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Translation Priming across L1 and L2: The Case of Abstract vs. Concrete Primes

Birinci ve İkinci Dil Arası Sözcük Çevirileri: Soyut ve Somut Sözcüklerin Durumu

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Abstract

Bilingual memory representation or the way bilinguals restore and retrieve words in their mental lexicon has intrigued psycholinguists in the past decade. Research on the psycholinguistic elements of bilingualism has increased at a "dizzying rate" over the years (Kroll & De Groot, 2005). The present study explores how bilinguals share semantic features of their L1 and L2 using a masked semantic paradigm. Target-prime pairs addressed in the study were cross-language translation pairs in two different directions from L1 to L2 and vice versa including abstract and concrete words. All experiments were done using DMDX software for measuring reaction times in lexical decision tasks with non-cognate prime-target pairs. The results of experiment 1 showed a significant priming effect from L1 to L2 for concrete words. In the opposite direction, the results of experiment 2 showed a significant priming effect from L2 to L1 for abstract words. The results suggest that L1 and L2 are represented using a similar lexico-semantic architecture and network. In this network, L2 words are able to activate semantic information as well as L1 words. This is consistent with models emphasizing quantitative rather than qualitative differences between L1 and L2 representations.

Keywords: Bilingual memory, cross-language priming, translation priming, lexical decision tasks, abstract vs. concrete words.

Özet

Zihinsel sözlükteki iki dilli hafıza temsilleri ya da sözcüklerin iki dilli düzenleme ve düzeltme yolu geçmiş on yılda psikodilbilimcilerin ilgisini çekmekteydi. İki dilliliğin psikodilbilimsel ögeleri üzerine araştırmalar yillar boyunca baş döndücürücü bir hızda artmaktadır (Kroll & De Groot, 2005). Şu anki çalışma iki dillilerin gizlenmiş anlamsal paradigmalarının, birinci ve ikinci dillerinin kullanım özelliklerinde nasıl paylaşıldığını araştırmaktadır. Çalışmada belirlenen hedef sözcük çiftleri, birinci dilden ikinci dile iki farklı yönde diller arası çevrilen çiftlerdir ve karşılıklı olarak soyut ve somut sözcükleri içermektedir. Araştırma sürecinin tamamında, yakınlığı olmayan hedef sözcük çiftlerinin, sözcüksel amaca karar vermede karşılık verme sürecini hesaplamak için DMDX yazılımı kullanılmıştır. Birinci araştırmanın sonucu, somut sözcükler için birinci dilden ikinci dile somut sözcükler için başat sözcük etkisinin (priming effect) anlamlı olduğunu göstermektedir. Diğer taraftan ikinci araştırmanın sonucu, soyut sözcükler için ikinci dilden birinci dile başat sözcük etkisinin anlamlı olduğunu göstermiştir. Sonuçlar, birinci ve ikinci dilin kullanımının benzer sözcüksel-anlamsal yapıda ve ağda temsil edildiğini göstermektedir. Bu ağda, ikinci dildeki sözcükler birinci dildeki

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sözcük bilgileri gibi aktive edilebilir. Bu durum da birinci ve ikinci dildeki temsiller arasında farkın nitelikselden ziyade niceliksel olduğunu vurgulayan modellerle tutarlıdır.
Anahtar Sözcükler: İki dilli bellek, diller arası başat sözcükler, çeviri sözcükler, sözcüksel karar amaçları, soyut ve somut sözcükler.

1. Introduction

1.1. Translation Priming across L1 and L2: The Case of Abstract vs. Concrete Primes

People are connected across political borders and cultures in today's globalized societies. As a result, an increasing number of individuals are becoming bilingual or multilingual. Given that more than half of the world's population speaks at least a second language (Grosjean and Li, 2012), it's not surprising that researchers are becoming increasingly interested in bilingual speakers' language systems.

Bilingualism is a topic of study in various fields, including psychology, applied linguistics, education, literature, and translation studies, among others. Language acquisition theories, which guide language teaching approaches and materials design, frequently depend on psychological evidence. The cognitive architecture of the bilingual language processing system can be investigated by studying bilinguals' language performance. Furthermore, knowledge gained through multilingual language use can give information on the language processing system as a whole. The fact that most of the world's population speaks more than one language is one strong argument for researching bilingualism (Traxler, 2012). Furthermore, given the popularity and importance of learning second languages, it is critical to get better knowledge of how second languages are learned and utilized, as well as how the first language might aid or obstruct these learning processes.

One of the most critical questions for models of bilingual memory is whether the semantic representation of one language is shared with the other. Although it is often considered that the two languages have independent word-form lexicons and a shared semantic level that allows cross-language semantic priming (i.e. hierarchical models), empirical evidence is mixed. Indeed, Kroll & de Groot (2005), suggest that a review of the research on semantic representations in bilinguals found that "the evidence may not be strong enough to confirm completely shared representations at the semantic level" (Francis, 2005, p. 260). This is not unexpected considering that the majority of the studies have focused on people who, although fluent in a second language (L2), did not learn it in a natural setting. In such cases, vocabulary development in the second language may diverge significantly from that in the first language (Basnight-Brown, Chen, Hua, Kostic, & Feldman, 2007; Bosch, Costa, & Sebastian- Galle's, 2000; Brysbaert, 2003; Jiang & Forster, 2001).

A masked priming paradigm is being used in different studies to see how the lexical entries in L1 and L2 are related in bilinguals (Gollan et al., 1997; Grainger & Frenck-Mestre, 1998; Jiang, 1999; Jiang & Forster, 2001, Davis, Kim & Sanchez-Casas, 2003, Finkbeiner et al., 2004). A target word in one language was primed with a translation-equivalent term in the other language in these experiments. The prime was shown for a short time (40-60 milliseconds)

before the target word. Furthermore, the prime was preceded by a front mask and occasionally followed by a reverse mask, obscuring the prime for the participants. Because the participants were uninformed of the prime, it was improbable that they would use the translation equivalent of the prime to anticipate the target word. Otherwise, they wouldn't use a retroactive technique, in which the target's relationship to the prime serves as a cue for the decision. As a result, utilizing this method has the benefit of being more sensitive to automatic processes while being less sensitive to strategic activities. Response times and mistake rates on primed target words are compared to unprimed examples in measurement. When the primed target responds quicker than the unprimed target, a priming effect is noticed, which is regarded as indicating that the lexical entries in both languages are related in some manner, either at the lexical or semantic level or both.

