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A psycholinguistic study of semantic priming across L1 and L2

Ali Akbar Ansarin[1]
University of Tabriz
Masoud Yaghoubi Notash[2]
University of Tabriz
Solmaz Saeeidi Manesh[3]
University of Tabriz

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Abstract

One of the main issues in psycholinguistics is bilingual memory. The field has long been concerned with the way bilinguals restore words in their mental lexicon and how they retrieve them. The more information regarding bilingual memory is obtained, the more efficient would be second language teaching methods. The present study attempts to investigate if bilinguals share semantic features of their L1 and L2 using a masked semantic paradigm. Target-prime pairs addressed in the study 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. Both experiments were done using DMDX software for measuring reaction times in lexical decision tasks with noncognate prime-target pairs. 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. These data suggest that L1 and L2 are represented by means of a similar lexico-semantic architecture in which L2 words are also able to activate semantic information. This is consistent with models assuming quantitative rather than qualitative differences between L1 and L2 representations.

Keywords bilingual memory, cross-language priming, semantic priming, lexical decision tasks, abstract vs. concrete words

1. Introduction

Bilingualism is far more frequent across the world than monolingualism, or the ability to communicate in only one language (Bhatia & Ritchie, 2004; Edwards, 2004; Tabouret-Keller, 2004). Researchers in psychology, linguistics, sociology, anthropology, neurology and other fields have indeed been intrigued by the concept that people may simultaneously communicate or process information in one language domain while switching to the second mode of cognition based on a different language. Little is known about how the brain acquires the capacity to reliably store and process several languages in memory while yet being able to function well as a monolingual.
How bilinguals retrieve words in their two languages is a major subject in bilingual lexical processing research. Bilinguals activate only word

[1] Bio: Ali Akbar Ansarin, Ph. D., University of Tabriz, Interests: Second Language Acquisition, Psycholinguistics, Discourse Analysis, Email: Ansalak@gmail.com
[2] Bio: Masoud Yaghoubi Notash, Ph. D., University of Tabriz, Interests: Second Language Acquisition, Applied Linguistics, Language Teaching Email: Masoud.yaghoubi@gmail.com
[3] Bio: Solmaz Saeeidi Manesh, Ph. D. Candidate, University of Tabriz, Interests: Second Language Acquisition, Psycholinguistics, Language Teaching
(Corresponding Author) Email: s_saidi_m@yahoo.com

candidates from the language that corresponds to the language of the incoming information (in comprehension) or the language presently in use, according to the language-selective perspective (in production). On the other hand, the non-selective viewpoint states that words from both languages are activated. Even when the social and linguistic environment asks for just one language, lexical activation in bilingual memory occurs in a parallel, language non-selective manner, according to more than a decade of research (Kroll & De Groot, 2005). The bilingual memory system is fundamentally permeable across language boundaries, not only for bilinguals who speak two languages with the same script (Schwartz & Van Hell, 2012) but also for bilinguals whose two languages have different scripts (Gollan, Forster, & Frost, 1997; Hoshino & Kroll, 2008; Kim & Davis, 2003; Thierry & Wu, 2004; 2007), different gesture systems (Brown & Gullberg, 2010), or are even from two different modalities, as in sign-speech bilinguals (Morford, Wilkinson, Villwock, Pi˜nar, & Kroll, 2011; Van Beijsterveldt & Van Hell, 2009, 2012).

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, in the Handbook of Bilingualism (Kroll & de Groot, 2006), 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 study has 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 (Basnight-Brown, Chen, Hua, Kostic, & Feldman, 2007; Bosch, Costa, & Sebastian- Galle's, 2000; Brysbaert, 2003; Jiang & Forster, 2001).

