

**Effects of Semantic Awareness and Language Proficiency
Level on Processing Interlexical Homographs**

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1. Introduction

In this paper, I present the results of a bilingual visual word recognition test carried out among Spanish-English bilinguals. Visual word recognition is essential for reading all through life, but especially in the beginning phase of learning to read. Being a Spanish-English bilingual myself I became interested in how the bilingual mind processes two languages at the lexical level. This language processing can be observed in the way bilinguals activate languages when selecting the meanings of interlexical homographs (IHs). Interlexical homographs are words that exhibit identical written forms but different meanings across languages. For instance, the word ‘pan’ refers to a cooking utensil in English, while in Spanish it means *bread*. The visual word recognition test carried out aimed at shedding light on whether semantic awareness and language proficiency modulate the meaning activation of interlexical homographs. I hypothesized that higher semantic awareness and greater language proficiency lead to shorter reaction times and higher accuracy levels, which are measures for language activation. The inclusion of multimodal stimuli (interlexical homographs paired with images) in the task allows for more accurate results as it prevents any potential language-based bias in the meaning selection of the interlexical homographs.

This study is structured as follows. Chapter 1 provides a theoretical literature review upon which this research is built. Chapter 2 outlines the employed methodology. Chapter 3 and 4, respectively, offer the results and the discussion of the findings derived from the analysis of the reaction times and accuracy rates obtained from the semantic awareness task. Finally, in Chapter 5, I will summarize the key conclusions from this research.

1.1. Literature Review

1.1.1. Metalinguistic awareness and semantic awareness

Most individuals speak their (first) languages with little or no conscious understanding of their internal functioning. They can produce language without actively reflecting on its intricacies—unless they hold an interest in, for example, becoming a language teacher. This unconscious and intuitive language knowledge, which is also known as epilinguistic awareness (Gombert, 1992), opposes the concept of metalinguistic awareness (MeLA), which refers to the capacity to intentionally and thoughtfully access, comprehend and use language. Jessner (2006) describes it as the “ability to focus attention on language as an object in itself or to think abstractly about language, enabling one to play with or manipulate language” (p. 42). In addition, MeLA involves language users going through an initial stage, prior to the language encoding and/or decoding, where they analyze the meaning conveyed in the shape of a linguistic expression (Malakoff & Hakuta, 1991).

Metalinguistic awareness is closely connected to bilingualism and multilingualism since it both influences and is influenced by the learning or acquisition of languages, especially in the education context (Cummins, 1978; Reder et al., 2013). For example, Lasagabaster (1998, 2001) found that language proficiency and metalinguistic awareness strongly correlated in that the more proficient students were in the languages they knew, the greater they scored in metalinguistic awareness tasks. Furthermore, research done by Kopečková (2018) on trilingual children in a primary multilingual program asserted that:

Early multilingualism...carries positive implications for the pupils' metalinguistic awareness and knowledge of the L1, and...early and extensive contact with an L2...has positive effects on the acquisition of additional languages. (pp. 9–10)

Her findings indicated that students in multilingual programs performed better in metalinguistic awareness tasks in each of their languages (L1, L2, L3) than those in traditional language programs. This underscores the role of metalinguistic awareness in successful multilingual acquisition.

Metalinguistic awareness functions at all linguistic levels and allows for analysis of components ranging from sounds and letters to words and texts. Among these levels is semantic awareness,

which is critical for understanding and managing meaning within and between language(s). This capacity underlies vocabulary acquisition, recognition of sense relations, context comprehension, and meaning inference, which all add to the development of MeLA as a whole, therefore contributing to overall language proficiency.

At the heart of semantic awareness is semantics itself, the study of how language conveys meaning. Semantics analyzes relationships between words, such as synonymy (similar meanings), antonymy (opposite meanings), polysemy (multiple meanings), among others. This knowledge is essential for bilinguals, who must interpret and distinguish between meanings not only within language, but also across languages. It guides them in navigating cross-linguistic interactions and choosing words that fit the context more accurately.

Given that meaning is a core aspect in bilingual language processing, both in production and comprehension, semantics plays a central role in various models of bilingualism. This can be seen in the Bilingual Interactive Activation Plus (BIA+) model and the Semantic, Orthographic, Phonological Interactive Activation model (SOPHIA).

The BIA+ model (Dijkstra & van Heuven, 2002) incorporates phonological and semantic levels that are accessed through the separate Semantic, Orthographic, Phonological Interactive Activation model (SOPHIA). SOPHIA complements the BIA+ model to offer a more flexible understanding of how bilinguals recognize words. It includes both sound and meaning information by adding layers that account for letters and phonemes, clusters, syllables, whole words, and the processing of meaning. Unlike the BIA+ model, SOPHIA's language nodes do not suppress the non-target language, which allows for a more interactive relationship between languages.

The BIA+ model was built upon the Bilingual Interactive Activation (BIA) model (Dijkstra and van Heuven, 1998), which originated from the within-language Interactive Activation (IA) model of visual word recognition crafted by McClelland and Rumelhart (1981). The BIA model tailors the IA model for bilingual contexts by introducing “language nodes” for language membership and incorporating a system of activation and inhibition. These language nodes create an additional, higher-level representation layer (e.g., word level → word set level → native language node) that groups all the words from a single language. According to the BIA model, when we see a string of letters, this visual input activates words in both languages that share similar letter patterns while simultaneously inhibiting words with different patterns, regardless of their language.

The activated words then reach their respective language nodes, which in turn trigger inhibitory feedback that suppresses words associated with the opposite language node. For balanced bilinguals both L1 and L2 are equally dominant, therefore they exhibit similarly strong activation and inhibitory mechanisms.