Early research with masked priming technique suggested that translation priming was limited to cognate terms across alphabetic languages (de Groot, & Nas, 1991; Sanchez-Casas, Davis, & Garcia-Albea, 1992), but later work with languages with different scripts revealed that non-cognates (words that just shared semantic representations) produced strong priming as well (Finkbeiner et al., 2004; Gollan et al., 1997; Grainger & Frenck-Mestre, 1998, Forster & Jiang, 2001; Jiang, 1999). Cross-language translation priming, according to Forster and Jiang (2001), had to happen at the conceptual level because priming at the form level was impossible. A priming asymmetry effect (a stronger priming from L1 to L2 or vice versa) and a task effect have been reliably demonstrated with this type of priming. In lexical choice tasks, it has been hypothesized that priming occurs exclusively from L1 to L2, but not the other way around, with distinct bilingual individuals. This might indicate that bilinguals are unable to adequately process L2 primes in such a short period of time. Asymmetry is also determined by the task. The asymmetry disappears when the task is changed to semantic categorization and translation priming in the L2-L1 direction is restored (Grainger & Frenck-Mestre, 1998; Finkbeiner et al., 2004).

The concreteness or abstractness of the terms employed in the trials is another critical component in priming investigations. The difference between concrete and abstract words is that concrete words have physical referents, but abstract words do not. The concreteness effect has been tested for high and low-frequency words in the single word recognition paradigm, and the pattern of results varies. Gernbacher (1984) linked the conflicting patterns to familiarity, distorting the data, implying that familiarity substantially corresponds with concreteness and recognition latencies. Gernbacher could not find the primary effect of concreteness on recognition latencies when he controlled for familiarity with low-frequency terms. Jin (1990) asked English monolinguals to undertake a semantic priming task for concrete and abstract target terms as part of a cross-language semantic priming experiment and found no difference between the two. However, a pattern in the data suggests that abstract word pairs had a stronger semantic priming impact than concrete word pairs. More research is needed to validate these findings and make the appropriate methodological changes.

Gollan et al. (1997) looked at both English–Hebrew and Hebrew–English bilinguals and found that translation priming from L1 to L2 was significant but translation priming from L2 to L1 direction was not significant. Jiang (1999), who researched Chinese–English bilinguals, confirmed these findings. Except in one experiment, when a 13-msec effect was produced with relatively frequent stimuli, the L2–L1 priming effect was missing. Jiang and Forster (2001) found no significant priming effects from L2 to L1 in a similar study with comparable bilinguals but they could find strong priming effects from L1 to L2.

Grainger and Frenck-Mestre (1998) used the masked priming paradigm to study highly proficient English-French bilinguals in a lexical judgment task and a semantic categorization task. In the experimental condition, non-cognate translation equivalents in English and French were chosen as the prime and target. From L2 to L1, prime words were delivered in French and target words in English. The results showed that in both semantic categorization and lexical decision tasks, reaction times were identical. In the semantic categorization task, however, there was a considerable translation priming effect, but not in the lexical decision task.

Another element that influences how words are remembered in a bilingual memory is the word's properties. The cognate status of the translation pair is one of these features that has been studied in numerous studies and across several languages. Some empirical investigations looked at the distinctions between cognate and non-cognate words (Gollan et al., 1997; Lalor & Kirsner, 2001). Non-cognates are comparable translations in two languages with different spellings and sound patterns (for example, the Persian word /sabz/ and its English equivalent green). Cognates, on the other hand, are translation equivalents that have a comparable orthographic or phonetic form (Kondrak, Marcu, & Knight, 2003). The resemblance is mainly due to historical causes (for example, the Persian term /lab/ and its English translation lip) or borrowing from one language to another (for example, the Persian word /keyk/ and its English equivalent cake). Because these words are so similar in both languages, they must be eliminated from word stimuli for investigating automatic and pure priming effects. The degree of priming for cognates and non-cognates has frequently been studied in these investigations. They wanted to see if there was a difference between words that shared semantic, orthographical, and phonological representations (cognates) and words that just shared semantic representations under priming conditions (non-cognates).

Perea, Dunabeitia, and Carreiras (2008) investigated whether extremely proficient Basque–Spanish bilinguals have masked translation priming for non-cognates. They discovered that there was a large amount of masked translation priming effect. Furthermore, there were no persistent patterns of asymmetry in the magnitude of the masked translation priming effects across languages, suggesting that the subjects were well-balanced bilinguals. When the prime is in L1, and the target is in L2, masked translation priming is more robust with less balanced bilinguals.

Schoonbaert et al. (2009) investigated cross-language priming effects in imbalanced Dutch-English bilinguals using non-cognate translation pairings. They were able to get considerable translation priming from L1 to L2 as well as L2 to L1. The impact from L1 to L2 was, on the other hand, much greater than the effect from L2 to L1. With Greek-Spanish bilinguals, Dimitropoulou et al. (2011) discovered a masked priming effect in the L1 to L2 direction, but not the other way around. Although certain research (e.g., Duyck and Warlop, 2009) found evidence opposing translation priming asymmetry, most cross-language translation priming studies have shown asymmetry, with more strong priming from L1 to L2 than the opposite.

In the case of Persian and English, Fotovatnia and Taleb (2012) used a masked paradigm with cognates and non-cognates to study the semantic priming effect with Persian-English bilinguals. Non-cognates, on the other hand, did not show a substantial priming effect, according to the researchers. Ansarin & Javadi (2018) evaluated the priming effect with Persian-English bilinguals in four types of pairs using a masked paradigm. Translation equivalent pairings, semantically comparable pairs, associatively related pairs, and associatively/semantically related pairs were the four pairs studied. For translation comparable pairings, semantically similar pairs, and associatively related pairs, the authors could not identify a priming effect. They were only able to discover a priming effect for pairings that were associatively/semantically connected.

Using the semantic priming paradigm, Ansarin and Saeeidi Manesh (2015) studied whether bilinguals shared semantic aspects of their L1 (Persian) and L2 (English). Target-prime pairings that were semantically related were investigated in two trials. The semantic priming effect was not found in any of the experiments. Ansarin and Saeeidi Manesh (2017) used a masked paradigm to investigate the semantic priming impact on Persian-English bilinguals. Similarly, they reported no evidence of a semantic priming effect.

In another study, Ansarin et al. (2022) investigated if bilinguals share semantic features of their L1 (Persian) and L2 (English) using a masked semantic paradigm. In their study target-prime pairs were cross-language semantically related pairs in two different directions from L1 to L2 and L2 to L1 in two experiments, including abstract and concrete words. The experiments showed that semantic priming could not be observed either from L1 to L2 or from L2 to L1. The difference between abstract and concrete words was significant only in experiment 1 from L1 to L2.