There are different models trying to shed light on the issue of word processing; e.g., the Bilingual Interactive Activation (BIA) model (McClelland and Rumelhart, 1981) and the monolingual Interactive Activation model. Both models are visual word recognition models, with visual word recognition explained as the retrieval of orthographic representations matching the input letter string from the mental lexicon (Dijkstra and Van Heuven, 2002). The BIA model addresses features of the language selection process that are not applicable to its monolingual model. This question is considered in light of two major aspects of bilingual language processing: 1. Are candidates from both languages activated simultaneously, or is only one language active in visual processing (language nonselective access vs. language selective access), and 2. Are the languages' lexical representations represented in separate lexicons for each language or within a shared or integrated lexicon? "Competition or selection effects may exist between lexical candidates of both languages in an integrated lexical system, but competition effects are confined to candidates of one language only in two distinct lexical systems" (Dijkstra and Van Heuven, 2002).

The successor to the BIA model, the Bilingual Interactive Activation Plus (BIA+) model (Dijkstra & Van Heuven, 2002), was presented with a few key improvements to account for these shortcomings. To account for cross-

language effects in those areas, the BIA+ model included new variables, such as phonological and semantic representations. It's important to note, however, that these effects may not be visible in all contexts. According to the model, cross-language effects are stronger from L1 to L2 than from L2 to L1. The "temporal delay assumption" is the term for this. Because the perceived frequency of L2 words is lower than those of L1, semantic and phonological representations are activated more slowly in L2 than in L1. Second, the BIA+ model's language nodes no longer fulfill the original purpose of determining which language to activate. This problem is addressed in the BIA+ model by a task/control mechanism separate from the word identification system. The architecture of this model allows the word recognition system to activate lexical features from both languages at the same time, while the control system confines responses to the appropriate language. As a result, the BIA+ model predicts nonselective bilingual lexical processing. However, depending on the task need, it may appear selective in specific cases. Some prior studies have produced findings that are in line with the BIA+ model's predictions. To put it another way, lexical information is engaged in a nonselective manner across languages. Because the theory posits different systems for the lexical features of each language, these data show that the separate systems view is insufficient to explain bilingual lexical representations.

Kroll and Stewart's (1994) Revised Hierarchical Model (RHM) of bilingual representations, which assumes two levels of representation (lexical and conceptual) and accommodates independent lexical representations for L1 and L2 with a shared conceptual representation, is probably the most widely discussed model in the literature. The RHM also presupposes lexical links or ties between L1 and L2, as well as direct access from form to meaning in both languages. Both lexical and conceptual links are active in bilingual memory, according to this hypothesis. Nonetheless, the strength of the links varies depending on L2 fluency and L1 dominance over L2. As a result, two asymmetries are proposed: For example, L2 to L1 lexical item connections are more stable than L1 to L2 lexical item connections. Second, at the conceptual level, L1 words have greater connections to concepts than L2 words. The L2-concept relationship grows stronger as L2 competency improves. The lexical asymmetry, according to Kroll and Tokowicz (2001), may be due in part to L2's asymmetrical reliance on L1, as well as various mappings from a small L2 vocabulary to a large L1 lexicon for which certain L2 translation equivalents are missing. As a result, L1 to L2 mappings will be inconsistent and unstable. These statements are founded on the notion that L2 learning is accomplished through L1. Given the assumption that the activated concepts are shared by both L1 and L2, the conceptual asymmetry emerges from evidence that L1 words are more likely to engage semantic processing than their L2 translation equivalents. The lexical link from L2 to L1 continues when L2 competency is achieved, but the conceptual links between L2 lexical items and concepts must be developed.

The primed lexical decision task (LDT) is an important paradigm for testing independent and hierarchic theories (Meyer & Schvaneveldt, 1971). A target preceded by a related word (CAT-DOG) is evaluated to be a real word faster in monolingual trials than a target preceded by an unrelated word (TABLE-

DOG). This priming effect is thought to be caused by automatic activation (Posner & Snyder, 1975), transfer (Kolers & Roediger, 1984), or activation of a mixed cue (Kolers & Roediger, 1984). (Ratcliff & McICoon, 1988).