1.1.2. Sense relations

Sense relations imply an internal reference with connections between units within a vocabulary, as opposed to the concept of meaning relations that embody an external link between a word and an entity in the physical or abstract world (Jackson & Amvela, 2000). Sense relations lie on a paradigmatic axe where a word can be replaced by another one in a specific sentential spot. Some sense relations represent similarity (synonymy) and opposition (antonymy), while others express hierarchical relation (hyponymy and hyperonymy) and part-whole relationship (meronymy).

Synonyms are conceived to have identical meanings. However, there are always subtle differences that prevent them from being used interchangeably in all situations. For instance, in a sentence like *I hold my loved ones close to my heart*, the word ‘close’ cannot be changed for ‘near’ as the idea of emotional attachment will be missed. Antonyms exhibit contrast between elements that are oppositional (the adjective ‘short’ is the opposite of the term ‘tall’). There are different types of antonyms: gradable antonyms, contradictory or complementary antonyms (Jackson & Amvela, 2000).

Hyponyms and hypernyms represent a generality/specificity relationship where a subordinate element (kind-of) belongs to a superordinate category. For example, the words ‘pine’ and ‘maple’ are members (hyponyms) of the super category ‘tree’ (hyperonym). In the same line, meronyms draw a part-of relation in which there is representation of a single entity in connection with its constituents; for instance, ‘petal’ and ‘stamen’ are parts (meronyms) of ‘flower’.

1.1.3. The bilingual mental lexicon

One of the most important questions that has been debated in bilingualism research is how bilinguals store the two languages and therefore how they access lexical units. Two opposing hypotheses have been formulated. The first one is built upon the assumption that word access is language dependent, that is, bilinguals only activate and search for word candidates from the mental lexicon of the language that is relevant to the context (language-selective access hypothesis) as suggested by Gerard & Scarborough, (1989). This view presupposes that there is no interaction between the two languages since they are stored in two separate memories (Kollers, 1963, 1966b; Tulving & Colotla, 1970). In contrast, the language-nonselective access hypothesis posits that there is one integrated lexicon, a single compartment, which contains both languages; so, bilinguals initially process an input irrespective of the language system, allowing for a dynamic interrelatedness between languages where they compete. Even though there is supporting evidence for both perspectives, recently, the integrated lexicon hypothesis is more accepted. In fact, it has been widely tested and validated through a variety of approaches and methods (De Groot, 2011; van Assche, Duyck, & Hartsuiker, 2012). The sources for investigating language non-selectivity in lexical access come from how bilinguals process ambiguous words: interlexical homographs (words that have the same orthographic form but different meanings across languages), interlingual homophones (words that have identical sounding patterns but different meanings from one language to another), and cognates (words that share the same or a similar spelling/pronunciation and refer to the same notion).

1.1.4. Visual word recognition studies

Several studies involving visual word recognition in Spanish-English bilinguals have been carried out since the 1980s. One of the first scholars who conducted research in this regard was Jyotsna Vaid (1988). She assessed how bilinguals recalled words (translated words or imaged words, synonyms and monolingual copied words) compared to monolinguals. She found better remembrance of translated words given that bilinguals benefited from activating both separated lexicons, shedding light on the language-selective hypothesis. Later, Macizo et al. (2010) described the inhibitory mechanisms underlying language selection in a comprehension task. More

recently, others have investigated how different factors can affect visual word recognition. For example, Shi & Sánchez (2010b) highlighted the role of word familiarity and Martínez (2023) noted the effects of orthography on the recognition of words among Spanish-English bilinguals.

Homographs (words that have the same spelling but denote different notions) have been used to account for visual word recognition processing either within language or across languages. In monolingual literature, a key issue is whether all meanings of a homograph are initially activated, or they are context constrained. Some studies support the first observation, yet they claim that the level of activation is modulated by meaning frequency (Hogaboam & Perfetti, 1975). However, a preceding sentential context biased toward one of the readings might facilitate its activation while restraining the other, regardless of meaning frequency (Duffy et al., 1988). This would support the idea that meaning selection depends on context.

In bilingualism research, interlexical homographs (the word ‘fin’ means ‘end’ in Spanish, whereas in English it represents the part of a fish) have served to provide evidence for the language-nonselective activation by primarily relying on words in isolation. In doing so, different approaches have been taken, ranging from the comparison of word frequency in each language (Dijkstra, Timmermans, & Schriefers, 2000; Kerkhofs et al., 2006) and the analysis of processing time (measured by reaction times) and accuracy when encountering interlexical homographs, in contrast to monolingual control words (Dijkstra et al., 1998; 1999).

Analyzing interlexical homographs through several paradigms and tasks has yielded different nuanced results. In a semantic paradigm, Beauvillain and Grainger (1987) discovered priming effects in a lexical decision task, since interlexical homographs, used as primes, facilitated the activation of only the meaning of the homographs with high frequency. On the other hand, Dijkstra et al. (1998) has identified no homograph interference (slower recognition processing due to the competition of the two meanings) when the stimulus list composition only had interlexical homographs, words in the L2 target language, and non-words. Once L1 lexical items were included and they required a “no” answer, Dutch-English bilinguals exhibited facilitation (faster reaction times) in a lexical decision task where they responded “yes” if a word in either language was shown. This facilitation effect resulted from participants having two meanings available to be used in either language to make that decision. As a result, task demands along with the inclusion of stimuli in only one or both languages can imply equal, faster or slower processing.