For a variety of reasons, research into priming effects for translation word pairs is crucial. First, the approach adopted is generally recognized as one that leads to the discovery of language representational structure in human memory. Second, the field's focus is on a situation that affects the vast majority of people across the world: learning and communicating in several languages. Third, work in this general area has led to the development of research tools that have been used to uncover general language-processing mechanisms that apply to monolingual people as well, since cross-language stimuli may

help in the investigation of basic levels of language representation that is semantics while others are held constant that is lexicality. Fourth, it is commonly believed that the priming approach may be utilized to investigate the automaticity of language processing. When language representation and processing models are investigated, masked priming method can be more revealing. Finally, this sort of investigation is practical and relatively simple to conduct, implying that further development of the approach and careful consideration of methodological difficulties are required to promote this type of work across cultures.

Because Persian and English employ entirely distinct scripts, the two languages appeared like suitable candidates for the masked priming paradigm in this study. The goal of this study was to look at multilingual mental lexicon and mental access. As previously stated, one of the most effective techniques to evaluate the status of words from two different languages in the bilingual mental lexicon is to check for priming effects across languages. However, because it removes bilinguals' strategic use of primes, masked priming rather than unmasked priming is thought to provide more exact results. The study was conducted to answer the following questions:

RQ1: Can masked translation priming effect be achieved using L1 Persian abstract primes for Iranian EFL learners?

RQ2: Can masked translation priming effect be achieved using L1 Persian concrete primes for Iranian EFL learners?

RQ3: Can masked translation priming effect be achieved using L2 English abstract primes for Iranian EFL learners?

RQ4: Can masked translation priming effect be achieved using L2 English concrete primes for Iranian EFL learners?

1.2. Statement of the Problem

Traditional techniques for teaching vocabulary were employed until recently. Some teachers haven't given enough thought to how to teach vocabulary growth efficiently. It was believed that teachers used to overlook vocabulary learning and did not devote enough time to it since they assumed that students could easily acquire language on their own. The employment of methods and techniques for coping with vocabulary items is crucial and beneficial. Translation priming through vocabulary retention is one of the ways which helps pupils remember words, enhance their vocabulary, and better understand unfamiliar terms.

1.3. Purpose of the Study

The purpose of this study was to look at how second language learners' native language interacts with their second language. The level to which a language learner's native language is active during the use of a second language, as well as the extent to which the languages may interact during language usage, are all widely debated issues. The purpose was to investigate adult language learners' performance in their native and second

languages in order to address this controversy. Adult English language learners who spoke Persian as their first language were the participants. In the lexical decision task, the current study was also meant to see under what conditions two forms of cross-language priming, translation priming and cross-language semantic priming, occur. This helps us to distinguish between models that propose qualitatively distinct L1 and L2 representations and models that propose quantitatively different L1 and L2 representations.

2. Method

2.1. Design of the study

The masked priming paradigm in experimental research design is used in this study because it is a well-established and successful strategy for researching bilingual lexicon and lexical retrieval. Two experiments were conducted to investigate masked priming utilizing L1 and L2 primes and targets between Persian and English.

2.2. Participants

A total of 97 male and female undergraduate students from the University of Tabriz took part in the study. For their involvement in the study, the participants received extra course credit. They had all completed at least six years of formal English training and had learned Persian as the country's official language since childhood. All subjects had normal vision or eyesight that had been corrected to normal vision with glasses.

2.3. Materials

Four groups of prime-target pairs were created: in group one, primes were translations in Persian, and targets were in English using abstract words (e.g., خطر - danger). In group two, primes were translations in Persian, and targets were in English using concrete words (e.g., باران - rain). In group three, primes were translations in English, and targets were in Persian using abstract words (e.g., danger - خطر). In group four, primes were translations in English, and targets were in Persian using concrete words (e.g., rain - (باران. In all experiments, primes were masked. In dealing with the two languages of Persian and English, the components of the pairs were non-cognates. Each experiment consisted of 20 related pairs and 20 unrelated pairs. In each experiment, there were 20 pairs of nonwords derived from the Australian Research Council (ARC) nonword database for the lexical decision task. Since the words used in the study varied from 2 to 8 letters in length, the nonwords were also derived concerning the same criteria. Each participant received 60 trials per experiment, 120 trials in two experiments. The order of the trials and experiments was randomized for each participant.

A TOEFL proficiency exam was administered to ensure that the study participants were balanced bilinguals. Based on their TOEFL test scores, proficiency level of the all paticipants was intermediate. Each student was called individually to schedule a time to participate in the studies. In addition, each participant was requested to complete a linguistic background

questionnaire. Questions about their age, years of English instruction, if they had eyesight issues, and whether they had ever lived in an English-speaking nation were all included in the survey. They were told that if they were using glasses, they should bring them with them on the exam day.

In a quiet environment, each participant was assessed separately. The participants were informed prior to the commencement of the session that they would be assessed to determine how quickly they could recognize English words without making any mistakes. The words, they were informed, were simple words like rain. Each participant was given 24 pilot trials to practice and master the yes/no keys by putting stickers on the keyboards to indicate yes and no on the right and left shift keys. It was ensured that the terms used in the practice test did not appear on the final exam. Because the total number of trials in the four studies was large, the participants were given a break after each group. The session lasted around 15 to 20 minutes in total. The research was conducted in the Faculty of Persian Literature and Foreign Languages at the University of Tabriz.

2.4. Procedure

Participants were tested individually in a quiet room. Presentation of the stimuli and recording of reaction times were controlled by a Lenovo laptop computer. In each trial, a row of ten hash marks (##########) was presented for 500 ms on the center of the screen to indicate where the participants should have expected the words also to hide the prime. Then the prime word was presented in the center of the screen for 50 ms. Primes were immediately replaced by the target words. Participants were instructed to press one of the two buttons on the keyboard (right shift key for yes and left shift key for no) to indicate whether the presented word was a word or a nonword. Right and left shift keys were marked as yes and no using some stickers on keyboards. Participants were told that the software could measure milliseconds and that each word would flash on the screen. They were instructed to answer as quickly and accurately as possible to all trials. It should be noted that the instructions were given in Persian, and reaction times were measured from target onset till participants' responses. Reaction times were measured using DMDX software developed by Forster and Davis (1984).

2.5. Data Analysis

At first, incorrect answers were left out of the data analysis. Reaction times (RTs) of less than 300 milliseconds and more than 1,800 milliseconds were also removed from the study since they were either late answers to a preceding item or no responses in the period allotted. It was carried out to reduce the impact of outliers. The SPSS was used to examine the data. The data was subjected to eight within-group T-tests to examine the RTs of related vs. unrelated couples under eight distinct situations. A total of 97 people took part in 120 trials, for a total of 11,640 trials. However, 514 trials had wrong answers between related and unrelated word pairings, so they were removed. Ten trials out of the remaining 11,126 were

either below 300 ms or above 1,800 ms, so they were also eliminated. As a result, 11,116 trials were subjected to analysis.

