examined the bilingual individual's two-language system, specifically the processing that occurs as that system encounters IHs. The authors set out to answer the question of whether an IH effect can arise from the activation of two concepts for IHs versus a single concept for non-IH words. It appears that, as predicted, an IH effect (longer RTs caused by the interference of both meanings being initially elicited) can be replicated from the traditional paradigms using this new paradigm, which has the advantage of a more direct activation of the representation, bypassing the possibly of confounding effects of repeating the grapheme at the time of retrieval. Thus, not only are IH effects evident using lexical decision and naming tasks, as previously reported, but they also appear to directly affect the memory retrieval process, as evidenced here. So, to answer the first research question regarding whether representations in both languages are activated when an IH is presented, the answer appears to be yes.

Do we find any differences when using a picture during the recognition phase compared to words (our second research question)? The IH results of the present study, which used a pictorial presentation, are consistent with findings from other researchers focused on bilingualism. The fact that RTs were faster in response to pictures of the language-specific words compared to IH words indicates that IH words take longer to access or retrieve, perhaps because the words in both languages are initially activated by the picture, requiring a choice between the two and a reaction time delay. Specifically, the fact that IH words exist in both of the bilingual individual's languages delays the retrieval process because it requires an additional (language-level) step in order to access the correct word (i.e., in the correct language). This effect should not be surprising in light of the models discussed herein.

The results obtained also suggest automatic, non-specific access, supporting Paivio and Desrochers' (1980) Bilingual Dual Coding Hypothesis. As this model suggests, each IH letter string is associated with two meanings, one for each language, along with their translation equivalents. That is to say that the grapheme

Figure 2. *The Effect of Word Category on Reaction Time (ms).*



pain would elicit "bread" and "pain" from the English lexicon and *pain* "bread" and *douleur* "pain" from the French lexicon. Comparatively, an exclusively English word such as *apron* would only elicit its translation equivalent of *tablier* "apron." Taking this difference into account, it is perhaps not surprising that IH words take longer to differentiate than French or English words. Importantly, in the current pictorial study this increase must be due to the activation of concepts and not to superficial overlap between studied and tested items because pictures were used in the test phase. The evidence found here adds to the growing support for the idea that lexical access in bilingual individuals is non-selective.

As previously mentioned, there were mean differences in word length across conditions, which may have influenced RTs. However, from these means, one would expect longer words to be more difficult and consequently produce longer RTs, which is the opposite of what was found (e.g., New, Ferrand, Pallier, & Brysbaert, 2006, presents a review of the consistent findings of inhibitory or null effects for word length in a variety of tasks, but also presents a unique conclusion that the exact word length effect differs based on the total number of letters in the word). The authors found the fastest RTs for pure French and pure English stimuli, even though these were the longest words. If word length had affected performance, it should have resulted in longer RTs for both groups of pure words, not shorter ones. Comparatively, IH stimuli were the shortest but had the longest RTs, which is again contrary to expectations.

The BIA+ allows for the possibility that non-linguistic context effects (such as task instructions, participants' expectations or strategy use) would affect processing through the task schema system. The present researchers went to great lengths to ensure that participants' expectations were not biased towards one or the other language and presented everything in both languages, in a randomized order. The participants should have expected this to be a completely bilingual task.

Could it be, then, that participants engaged in a particular strategy that could explain the lack of proficiency effects? Somewhat consistent with the predictions, balanced bilingual individuals did exhibit the fastest RTs for both French and English pure words. It is possible, then, that they may have been at a disadvantage for processing the IH items because the simultaneous activation of both words (English and French) resulted in interference. This sort of delay is predicted by both the BIA and BIA+ since initial language access is non-selective. At the very least, results do not appear to be affected by a speed-accuracy trade-off strategy since pure French words elicited the best performance overall, with both fastest RTs and highest accuracy, followed by English pure words, and then the two types of IH stimuli. This suggests that participants followed the researcher's instructions to respond as quickly and as accurately as possible.

Kroll and Stewart's (1994) Revised Hierarchical Model also suggests the possibility of bilingual differences, and so the language dominance variable was included in the analyses. However, no such differences were found in the present study, thus answering the final research question. Bilingual performance advantages have been reported in the literature, though not consistently, and results seem to suggest that advantages are more prominent (or sometimes exclusively found) in balanced or highly proficient bilinguals (Bialystok, 2001; Kessler & Quinn, 1987). In line with this, the fastest RTs (by language dominance) occurred in the balanced bilingual group for both English pure words (2093.6ms compared to 2245.1ms for French-dominant and 2340.8ms for English-dominant) and French pure words (2016.8ms compared to 2077.1ms for French-dominant and 1962.8msec for English-dominant). So, this is consistent with the predictions of the Revised Hierarchical Model (Kroll & Stewart, 1994) with stronger connections (and thus faster retrieval) existing at higher levels of proficiency. As such, a complete and accurate model of bilingual memory and language processing must account for these proficiency effects.