Most of the data (reaction times – accuracy levels) collected with regards to interlexical processing come from proficient bilinguals. Nevertheless, in real life, unbalanced bilinguals outnumber those who are equally proficient in both languages. Unbalanced bilinguals have a language that is more dominant, which usually, but not always, corresponds to their native language. For instance, in Schwartz and Kroll's (2006) study, Spanish-English bilinguals with higher and lower English proficiency levels were asked to identify as quickly as possible specific words embedded in English sentences, which were semantically constrained at different degrees. The target words could be either interlexical homographs (IHs), cognates, or control words (only English words). The findings concluded that lower-proficient bilinguals struggled more with IHs as seen in accuracy rates being reduced compared to regular English words. This difficulty was present irrespective of semantically sentential constraints. Bilinguals with lower proficiency found it harder to inhibit Spanish meanings of the interlexical homographs. In contrast, higher-proficient bilinguals could benefit from the English language context and sentence meaning to lower confusion from their first language. This highlights the importance of language proficiency in managing cross-language interference, influence and interaction.

Lastly, top-down influences can affect how recognition of interlexical homographs operates. Being in a setting (a country) where L1 or L2 is spoken or widely used as a language of communication for work or school purposes can bias participants toward interpreting IHs in the reading of the prominent language (be it L1 or L2). According to Grosjean (2001), bilinguals behave linguistically differently in a completely monolingual environment than in a bilingual setting.

1.2. Current study

1.2.1. Research questions

The main objective of this study is to describe whether semantic awareness and language proficiency influence the recognition of interlexical homographs within the context of an awareness task with multimodal stimuli. The research question of the study is:

- Do semantic awareness and language proficiency level affect the activation of both languages to the same extent in Spanish-English bilinguals?

This main question can be broken down into the following sub-questions:

1. Does proficiency level modulate language activation while reading interlexical homographs?
2. Does semantic awareness reflect accuracy in the processing of interlexical homographs?

1.2.2. Hypotheses

- (1) It is expected that high proficiency levels in both languages lead to greater accuracy and shorter reaction times in recognizing interlexical homographs as proficient bilinguals manage the inhibition of their more dominant language more efficiently (Schwartz and Kroll's, 2006).
- (2) Higher semantic awareness should yield shorter reaction times and higher accuracy rates, particularly in unrelated conditions (stimuli without cross-language semantic conflicts), as unrelated stimuli lack the complexity of language interference, no inhibitory processes need to be mobilized (Macizo et al., 2010), which allows for faster semantic processing.

2. Methodology

2.1. Design

This study has a single-factor within-participants design. 30 subjects performed a semantic awareness task and administered a Bilingual Language Profile questionnaire (Birdsong et al. 2012).

2.2. Participants

30 Spanish-English bilinguals (19 females) took part in this research. However, the results of five of them were excluded from the analysis because they did not reach the threshold score in the pre-test (at least 80% of correct responses, see Semantic awareness test section for more details). Consequently, the materials of 25 participants (16 females) were subject to analysis. All participants were native speakers of Spanish. Most of them (18) can be considered as late bilinguals since they began to be exposed to English after age seven (Silverberg and Samuel 2004). In contrast, the remaining participants can be described as early bilinguals due to their exposure to the second language starting at age of three to six years (Meisel 2004). Despite displaying heterogenous language competences, they fit in Grosjean's definition regarding bilingualism. They all regularly use both of their languages with different people and purposes to fulfill everyday life activities (Grosjean, 1998). The mean age of participants was 28.00 (SD=7.74). 15 participants were between the ages of 19-27, and 10 participants were over 27 years old. All participants were undergraduate or graduate students residing in Hungary at the time of the experiment. Further information on the participants' linguistic background is reported in the Results section (Chapter 3), as part of BLP questionnaire results.

2.3. Instruments

2.3.1. Bilingual language profile

The BLP questionnaire was the first instrument administered before participants undertook the awareness task. To ensure that all the information is correct, the BLP questionnaire was compiled in the L1 of the participants, i.e. in Spanish. It consisted of 19 questions in total, inquiring about

some relevant personal information and linguistic background. However, the data gained from the questionnaire is not revealed in this research to protect the anonymity of the participants. Even though the BLP questionnaire provides information on language dominance, for the purposes of this research, only some of its modules will be taken into account to see the effects of specific dimensions of language dominance in activating interlexical homographs.

2.3.2. Semantic awareness test

A semantic awareness test was administered in this research, in which participants were asked to decide whether the presented stimuli on the screen were related in meaning. A custom-made program was built in MATLAB using the Psychtoolbox-3 software. The codification of the program was developed with assistance of ChatGPT AI chatbot. Before conducting the experiment, the appropriateness of its design as well as its functioning were meticulously tested several times not only by the researcher, but also by two scholars that are familiar with this kind of behavioral methods. The whole experiment consisted of three sections: (i) an AI-generated instructional video, (ii) a semantic awareness pre-test and (iii) a semantic awareness test where interlexical homographs were presented.

The instructional video was in Spanish and lasted 2 minutes 24 seconds. It explained the task to be performed along with some examples of the sense relations and non-sense relations participants could encounter in the task. The examples included a word followed by an image and then a short explanation of the sense relation or non-relation between the two of them. Moreover, they were unable to skip the video and had to watch it until the end.

As for the pre-test, it aimed at measuring participants' semantic awareness prior to the interlexical homograph test. Participants were not informed of the existence of a pre-test. It had an eliminatory nature. Participants needed to meet a pre-defined threshold (80% of correct responses), for their results to be included in the study. Those who did not reach that percentage were eliminated (five subjects). This accuracy threshold, widely used in cognitive and psycholinguistic research, guaranteed that participants exhibited a clear understanding of the task and that they were able to adequately identify sense relations. The stimuli employed in the pre-test consisted of 20 relatively frequent content words (see appendix 1); each one was matched with an image related or unrelated to the meaning of the word in terms of sense relations. There were no cross-language competitors

in the stimulus list. Since I wanted participants' both languages to be activated before the interlexical homograph test, half of the words were in Spanish, and the other half in English.