3. Results

3.1. Experiment 1: Translation Priming from L1 to L2

3.1.1. Abstract words

Only the correct responses to the word trials were analyzed. Outlier data along with reaction times below 300 ms and above 1,800 ms were excluded from data and removed from analyses. In the abstract words group, within related and unrelated word pairs, 88 trials were wrong answers, and 6 trials were outliers, so they were excluded from the total data, which was 2,910 trials. The analysis was carried out on 2,816 trials. Mean latencies for correct responses were calculated across items. A summary of mean RTs for this group appears in Table 1.

Table 1. Mean RTs for translation priming from L1 to L2 for abstract words

	Grouping	N	Mean	Std. Deviation	Std. Error Mean
Reaction Time	Related Condition	926	444.46	885.57	2.91017
	Unrelated Condition	926	446.88	928.96	3.05277

Table 2. T-Test results for translation priming from L1 to L2 for abstract words

	Grouping	t	df	Sig. (2-tailed)	Means Difference
Reaction Time	Related Condition	-.693	925	.489	3.49014
	Unrelated Condition	-.691	916	.489	3.49014

The mean reaction times for related and unrelated pairings differed; a t-test based on participants' reaction times was used to determine if this difference was significant. The recognition of English targets preceded by a Persian translation (444 ms) was faster than that of targets preceded by an unrelated Persian phrase (446 ms). The priming effect of 2 milliseconds was insignificant. As a result, the main effect of priming in the translation priming experiment from L1 to L2 for abstract terms was insignificant (sig. .489 >.05), as shown in Table 2.

Research Question 1 (RQ1): Can masked translation priming effect be achieved using L1 (Persian) abstract primes for Iranian EFL learners?

Null Hypothesis 1 (H01): Masked translation priming effect cannot be achieved using L1 (Persian) abstract primes for Iranian EFL learners.

Based on the findings, the null hypothesis was confirmed, and the alternative hypothesis was rejected.

3.1.2. Concrete words

In the concrete words group, 162 trials had wrong answers between related and unrelated word pairings, and 4 trials were outliers, so they were removed from the data of 2,910 trials. A total of 2,744 trials were examined subsequently. For each item, mean latencies for accurate replies were computed. Table 3 shows a summary of mean RTs for this group.

Table 3. Mean RTs for translation priming from L1 to L2 for concrete words

	Grouping	N	Mean	Std. Deviation	Std. Error Mean
Reaction Time	Related Condition	889	472.33	115.05	3.85876
	Unrelated Condition	889	495.78	141.95	4.76107

Table 4. T-Test results for translation priming from L1 to L2 for concrete words

	Grouping	t	df	Sig. (2-tailed)	Means Difference
Reaction Time	Related Condition	-5.129	888	.000	4.57336
	Unrelated Condition	-5.133	894	.000	4.57336

The mean reaction times for related and unrelated pairings differed; a t-test based on participants' reaction times was used to see if this difference was significant. The recognition of English targets preceded by a Persian translation (472 ms) was faster than that of targets preceded by an unrelated Persian phrase (495 ms). The priming effect of 23 milliseconds was considerable. In the translation priming experiment from L1 to L2 for concrete terms, the main effect of priming was significant (sig. .000 < .05), as shown in Table 4.

Research Question 2 (RQ2): Can masked translation priming effect be achieved using L1 (Persian) concrete primes for Iranian EFL learners?

Null Hypothesis 2 (H02): Masked translation priming effect cannot be achieved using L1 (Persian) concrete primes for Iranian EFL learners.

Based on the findings, the alternative hypothesis was confirmed, and the null hypothesis was rejected.

3.1.3. Abstract vs. Concrete words

Comparison of the data related to Abstract and Concrete words revealed that there was a trend for stronger priming with abstract vs. concrete targets. Mean latencies were calculated across items. A summary of mean RTs appears in Table 5.

Table 5. Mean RTs for translation priming from L1 to L2 for abstract vs. concrete words

	Grouping	N	Mean	Std. Deviation	Std. Error Mean
Reaction Time	Related Condition	913	443.31	877.37	2.90368
	Unrelated Condition	913	476.84	1224.16	4.05138

Since the mean reaction times were different, a t-test based on the individuals' RTs was used to see if the difference was significant. In the translation priming experiment from L1 to L2,

the main effect of priming was significant for abstract vs. concrete terms (sig. .000 <.05), as shown in Table 6.

Table 6. T-Test results for translation priming from L1 to L2 for abstract vs. concrete words

	Grouping	t	df	Sig. (2-tailed)	Means Difference
Reaction Time	Related Condition	-8.007	912	.000	4.18788
	Unrelated Condition	-8.045	923	.000	4.18788

Only concrete terms demonstrated a significant translation priming effect from L1 to L2 in Experiment 1. These findings support previous research suggesting that L1-L2 translation priming is a common occurrence in bilingual word recognition (see, e.g., Gollan et al., 1997; Jiang, 1999; Jiang & Forster, 2001; Kim & Davis, 2003). They are consistent with a developmental version of the updated hierarchical model (Kroll and Stewart, 1994), in which beginning bilinguals show the most prominent directional asymmetry in priming due to the lack of semantic linkages between L2 and L1. We used the identical stimuli in Experiment 2 to see if translation priming from L2 to L1 could be achieved. First Experiment's L2 targets were now L2 primes, while first Experiment L1 primes were now L1 targets.

3.2. Experiment 2: Translation Priming from L2 to L1

3.2.1. Abstract words

In the abstract words group, 68 trials were inaccurate replies for related and unrelated word pairings, so they were removed from the overall data of 2,910 trials. A total of 2,842 trials were examined for this study. For each item, mean latencies for accurate replies were computed. Table 7 shows a summary of mean RTs for this group.

Table 7. Mean RTs for translation priming from L2 to L1 for abstract words

	Grouping	N	Mean	Std. Deviation	Std. Error Mean
Reaction Time	Related Condition	936	438.62	947.54	3.09714
	Unrelated Condition	936	449.60	890.40	2.91036

A t-test based on participants' RTs was conducted across two sets of items to examine a possible difference. Persian targets followed by an English translation (438 ms) were identified faster than unrelated English words (449 ms). The priming effect of 11 milliseconds was considerable. In the translation priming experiment from L2 to L1 for abstract words, the main effect of priming was significant (sig. .003 < .05), as shown in Table 8.

Table 8. T-Test results for translation priming from L2 to L1 for abstract words.