The authors attempted to ensure that the context was truly bilingual throughout the experiment and this could explain the lack of language context effect, though previous studies do not report consistent findings. Some have reported retrieval advantages for matching linguistic contexts whereby language is used as a retrieval cue or strategy, especially by highly proficient bilingual people (Marian & Faussey, 2006); others find no such difference (Insua, 2002). It is possible that differences between the groups of bilinguals in the present study were not large enough to produce significant effects (i.e., dominant participants may have been close to being balanced bilingual and only slightly dominant in the language in question). Future research may improve on the self-reported dominance categorization by administering a language proficiency assessment (e.g., language placement test) in order to overcome this possible limitation. A second possibility is that the nature of the task prevented this effect from occurring, perhaps masking a significant effect. Because this is a new way of examining bilingual processing, further studies using this new picture paradigm are required to tease apart these possibilities and examine whether there is any effect of dominance on memory retrieval at a purely conceptual level. Nonetheless, self-reported proficiency may be considered a limitation.

Since the present methodology is a new way of examining bilingual processing, the bilingual list of words used maximizes the likelihood of bilingual language activation, thus maximizing the likelihood of showing an effect. If this manipulation proves to be successful, then it would be necessary to examine the robustness of the effect by examining processing in a single-language list as well. Previous research examining lexical access in bilinguals has typically used partial or whole words during the recognition process. For the recognition task in the present experiment, stimuli were shown in pictorial form (French, English, and both IH referents). This has at least one advantage that had not yet been exploited in the literature. The most important benefit of this format is that it avoids the problem of superficial recognition, based solely on the surface details. Pictures directly activate the representation without any influence of the grapheme, thus allowing a more direct evaluation of the participant's conceptual representation from the time of encoding.

Finally, a brief discussion of the two items that were omitted from the analyses due to very low accuracy: *bras* ("arms" in French) and *roman* ("novel" in French). The fact that these two items had very low recognition rates suggests that the original encoding of the semantic representation of the IH at the time of presentation did not include the French meaning (since it was not recognized as having previously been presented during the pictorial recognition phase). Why might this have occurred for these two words in particular? The reader may have noticed that both of the English translations provided for these words at the beginning of this paragraph ("arms" and "novel") are ambiguous words in English. Although IHs are ambiguous cross-linguistically, the English-translation of these particular IHs are also ambiguous within the language. In English, *arms* can have a weapon meaning or a human limb meaning. Likewise, *novel* in English can mean something new or a book. Because the English meaning is ambiguous, it can be argued that it has more entries or connections in the mental lexicon, thus increasing the likelihood of its activation (Millis & Button, 1989). As such, it may have been activated so strongly and so quickly that the activation of the French meaning suffered as a result, given the proposal that there is a finite amount of activation which can be used at a given time (Gorfein, 2001). This proposal is purely speculative at this point, but it would be interesting to further probe this possibility in future research.

Future research may also extend these findings to monolingual contexts to assess whether similar activation patterns are evident in a single-language, rather than mixed, context or explore the possibility that a more polarized sample of bilinguals or a different measure would bring to light proficiency effects using this paradigm.

In conclusion, the present study overcomes the limitations of previous IH studies (i.e., the potential confound introduced when using a word during the recognition or test phase) by using pictures during the test phase where encoded stimuli are retrieved. This results in a more direct assessment of concepts, without the influence of the surface-features of the words. Results provide support for an automatic, non-specific access to the lexicon.

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Appendix A- Word Stimuli

French (n = 20)	English (n = 20)	Homographs (n = 33)
Bateau (boat)	Back	Son
Tablier (apron)	Feather	Vent
Pomme (apple)	Duck	Pain
Lait (milk)	Wave	Rides
Avion (airplane)	Toe	Raisin
Parapluie (umbrella)	Hat	Bras
Soleil (sun)	Frog	Store
Mouche (fly- insect)	Spoon	Fin
Septembre (September)	Three	Champ
Papillon (butterfly)	Hammer	Case
Ordinateur (computer)	Flower	Pin
Porte (door)	Shoes	Coin
Couteau (knife)	Castle	Four
Oiseau (bird)	Candle	Tire
Doigt (finger)	Blanket	Dent
Arbre (tree)	Cat	Ballot
Cochon (pig)	Garlic	Robe
Vache (cow)	Calculator	Gorge
Stylo (pen- for writing)	Hand	Point
Deux (two)	Window	Biscuit
		Crayon
		Lime
		Baton
		Tour
		Court
		Front
		Habit
		Singe
		Sale
		Tiers
		Roman
		Castor
		Crane