Finally, the semantic awareness test's stimuli consisted of 32 Spanish-English interlexical homographs adapted from Macizo et al., (2010). For clarity purposes, from now on, this semantic awareness task will be referred to as *interlexical homograph test*. The interlexical homographs were all content words; function words were excluded because of their lack of meaning. The Spanish-English interlexical homographs were chosen irrespective of their meaning frequency, due to their limited number. All images had black & white drawing line style. They were AI-generated using DALL-E and then edited if necessary. The images depicted sense relations of the standard meaning (culture-independent notion) of the interlexical homographs. As seen in Figure 1, for example, the interlexical homograph “pan” was paired with an image representing a hyponymic relation of its meaning in Spanish “bread” (a baguette is a kind of “bread”). Similarly, it was matched with an image drawing a hyponymic / hypernymic relationship of its meaning in English; “pan” and “pot” are both members of the same super category “cooking utensils”. Finally, the interlexical homograph was paired with an image unrelated to either of the two meanings: a chair does not establish a sense relationship with the word “pan”. To ensure that the images represented the target meanings, around 15 students from the Applied Linguistics MA program at the University of Pannonia were asked to name the images during an in-person session. The students belonged to 8 different nationalities and their responses were compared to the intended meanings.

All items were presented in the center of a 15-inch computer screen set to $1,366 \times 768$ pixel resolution and they were seen from a distance of approximately 50-80 cm. Words were presented in black lowercase letters against a white background. Images were displayed 400×400 pixel resolution against a white background. The software Psychtoolbox-3 was used for data collection.

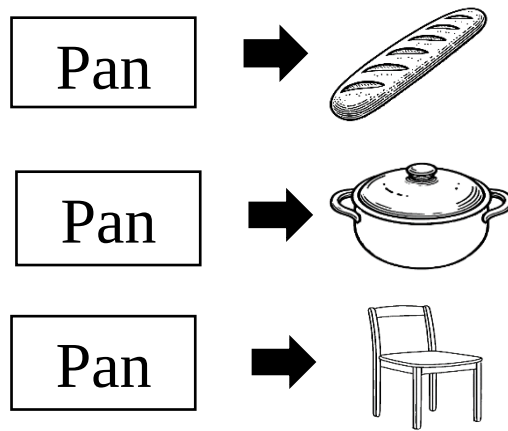


Figure 1. Example of an interlexical homograph paired with images

2.4. Procedure

The participants were tested individually, in a quiet room. They received some preliminary instructions from the investigator. Once they entered an identified code given in advance, the instructional video was displayed on the computer screen. All participants were instructed to press the appropriate button on the keyboard as quickly and correctly as possible. In both the pre-test and the interlexical homograph test, the reaction times were measured from the time span between the display of the image on the screen to the pressing of one of the response buttons. As can be seen in the Figure 1, a trial consisted of: (1) a fixation cross for 500 ms; (2) a word for 1000 ms; (3) a blank screen for 500 ms; (4) an image for 3000 ms. There was an intertrial blank screen for 1000 ms.

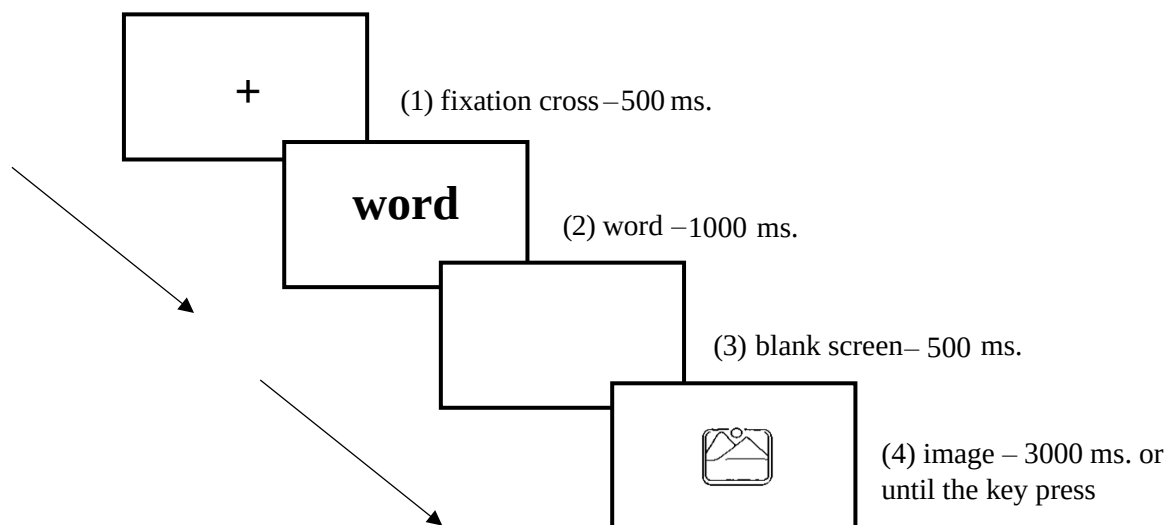


Figure 2. Example of a task trial for both pre-test and interlexical homograph test

The participants were instructed to decide whether the presented image was related in meaning to the word they saw previously by pressing one of the buttons on the right (yes) or left (no) sides of the keyboard. The pre-test consisted of 40 trials in total. A word randomly appeared twice followed by an image for each of the two conditions (related to the word meaning and unrelated). The interlexical homograph test had 96 trials in total. The pattern of presentation is as follows: a word (interlexical homograph) was randomly displayed at three different times followed by an image for each of the three conditions (related to the Spanish meaning of the interlexical homograph, related to the English meaning and unrelated).