	Grouping	t	df	Sig. (2-tailed)	Means Difference
Reaction Time	Related Condition	-3.014	935	.003	3.64339

	Unrelated Condition	-3.127	951	.003	3.64339

Research Question 3 (RQ3): Can masked translation priming effect be achieved using L2 (English) abstract primes for Iranian EFL learners?

Null Hypothesis 3 (H03): Masked translation priming effect cannot be achieved using L2 (English) abstract primes for Iranian EFL learners.

According to the findings, the alternative hypothesis was confirmed, and the null hypothesis was rejected.

3.2.2. Concrete words

Within related and unrelated word pairings in the concrete words group, 62 trials were incorrect, and two trials were outliers, so they were removed from the entire data set of 2,910 trials. A total of 2,846 trials were examined for this study. For each item, mean latencies for accurate responses were computed. Table 9 shows a summary of mean RTs for this group.

Table 9. Mean RTs for translation priming from L2 to L1 for concrete words.

	Grouping	N	Mean	Std. Deviation	Std. Error Mean
Reaction Time	Related Condition	939	439.86	956.94	3.12287
	Unrelated Condition	939	443.97	896.39	2.92528

Table 10. T-Test results for translation priming from L2 to L1 for concrete words.

	Grouping	t	df	Sig. (2-tailed)	Means Difference
Reaction Time	Related Condition	-1.182	938	.238	3.47617
	Unrelated Condition	-1.167	926	.238	3.47617

The mean reaction times for related and unrelated pairings differed; a t-test based on participants' reaction times was used to determine if this difference was significant. Persian targets followed by an English translation (439 ms) were identified faster than unrelated English words (443 ms). In the translation priming experiment from L2 to L1 for concrete words, however, the main effect of priming was insignificant (sig. .238 > .05), as shown in Table 10.

Research Question 4 (RQ4): Can masked translation priming effect be achieved using L2 (English) concrete primes for Iranian EFL learners?

Null Hypothesis 4 (H04): Masked translation priming effect cannot be achieved using L2 (English) concrete primes for Iranian EFL learners.

Based on the findings, the null hypothesis was confirmed, and the alternative hypothesis was rejected.

3.2.3. Abstract vs. Concrete words

A priming effect for abstract targets may emerge when one compares Abstract and Concrete terms. The mean latencies for each item were calculated. Table 11 shows a summary of mean RTs.

Table 11. Mean RTs for translation priming from L2 to L1 for abstract vs. concrete words

	Grouping	N	Mean	Std. Deviation	Std. Error Mean
Reaction Time	Related Condition	940	437.18	936.14	3.05335
	Unrelated Condition	940	439.61	959.30	3.12892

Table 12. T-Test results for translation priming from L2 to L1 for abstract vs. concrete words

	Grouping	t	df	Sig. (2-tailed)	Means Difference
Reaction Time	Related Condition	-.673	939	.501	3.60969
	Unrelated Condition	-.669	932	.501	3.60969

The mean reaction times were different, so a t-test based on the individuals' RTs was used to see if the difference was significant. In the translation priming experiment from L2 to L1, the main effect of priming was insignificant for abstract vs. concrete terms (sig. .501 > .05), as shown in Table 12.

3.3. Combined analysis for Experiments 1 and 2

To test for a translation priming asymmetry, we analyzed the data from Experiments 1 and 2. Mean latencies were calculated across abstract and concrete items. A summary of mean RTs appears in Table 13 and Table 14 for abstract and concrete words, respectively.

Table 13. Mean RTs for translation priming for abstract words in L1 - L2 vs. L2 - L1

	Grouping	N	Mean	Std. Deviation	Std. Error Mean
Reaction Time	Related Condition	933	444.04	879.26	2.87857
	Unrelated Condition	933	438.70	951.05	3.11361

Table 14. Mean RTs for translation priming for concrete words in L1 - L2 vs. L2 - L1

	Grouping	N	Mean	Std. Deviation	Std. Error Mean
Reaction Time	Related Condition	919	476.80	1223.80	4.03695
	Unrelated Condition	919	437.71	948.82	3.12988

Because the mean RTs differed, a T-test based on the individuals' RTs was conducted across four sets of items to see if the difference was significant. In the translation priming experiment for abstract terms in L1- L2 vs. L2- L1 (sig. .154 >.05), the main effect of priming was insignificant, as shown in Table 15. In the translation priming experiment for concrete

terms in L1- L2 vs. L2- L1, however, the main effect of priming was significant (sig. .000 < .05), as it is shown in Table 16.

Table 15. T-Test results for translation priming for abstract words in L1 - L2 vs. L2 - L1

	Grouping	t	df	Sig. (2-tailed)	Means Difference
Reaction Time	Related Condition	1.428	932	.154	3.74142
	Unrelated Condition	1.436	938	.154	3.74142

Table 16. T-Test results for translation priming for concrete words in L1 - L2 vs. L2 - L1

	Grouping	t	df	Sig. (2-tailed)	Means Difference
Reaction Time	Related Condition	8.901	918	.000	4.39155
	Unrelated Condition	8.845	905	.000	4.39155

For abstract terms, Experiment 2 revealed a strong translation priming effect from L2 to L1. In terms of numbers, the total RTs in the L2- L1 condition were shorter than those in the L1- L2 condition (Experiment 1). Differences in mean RTs for abstract and concrete words were minimal when it came to L1 targets. It demonstrates that abstract and concrete words were processed identically since individuals were more competent in L1. However, only the L2- L1 direction shows a trend for abstract target to be processed faster than concrete targets. L2 targets elicited slower reactions in both groups than L1 targets. In the lexical decision task, the expected translation priming asymmetry was seen in general. Translation priming asymmetry was large and noticeable for concrete words compared to abstract terms. The most plausible interpretation we could make is that in the brains of second language learners, the connections between concrete words are stronger. It's in line with the current trend of using concrete rather than abstract targets for priming.

4. Discussion

Because little is known about how language is represented in mind, finding the best strategies to teach a second language has always been a difficult task. The issue is much more problematic when it comes to multilingual memory. Psycholinguistics have long debated whether information about two different languages should be kept in a single lexicon or two distinct lexicons, as well as how they are accessed. Despite the fact that several studies have been conducted on the subject, cross-language research on languages with different scripts needs additional investigation.

According to prior findings, cross-language semantic priming research done under unmasked and masked settings has produced a wide range of outcomes. As previously stated, the conclusions of diverse research are not always in agreement. There have been reports of a significant priming effect in the unmasked condition (e.g., Chen & Ng, 1989; Williams, 1994; Kotz, 2001; Kotz & Guttler, 2004; Kiran & Lebel, 2007; Guasch et al., 2011),

as well as mixed findings (e.g., Keatley & de gelder, 1992; Keatley et al., 1994; Basnight-Brown & Altarriba, 2007). However, there have been reports of a null effect in unmasked condition. (e.g., Scarborough et al., 1984; Kotz & Guttler, 2004). There have also been reports of a considerable priming effect under masked settings (e.g., Williams, 1994; Grainger & Frenk-master, 1998; Jiang & Forster, 2001; Duyck, 2005; Perea et al., 2008; Schoonbaert et al., 2009; Zhao et al., 2011; Chen et al., 2014). Various experiments have also reported a null effect in masked condition. (e.g., De Groot & Nas, 1991; Sanchez-Caas et al., 1992; Gollan et al., 1997; Finkbeiner et al., 2004; Davis et al., 2010; Fotovatnia & Taleb, 2012; Ansarin & Saeeidi Manesh, 2017; Ansarin & Javadi, 2018).

Fotovatnia and Taleb (2012) used a masked paradigm with cognates and non-cognates to examine the semantic priming effect with Persian-English bilinguals. Non-cognates, on the other hand, did not show a substantial priming effect, according to the researchers. They attributed their participants' lower proficiency levels to the lack of non-cognate priming. De Groot and Nas (1991) also proposed that non-cognates do not exchange representations at the conceptual level. Ansarin & Javadi (2018) evaluated the priming effect with Persian-English bilinguals in four types of pairs using a masked paradigm. The authors did not observe a priming effect. They were only able to discover a priming effect for pairings that were associatively/semantically associated.

Using the priming paradigm, Ansarin and Saeeidi Manesh (2015) studied whether bilinguals share semantic aspects of their L1 and L2. The semantic priming effect was not found in any of the experiments. The authors concluded that, at least at intermediate competency levels, utilizing semantically related words for non-cognate words in language education is ineffective. Ansarin and Saeeidi Manesh (2017) used a masked paradigm to investigate the semantic priming effect in Persian-English bilinguals. Similarly, there was no evidence of a semantic priming effect.

Ansarin et al. (2022) investigated if bilinguals share semantic features of their L1 (Persian) and L2 (English) using semantically related pairs in two different directions from L1 to L2 and L2 to L1 in two experiments, including abstract and concrete words. The experiments showed that semantic priming could not be observed either from L1 to L2 or from L2 to L1. The difference between abstract and concrete words was significant only in experiment 1 from L1 to L2. Their findings were in line with language models assuming quantitative rather than qualitative differences between L1 and L2 representations.

In this study, we have found a translation priming effect across Persian and English under a masked paradigm using L1 and L2 primes for abstract words (Experiment 2) and concrete words (Experiment 1). We also observed several patterns consistent with previous findings, such as priming asymmetry. One possible source of the cross-language priming patterns could be the nature of the L2 representation in the bilinguals' mental space. L2 words are often projected close to their translation equivalents and to the L1 words, which are semantically related. Such close distribution in semantic representation allows spreading

activation to occur more easily from words in one language to their semantically-related words in the other language, which in turn causes the cross-language priming effects. Since there is more overlap in meaning between translation equivalents than between semantically related words, translation priming is often larger than semantic priming (Zhao & Li, 2010).

On the other hand, the present study failed to find translation priming effects with Persian-English bilinguals for abstract words (Experiment 1) and concrete words (Experiment 2). As for this, one may suggest that since different scripts activate different lexical levels, (i.e., nonselective access), as predicted by the Revised Hierarchical Model, words from L1 may fail to prime L2 words and vice versa.

Translation priming is thought to occur because abstract and concrete words are related at the lexical level, and semantics and conceptual representations are not active when translation counterparts are processed (de Groot & Nas, 1991). As a result, one possible explanation for why translation priming was detected in Experiments 1 and 2 is that the participants were processing certain word types at a lexical level. This might be true for bilinguals who are less fluent in their second language. Although semantic and translation word pairs are related in a similar way at the lexical level, translations may differ in that they have more conceptual overlap. Another explanation would be that regardless of translation direction, common conceptual characteristics in the L1 and L2 remain constant (de Groot, 1992a, 1992b). This means that priming in one direction (L1- L2) should be equally distributed in the other direction (L2- L1), as shown in the current investigation (for abstract words in L2- L1 direction and concrete words in L1- L2 direction).

There might be two interconnected sources of priming asymmetry. On the one hand, due to greater lexical competition from surrounding items, lexical items in L2 are represented in more dense neighborhoods and hence in a more confusable manner. A very brief exposure may not generate activations strong enough to propagate to the target L1 items not directly nearby in mental representation when they function as primes. Activations of L1 items, on the other hand, maybe more resilient due to the fact that they are more infrequently represented and hence face less competition. Bilinguals' interpretation of an L2 term is strongly reliant on their knowledge of its L1 counterpart's properties. When an L1 word is used as a prime, all of the properties and connections that the word confers on its L2 counterpart are engaged, making the L2 equivalent more straightforward to identify as a target. It corresponds to the conclusions of our research on concrete terms. In the L1 to L2 direction, we discovered considerable translation priming for concrete terms, but not in the L2 to L1 direction.

The meaning of a new word can be learned and stored during L2 acquisition by copying or transferring information from the L1 language system to the new L2 language system. Whereas the L1 representation would include multiple L1-specific encodings of experiences of the word, including rich connections both internally and across memory systems, the L2

representation would initially include only a portion of this information, modified by the different linguistic network of the L2 store and by the diverse experiences of the student in L2 contexts. In general, L1 representations would have richer and stronger linkages across memory systems than L2 representations. As a result, the lack of priming effect in Experiments 1 and 2 might be related to participants' lower proficiency levels. Late bilinguals' mental representations of L2 will become less dense and more structured as their L2 knowledge and skill improve. To put it another way, there will be less misunderstanding and a better structure of semantic linkages for L2. As a result of these changes, the priming effects from L2 to L1 may become greater, and the priming asymmetry may become less noticeable.

Most bilingual models assume that L1 and L2 share the same semantic system or they are semantically distinct yet linked by lexical linkages. One critical question in bilingual processing is whether bilinguals have immediate access to a conceptual representation from the L2 lexical representation or if they must go through the L1 lexical representation. To account for multilingual lexical representation and processing, several theoretical frameworks of bilingual mental lexicon have been developed. According to Paivio's dual-coding model (1986), single representations of words contain all lexical and conceptual information about the words in one entity. These diagrams depict the perceptual-sensory system as well as the unique symbol system used in their encoding. The position of a representation in a network of connected representations, such as that described in semantic network models, determines its meaning inside a language-specific memory store (Collins & Loftus, 1975). Word representations may have direct linkages to representations in other symbol-system-specific modules, maybe due to the two stimuli being paired. Translation equivalents, for example, may have direct ties as a result of experiences in which two stimuli are linked and identified as equivalents. In cross-language association priming, one-to-one connections across language-specific systems do not extend beyond the linked representations; instead, priming effects exist across connections between translation equivalents but not to associates of translation equivalents. Our findings support the same idea since there was no significant priming in translation pairings.