2.5. Result analysis procedure

In order to investigate the influence of language proficiency and semantic awareness on reaction times and accuracy while processing interlexical homographs, language proficiency and semantic awareness measurements are required. The BLP questionnaire that was used in this research allowed for collecting data on the participants' language background. In addition, the pre-test served as an assessment tool for participants' semantic awareness. To report on reaction times, accuracy rates and correlations, mean response accuracy and reaction times in all different conditions (for both the pre-test and the interlexical homograph test) were calculated and used for analysis (e.g.: mean accuracy for Spanish related trials). The calculations and correlations were performed in JASP statistics program.

3. Results

3.1. BLP questionnaire analysis

This section presents the participants' language proficiency in L1 and L2 as measured by the BLP. Table 1 shows that on average, participants'

- L1 exposure, as measured by the language history, was significantly greater than L2 exposure ($t(24) = 23.39, p < 0.001$);
- L1 use was significantly more frequent than L2 use ($t(24) = 5.07, p < 0.001$);
- L1 proficiency level was significantly higher than L2 proficiency ($t(24) = 6.54, p < 0.001$).
- L1 attitude was significantly better than L2 attitude ($t(24) = 7.50, p < 0.001$);
- L1 total background was significantly stronger than L2 total background ($t(24) = 14.35, p < 0.001$).

Table 1. Participants' linguistic background data

	L1(Spanish)	L2(English)	Significance
Language History	M=45.63 SD=4.62	M=12.42 SD=5.61	$p < 0.001$
Language Use	M=32.30 SD=6.68	M=19.66 SD=7.39	$p < 0.001$
Language proficiency	M=53.48 SD=1.86	M=45.30 SD=5.95	$p < 0.001$
Language Attitude	M=52.75 SD=4.36	M=32.23 SD=11.90	$p < 0.001$
Total Language Background	M=184.18 SD=7.96	M=109.62 SD=22.44	$p < 0.001$

As noted in Table 1, values across all dimensions of the linguistic background are more homogenous in L1 than in L2. This would indicate a greater variability in L2 scores, suggesting a more heterogeneous diversity in participants' language experiences and skills with regards to English. On the other hand, L2 proficiency and L2 history influence each other because they both

correlate ($r = 0.44$; $p = 0.02$), indicating that as one variable increases, the other tends to increase as well.

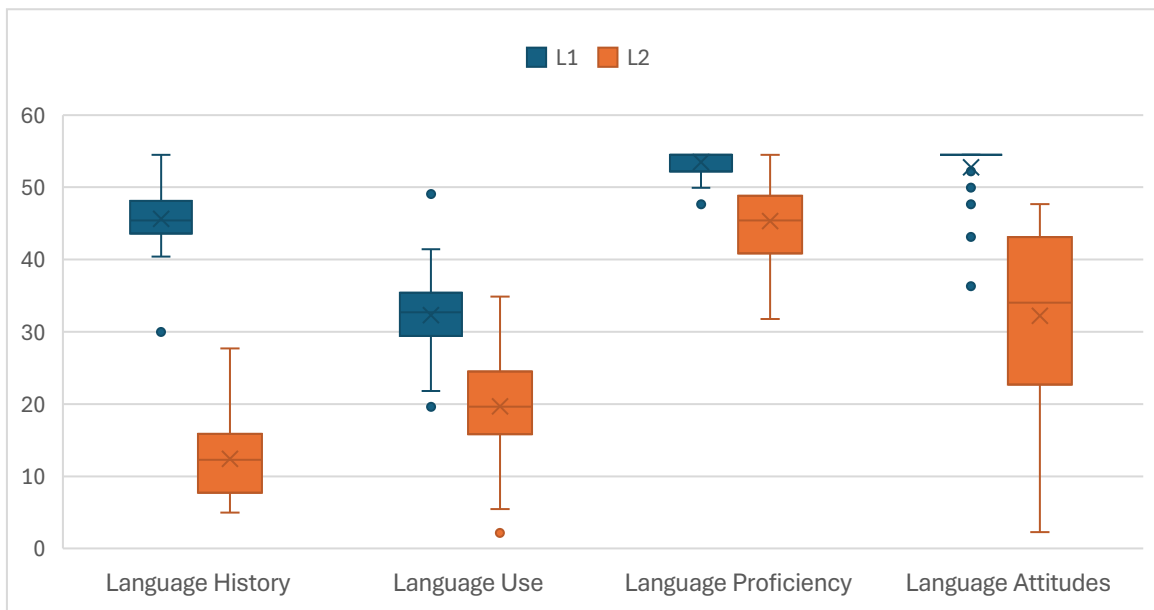
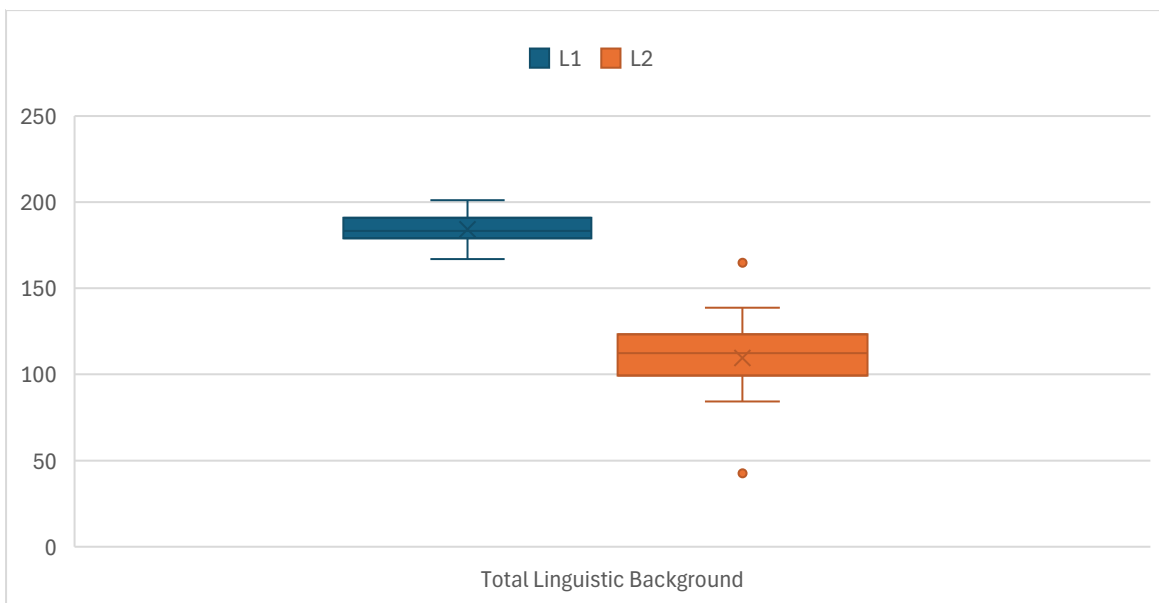