5. Conclusions

In sum, this study intended to see if a semantic priming effect for translation pairs could be produced by applying L1 and L2 primes in two different directions for abstract and concrete terms. For concrete words, Experiment 1 revealed a strong translation priming effect from L1 to L2. And there were considerable disparities between abstract and concrete terms. For abstract words, Experiment 2 revealed a strong translation priming effect from L2 to L1. There were no significant differences between abstract and concrete terms. Only concrete terms showed priming asymmetry in Experiment 2 compared to Experiment 1. For both abstract and concrete words, the priming asymmetry was discovered. There was a trend for concrete terms to have stronger priming effects than abstract words. It should be

emphasized that in the Experiments, priming effects interacted substantially with concreteness only from L1 to L2.

The Revised Hierarchical Model (RHM) (Kroll & Stewart, 1994), the Bilingual Interactive Activation Model (BIA) (McClelland & Rumelhart, 1981), and the interdependent hypothesis were all supported by the outcomes of this study. When bilinguals recognize a word or linguistic form in one language, they frequently depend on information from the other language, whether consciously or subconsciously, according to the BIA (McClelland & Rumelhart, 1981) and the RHM (Kroll & Stewart, 1994). This assertion is in line with the interdependent hypothesis, which states that the memory storages for each of a bilingual subject's two languages are both interrelated and interacting. According to French and Jacquet (2004), studying multilingual memory can help with a broader understanding of memory and processing. Understanding bilinguals' general language processing is beneficial to bilingual and monolingual studies. To better understand lexical acquisition and processing in L1 and L2, the current study looked at the mental representation of words in bilingual memories. At the theoretical level, such knowledge contributes to models that investigate the structure of the mental cognitive structure that is responsible for the storage and processing of information. At the pedagogical level, it contributes to the effective design and implementation of instructional materials. Because the function of L2 competence in priming has to be examined further, the same experiment might be repeated with multiple groups of participants with varying proficiency levels. Using highly skilled speakers from completely bilingual regions might bring crucial insights into multilingual memory research. It may supplement data from second language learners of various skill levels, allowing for a better understanding of the organization of a bilingual's lexical memory. It's also feasible to repeat the experiment with varied stimulus onset asynchrony (SOAs). In addition, future research should consider whether cognate vs. non-cognate terms should be included.

References

Ansarin, A. & Javadi, Sh. (2018). Masked semantic/associative and translation priming across languages. East European Journal of Psycholinguistics, 5(1): 7-15.

Ansarin, A. & Saeeidi Manesh, S. (2015). Reaction time in semantic priming experiments with Persian (L1) vs. English (L2) primes. Journal of Pan-Pacific Association of Applied Linguistics, 19(1): 121-132.

Ansarin, A. & Saeeidi Manesh, S. (2017). Reaction time in masked semantic priming experiments with Persian vs. English primes. Eurasian Journal of Applied Linguistics, 3(1): 25–35.

Ansarin, A. Yaghoubi Notash, M. & Saeeidi Manesh, S. (2022). A psycholinguistic study of semantic priming across L1 and L2. Journal of Second and Multiple Language Acquisition. 10(3): 334-360.

Basnight-Brown, D. M., Chen, L., Hua, S., Kostic´, A., & Feldman, L. B. (2007). Monolingual and bilingual recognition of regular and irregular English verbs: Sensitivity to form similarity varies with first language experience. Journal of Memory and Language, 57: 65–80.

Bosch, L., Costa, A., & Sebastian-Galle´s, N. (2000). First and second language vowel perception in early bilinguals. European Journal of Cognitive Psychology, 12: 189–222.

Brysbaert, M. (2003). Bilingual visual word recognition: Evidence from masked phonological priming. In S. Kinoshita & S. J. Lupker (Eds.), Masked priming: The state of the art (pp. 323–343). Hove, UK: Psychology Press.

Chen, H. C., & Ng, M. L. (1989). Semantic facilitation and translation priming effects in Chinese–English bilinguals. Memory & Cognition, 17: 454-462.

Chen, B., Zhou, H., Gao, Y., & Dunlap, S. (2014). Cross-language translation priming asymmetry with Chinese-English bilinguals: A test of the sense model. Journal of psycholinguistic research, 43(3): 225-240.

Collins, A. M., & Loftus, E. F. (1975). A spreading-activation theory of semantic processing. Psychological Review, 82: 407-428.

Davis, C., Kim, J., & Sánchez-Casas, R. (2003). Masked priming across languages: An insight into bilingual lexical processing. In S. Kinoshita & S. J. Lupker (Eds.), Macquarie monographs in cognitive science. Masked priming: The state of the art (pp. 309-322). New York, US: Psychology Press.

Davis, C., Sánchez-Casas, R., García-Albea, J., Guasch, M., Molero, M., & Ferré, P. (2010). Masked translation priming: Varying language experience and word type with Spanish-English bilinguals. Bilingualism: Language and Cognition, 13: 137–155.

De Groot, A. M. B. (1992a). Bilingual lexical representation: A closer look at conceptual representations. In R. Frost & L. Katz (Eds.), Orthography, phonology, morphology, and meaning (pp. 389-412). Amsterdam: Elsevier.

De Groot, A. M. B. (1992b). Determinants of word translation. Journal of Experimental Psychology: Learning, Memory, & Cognition, 18: 1001-1018.

De Groot, A. M. B., & Nas, G. L. J. (1991). Lexical representation of cognates and non-cognates in compound bilinguals. Journal of Memory & Language, 30: 90-123.

Dimitropoulou, M., Duñabeitia, J. A., & Carreiras, M. (2011). Masked translation priming effects with low proficient bilinguals? Memory & Cognition, 39, 260–275.

Dimitropoulou, M., Duñabeitia, J. A., & Carreiras, M. (2011). Two words, one meaning: Evidence for automatic co-activation of translation equivalents. Frontiers in Psychology, 2, 1–20.

Duyck, W. (2005). Translation and associative priming with cross-lingual pseudohomophones: Evidence for nonselective phonological activation in bilinguals. Journal of Experimental Psychology: Learning, Memory, & Cognition, 31: 1340-1359.

Duyck, W., & Warlop, N. (2009). Translation priming between the native language and a second language: New evidence from Dutch– French bilinguals. Experimental Psychology, 56: 173-179.