Figure 3. Distribution of total linguistic background values in L1 and L2



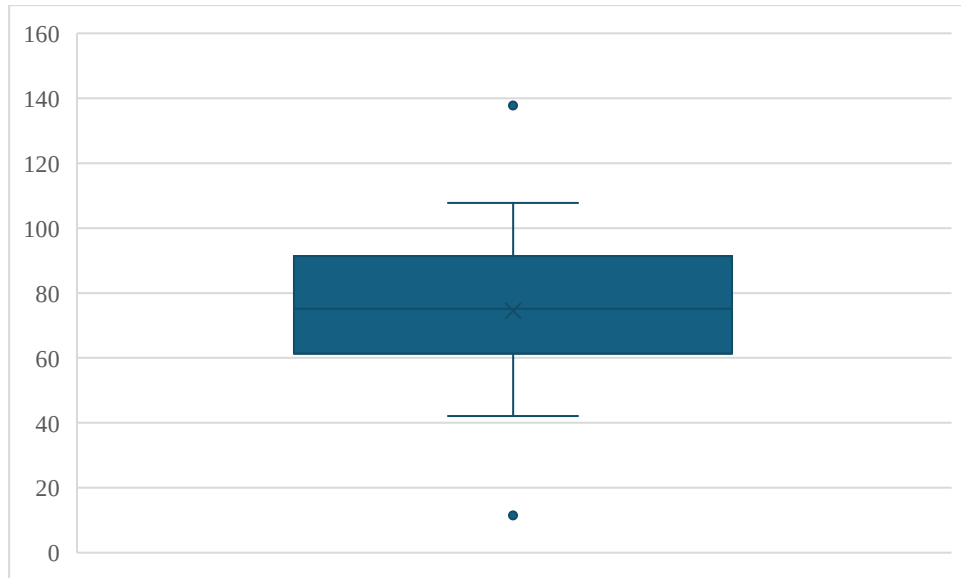


Figure 4. Distribution of language dominance values among participants

On average, participants' language dominance was 74.55 according to the BLP formula ($M=74.55$, $SD=25.96$), which meant that the participants are L1 dominant bilinguals.

3.1.1. Reaction times

The mean of the reaction times (ms) for the overall pre-test was 1094.99 ms. ($SD=5.15$).

3.1.2. Accuracy rate

The mean of the accuracy rate (%) for the overall pre-test was 90% ($SD=6.6$; $p<0.001$).

3.2. Interlexical homograph test

3.2.1. Reaction times

The mean of the reaction times (ms) for the overall interlexical homograph test was 1215.26 ms. ($SD=201.62$). As seen in Table 2, there is no significant difference ($t(24) = 0.04$, $p=0.9$) between the reaction times of Spanish and English conditions, indicating that the mean scores are almost identical. However, it is possible to say that participants responded slightly more slowly to the Spanish meanings of the interlexical homographs in relation to the English ones.

Reaction times comparison: Spanish and English conditions				
Spanish related		English related		Significance
M	SD	M	SD	
1251.90	204.24	1250.77	206.61	p<0.9

Table 2. Reaction times comparison: Spanish vs English conditions in the interlexical homograph test

However, when the reaction times of the Spanish and English conditions were individually compared to the reaction times of the unrelated condition, some significant differences were found. First, as Table 3 shows, participants responded faster to the unrelated meaning of the interlexical homographs ($t(24) = -3.93, p < 0.001$) compared to the Spanish notion. Likewise, reaction times were slower in the English condition ($t(24) = 4.08, p < 0.001$) with regards to the unrelated one, as indicated in Table 4.

Reaction times comparison: Spanish and unrelated conditions				
Spanish related		Unrelated		Significance
M	SD	M	SD	
1251.90	204.24	1143.10	233.14	p<0.001

Table 3. Reaction times comparison: Spanish vs unrelated conditions in the interlexical homograph test

Reaction times comparison: English and unrelated conditions				
English related		Unrelated		Significance
M	SD	M	SD	
1250.77	206.61	1143.10	233.14	$p < 0.001$

Table 4. Reaction times comparison: English vs unrelated conditions in the interlexical homograph test

3.2.2. Accuracy rate

The mean of the accuracy rate (%) for the overall interlexical homograph test was 74.95% ($SD = 5.85$). As seen in Table 5, a significant difference between accuracy rates for the Spanish and English conditions is observed. Participants responded more accurately in the English related meanings ($t(24) = 3.41, p = 0.002$).

Accuracy rate comparison: Spanish and English conditions				
Spanish related		English related		Significance
M	SD	M	SD	
55.75 %	16.77	70.12 %	10.00	$p = 0.002$

Table 5. Accuracy rate comparison: Spanish vs English conditions in the interlexical homograph test

Moreover, when accuracy scores for the Spanish and English conditions are each compared to the unrelated condition, some significant differences arise. As Table 6 indicates, participants were more accurate in the unrelated meaning condition ($t(24) = 12.51, p < 0.001$) compared to the Spanish one. Similarly, they responded more accurately in the unrelated condition ($t(24) = 13.96, p < 0.001$) with regards to the English one, as shown in Table 7.

Accuracy rate comparison: Spanish and unrelated conditions				
Spanish related		Unrelated		Significance
M	SD	M	SD	
55.75 %	16.77	99.00 %	1.74	p<0.001

Table 6. Accuracy rate comparison: Spanish vs unrelated conditions in the interlexical homograph test

Accuracy rate comparison: English vs Unrelated and conditions				
English related		Unrelated		Significance
M	SD	M	SD	
70.12 %	10.00	99.00 %	1.74	p<0.001

Table 7. Accuracy rate comparison: English vs unrelated conditions in the interlexical homograph test

3.3. Comparison pre-test and interlexical homograph test

3.3.1. Reaction times

As shown in Table 8, participants responded significantly faster in the pre-test than in the interlexical homograph test ($t(24) = -3.29, p = 0.003$).

Reaction times comparison: pre-test vs Interlexical homographs test				
Pre-test		Interlexical homograph test		Significance
M	SD	M	SD	
1094.99	249.17	1215.51	201.62	p= 0.003

Table 8. Reaction times comparison: pre-test vs interlexical homograph test

3.3.2. Accuracy rate

Participants performed significantly better in the pre-test than in the interlexical homograph test ($t(24) = 12.56, p < 0.001$) as observed in Table 9.

Accuracy rate comparison: pre-test vs Interlexical homographs test				
Pre-test		Interlexical homograph test		Significance
M	SD	M	SD	
90.00 %	5.15	74.95 %	5.85	p<0.001

Table 9. Accuracy rate comparison: pre-test vs interlexical homograph test

3.3.3. Correlations

A strong positive significant correlation ($r = 0.69; p < 0.001$) was observed between the pre-test and the interlexical homograph test reaction times. This means that participants who had longer reaction times in the pre-test also tended to have longer reaction times in the interlexical homograph test. Conversely, those with shorter reaction times in the pre-test tended to have shorter reaction times in the interlexical homograph test. In addition to that, a medium positive significant correlation ($r = 0.41; p = 0.04$) was identified between accuracy rates in the pre-test and the

interlexical homograph test. Those who performed high on the pre-test also scored high in the interlexical homograph test and vice versa.

3.4. Interlexical homograph test correlations with linguistic background

When results from the interlexical homograph test (reaction times and accuracy rates) were paired with the scores of the different linguistic background dimensions (obtained from the BLP), two main significant correlations were found: L2 proficiency positively correlated with the mean of accuracy rate for the English condition ($r = 0.42$; $p = 0.03$) and, L2 history also showed a positive correlation with the mean of accuracy rate for the English condition ($r = 0.44$; $p = 0.02$). This suggests that participants with a higher L2 proficiency and a richer L2 history displayed greater levels of accuracy when recognizing the meaning of the interlexical homographs as opposed to bilinguals with a weaker L2 history and L2 proficiency.

4. Discussion

The findings of this study highlight the way in which language proficiency and semantic awareness modulate the processing of Spanish-English interlexical homographs (IHs), thereby providing insights into bilingual word recognition. Reaction times (RTs) and accuracy were measured during a semantic awareness task. Slower reaction times and lower accuracy in the interlexical homograph test compared to the pre-test support the idea of increased cognitive demands, as a result of navigating lexical ambiguity in the bilingual mind. When retrieving the meaning of interlexical homographs, bilinguals invest additional mental effort and time choosing from competitors across languages. Since in the pre-test participants process words existing only in one language system, they do not encounter such cross-linguistic competition: therefore, leading to faster responses and better performance. This aligns with the BIA+ model and the language-nonselective access hypothesis, which posit that bilinguals simultaneously activate both language systems.

Within the interlexical homograph test, an identical pattern was observed. Unrelated meanings exhibited significantly higher RTs and greater accuracy rates in contrast to Spanish and English related notions. This indicates that when mapping a single written form onto one of the two interlexical meanings, bilinguals experience cross-linguistic interference, that is, potential lexical candidates from the non-target language are also activated during word recognition (Dijkstra & van Heuven, 2002), delaying meaning selection in the target language. In order to manage such linguistic parallel activation, the bilingual mind mobilizes some inhibitory mechanisms (Macizo et al., 2010) that suppress the non-target language, resulting in prolonged reaction times and reduced accuracy. When the unrelated condition is left out of the equation and the Spanish-related and English-related conditions are compared to each other, participants tended to display similar reaction times with a small difference of 1.13 ms. These values suggest a close processing speed across both languages.

Accuracy rates provide evidence for the role of language proficiency and language history in resolving semantic conflicts. L2 proficiency was moderately correlated with accuracy rates obtained from the English-related condition ($r = 0.42$; $p = 0.03$). This reinforces the assumption that higher L2 proficiency enhances bilinguals' ability to resolve cross-language ambiguity effectively (Schwartz and Kroll, 2006), leading to more accurate retrieval of the English lexical

representations. In fact, proficiency might strengthen inhibitory control mechanisms that allow bilinguals to more easily deactivate their dominant language (L1) and focus on the L2 meaning (Green, 1998; Kroll et al., 2008). Furthermore, the correlation of L2 proficiency with accuracy rather than with reaction time indicates that proficiency affects accuracy more directly than speed in bilingual lexical processing. This may suggest that, while L2 proficiency facilitates correct meaning selection, the actual speed of activation is less dependent on proficiency and more reliant on the cognitive processes involved.