Finkbeiner, M., Forster, K., Nicol, J., & Nakamura, K. (2004). The role of polysemy in masked semantic and translation priming. Journal of Memory and Language, 51: 1-22.

Forster, K. I., & Davis, C. (1984). Repetition priming and frequency attenuation in lexical access. Journal of Experimental Psychology: Learning, Memory, & Cognition, 10: 680-698.

Forster, K. I., & Jiang, N. (2001). The nature of the bilingual lexicon: Experiments with the masked priming paradigm. In J. L. Nicol (Ed.), One mind, two languages: Bilingual language processing. (pp. 72-83). Malden, MA, US: Blackwell Publishing.

Fotovatnia, Z., & Taleb, F. (2012). Masked non-cognate priming across Farsi and English. Journal of Teaching Language Skills, 4(1): 25–48.

Francis, W. S. (2005). Bilingual semantic and conceptual representation. In J. F. Kroll & A. M. B. De Groot (Eds.), Handbook of bilingualism: Psycholinguistic approaches (pp. 251–267). New York, NY: Oxford University Press.

French, R. M., & Jacquet, M. (2004). Understanding bilingual memory. Trends in Cognitive Science, 8: 87–93.

Gernsbacher, M.A. (1984). Resolving 20 years of inconsistent interactions between lexical familiarity and orthography, concreteness, and polysemy. Journal of experimental psychology: General, 113(2): 256–81.

Gollan, T. H., Forster, K. I., & Frost, R. (1997). Translation priming with different scripts: Masked priming with cognates and non-cognates in Hebrew–English bilinguals. Journal of Experimental Psychology: Learning, Memory, & Cognition, 23: 1122-1139.

Grainger, J., & Frenck-Mestre, C. (1998). Masked priming by translation equivalents in proficient bilinguals. Language & Cognitive Processes, 13: 601-623.

Grosjean, F. and Li, P. (2012). The psycholinguistics of bilingualism. John Wiley & Sons.

Guasch, M., Sanchez-casas, R., Ferre, P., Garcia-Albea, J. E. (2011). Effects of the degree of meaning similarity on cross-language semantic priming in highly proficient bilinguals. Journal of Cognitive Psychology, 23(8): 942-961.

Jiang, N. (1999). Testing processing explanations for the asymmetry in masked cross-language priming. Bilingualism: Language & Cognition, 2: 59-75.

Jiang, N. (1999). Understanding bilingual lexical organization: Evidence from masked cross-language priming in Chinese-English bilinguals. US: ProQuest Information & Learning.

Jiang, N., & Forster, K. I. (2001). Cross-language priming asymmetries in lexical decision and episodic recognition. Journal of Memory & Language, 44: 32-51.

Jin, Y. S. (1990). Effects of concreteness on cross-language priming in lexical decisions. Perceptual & Motor Skills, 70: 1139-1154.

Keatley, C. W., & De Gelder, B. (1992). The bilingual primed lexical decision task: Cross-language priming disappears with speeded responses. European Journal of Cognitive Psychology, 4: 273-292.

Keatley, C. W., Spinks, J. A., & De Gelder, B. (1994). Asymmetrical cross-language priming effects. Memory & Cognition, 22: 70-84.

Kim, J., & Davis, C. (2003). Task effects in masked cross-script translation and phonological priming. Journal of Memory & Language, 49: 484-499.

Kiran, S., & Lebel. K. R. (2007). Crosslinguistic semantic and translation priming in normal bilingual individuals and bilingual aphasia. Clinical Linguistics & Phonetics, 21: 277-303.

Kondrak, G., Marcu, D., & Knight, K. (2003). Cognates can improve statistical translation models. In Proceedings of the 2003 Conference of the North American Chapter of the Association for Computational Linguistics on Human Language Technology (NAACL 2003), Edmonton, Alberta, Canada.

Kotz, S. A. (2001). Neurolinguistic evidence for bilingual language representation: A comparison of reaction times and event-related brain potentials. Bilingualism: Language and Cognition, 4: 143–154.

Kotz, S. A., & Elston-Guttler, K. E. (2004). The role of proficiency on processing categorical and associative information in the L2: Reaction times and event-related potentials. Journal of Neurolinguistics, 17: 215–235.

Kroll, J.F., & De Groot, A.M.B. (2005). Handbook of Bilingualism: Psycholinguistic Approaches. New York: Oxford University Press.

Kroll, J. F., & Stewart, E. (1994). Category interference in translation and picture naming: Evidence for asymmetric connection between bilingual memory representations. Journal of Memory & Language, 33: 149-174.

Lalor, E., & Kirsner, K. (2001). The representation of 'false cognates' in the bilingual lexicon. Psychonomic bulletin & review, 8 (3), 552-559.

McClelland, J. L., & Rumelhart, D. E. (1981). An interactive activation model of context effects in letter perception: I. An account of basic findings. Psychological Review, 88(5): 375-407.

Paivio, A. (1986). Mental representations A dual-coding approach. Oxford. Oxford University Press.

Perea, M., Duñabeitia, J. A., & Carreiras, M. (2008). Masked associative/ semantic priming effects across languages with highly proficient bilinguals. Journal of Memory & Language, 58: 916-930.

Sánchez-Casas, R. M., Davis, C. D., & García-Albea, J. E. (1992). Bilingual lexical processing: Exploring the cognate/non-cognate distinction. European Journal of Cognitive Psychology, 4: 293-310.

Scarborough, D. L., Gerard, L. & Cortese, C. (1984). Independence of lexical access in bilingual word recognition. Journal of Verbal Learning and Verbal Behaviour, 23: 84–99.

Schoonbaert, S., Duyck, W., Brysbaert, M., & Hartsuiker, R. J. (2009). Semantic and translation priming from a first language to a second and back: Making sense of the findings. Memory and Cognition, 37: 569-586.

Traxler, M.J. (2012). Introduction to Psycholinguistics: Understanding Language Science. Oxford: Wiley-Blackwell.

Williams, J. N. (1994). The relationship between word meanings in the first and second language: Evidence for a common, but restricted, semantic code. European Journal of Cognitive Psychology, 6: 195-220.

Zhao, X., & Li, P. (2010). Bilingual lexical interactions in an unsupervised neural network model. International Journal of Bilingual Education and Bilingualism. 13: 505-524.

Zhao, X., Li, P., Liu, Y., Fang, X., & Shu, H. (2011). Cross-language priming in Chinese English bilinguals with different second language proficiency levels. In L. Carlson, C. H¨olscher, & T. Shipley (Eds.), Proceedings of the 33rd Annual Conference of the Cognitive Science Society. Austin, TX: Cognitive Science Society