Since proficiency only reflects language skills at a specific moment, it cannot be considered in isolation but as the result of several factors, as seen in the correlation between L2 proficiency and L2 language history ($r = 0.44$; $p = 0.02$). L2 history seems to be a predictor of accuracy in bilingual word processing. A richer set of cumulative experiences with second language (L2 history) positively correlated with a better performance on accessing the English-related meanings ($r = 0.44$; $p = 0.02$). These experiences involved age of acquisition and the duration of language exposure and learning in different settings (school, foreign country, family, work) throughout participants' lives. Subjects with a more extended exposure to English scored higher in English-related conditions, while those with shorter-term language experience struggled more to successfully select the target notions. Efficient access to English meanings during tasks involving ambiguous words might be grounded by the strength of L2 lexical networks in the bilingual mind. The intensity of such semantic interconnections might be shaped and enhanced by the experiences participants have had with their second language. On the other hand, just like language proficiency, language history might also foster inhibitory processes that help subjects cope with L1 interference. These findings are in line with the integrated lexicon hypothesis, as bilinguals with richer L2 histories are likely to develop stronger inhibitory control mechanisms to silence irrelevant L1 information when processing interlexical homographs.

Semantic awareness, as one dimension of Metalinguistic Awareness (MeLA), has shown to have a critical influence on visual word recognition. In fact, the positive correlation between accuracy rates in the pre-test and in the interlexical homograph test ($r = 0.41$; $p = 0.04$) reveals the multifaceted nature of semantic awareness. It operates not only within language, allowing for the identification of words in a single language (as in the pre-test), but also across languages, facilitating the recognition of lexical items with cross-language competition (as in the interlexical homograph test). Consequently, semantic awareness acts as a cognitive foundation for bilingual

lexical processing since the ability to identify and interpret sense relations can be transferred and applied to tasks with different degrees of complexity involving one to multiple language systems. Based on the patterns of activation described, it is possible to say that participants simultaneously activated both languages. Furthermore, L2 language proficiency, along with L2 history, significantly modulated such activation by facilitating the selection of English meanings, as seen in L2 related accuracy rates. Semantic awareness also played a dynamic role in lexical ambiguity resolution. Those with high accuracy scores in the simple pre-test reached high performance in the more cognitive demanding task (interlexical homograph test) as well. Thus, I can conclude that hypothesis (1) was partially confirmed. While higher L2 proficiency levels led to greater accuracy, it did not significantly impact reaction times. This indicates that proficiency improves accurate meaning retrieval but does not affect processing speed. Hypothesis (2) was also partially validated, as semantic awareness did not influence reaction times in the interlexical homograph test, but only the overall accuracy rates.

5. Conclusions

This study adds to our understanding of the dynamic relationships between language proficiency and semantic awareness on one side, and visual word recognition of Spanish-English interlexical homographs on the other. The findings point out that both language proficiency and semantic awareness are predictors of correct L2 meaning selection during cognitive tasks. These results coincide with models of bilingual processing, like the BIA+ model, which propose that bilinguals have one integrated lexicon where the two languages are constantly interacting and influencing each other. This leads to cross-language interference and an increased cognitive burden when selectively retrieving meaning.

The consistent accuracy in identifying English meanings among participants supports the view that higher proficiency in the second language reinforces bilinguals' control over language-specific meaning selection. As a result, this will facilitate the inhibition of the non-target notions. However, the lack of influence of proficiency on reaction times suggests that accuracy rather than processing speed relies more on language proficiency in bilingual cognitive tasks.

To sum up, this paper demonstrates that bilingual lexical processing is a complex phenomenon where several role players intervene, for instance, bilinguals' linguistic background: L2 proficiency and L2 history, and semantic skills. These insights allow us to comprehend the bilingual cognitive workings as they show modulating effects (i.e. language-specific proficiency) that benefit and facilitate meaning activation across language systems.

Implications for the future

Future research should be conducted to examine the intricacies and interrelatedness between proficiency and other factors such as meaning frequency and local context in bilingual word recognition.

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Appendix 1

Stimuli of the pre-test	
Spanish *	English * *
Word	Word
Casa (house)	Pants
Juguete (toy)	Job
Vehículo (vehicle)	Food
Hormiga (ant)	Hungary
Cuchara (spoon)	Golf
Banco (bank)	City
Trompeta (trumpet)	Gun
Puerta (door)	Weak
Limpio (clean)	Tablet
Baraja (deck)	Bitter

*Taken from the Spanish Lexical Database (ESPAL)

* *Taken from the English Web Corpus (enTenTen)

Appendix 2

Stimuli of the interlexical homograph test

Interlexical homograph	Translation
Pie	Foot
Grape	Staple
Pan	Bread
Cave	Dig
Come	Eat
Dame	Give
Talon	Heel
Sale	Leave
Lame	Lick
Mate	Infusion
Red	Net
Pillar	Catch
Done	Donate
Sane	Heal
Case	Marry
Collar	Necklace

Tire	Throw
Meter	Put
Lean	Read
Arena	Sand
Dice	Say
Son	Sound
Time	Swindle
Gusto	Taste
Ate	Tie
Tea	Torch
Sauce	Willow
Vine	Come
Fin	End
Eleven	Rise
Tender	Hang
Mayor	Elder