A masked priming paradigm is being used in a study 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 tests. The prime was shown for a short time (40-60ms) before the target. 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. Or 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.

Various cross-language priming experiments have been carried out throughout the years. Scientists have observed translation and semantic priming effects across languages and found some interesting patterns, such as (1) translation equivalents are usually more significant than semantically related words (Basnight-Brown & Altarriba, 2007); and (2) priming effects in the L1-L2 direction (from first language primes to second language targets) are often found to be stronger than those in the L2-L1 direction, which is referred to as priming asymmetry (Jiang & Foster, 2001).

The concreteness of the terms employed in the trials is another important 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 discover the primary effect of concreteness on recognition latencies when he controlled for familiarity with low-frequency terms. Jin (1990) challenged 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.

The influence of concreteness on semantic priming for both prime and target words was explored by Bleasdale (1987). Circumstances constraining strategy use provide semantic priming for same category pairings but not for different category pairs, whereas conditions allowing for more controlled processes produce semantic priming for concrete word primes but not for

abstract word primes, according to the findings. More research is needed to validate these findings and make the appropriate methodological changes.

In the monolingual realm, semantic priming is a well-studied topic. Responses to target words like girl are generally faster after delivering a semantically comparable term like boy than after presenting an irrelevant word like day in this scenario. The cross-language variant of this paradigm is used to evaluate Persian–English bilinguals, and it employs prime–target pairs such as [boy]–girl from L1 to L2 and boy–[girl] from L2 to L1. Chen and Ng (1989), de Groot and Nas (1991), Jin (1990), Keatley et al. (1994), and Schwanenflugel and Rey (1995) were the first to discover cross-language semantic priming using a lexical choice problem (1986). These experiments, however, all employed unmasked priming procedures. Cross-language semantic priming effects, like translation priming, are frequently stronger from L1 to L2 than from L2 to L1. Other research used a masked priming paradigm to investigate cross-language semantic priming. De Groot and Nas's initial study, which tested Dutch–English bilinguals, failed to establish cross-language semantic priming effects from L1 to L2. Another research found that L1 pseudohomophones (e.g., pous) of semantically comparable terms (e.g., paus [pope]) prime L2 targets (e.g., church) among Dutch–English bilinguals (Duyck, 2005). This effect was not observed with L1 targets (e.g., been [leg]) or L2 pseudohomophone primes (e.g., knea [knee]), implying that cross-language semantic priming is asymmetric. Using prime–target pairs such as dia [day]–night among Spanish–English bilinguals, the third investigation failed to detect a significant cross-language semantic priming impact in either priming direction (Basnight-Brown & Altarriba, 2007). For balanced Basque–Spanish and Spanish–Basque bilinguals, Perea, Duabeitia, and Carreiras (2008) found a comparable cross-language semantic priming effect in both directions.

Perea and Rosa (2002) and Perea et al. (2008) differentiated between pairings that were semantically similar and pairs that were associatively connected. Perea and Rosa (2002) studied whether associative semantic priming exists under various stimulus onset asynchronies (SOAs) and found that it does. Perea et al. (2008) looked at bilinguals who learned their second language at the same time as their first language, as opposed to bilinguals who learned their second language later in life. Regarding the quantity of priming detected, they couldn't identify any difference between the two groups.

In the case of Persian and English, Fotovatnia and Taleb (2012) used a masked paradigm with cognates and noncognates to study the semantic priming effect with Persian-English bilinguals. Noncognates, 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 author could not identify a priming effect. She was 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 share semantic aspects of their L1 and L2. Target-prime pairings that were semantically linked were investigated in two trials. The target words were in English in both tests, while the primes were in Persian in the first and English in the second. For these stimuli, the reaction time of sixty Persian-English bilinguals was tested. The semantic priming effect was not present in any of the studies, according to the findings. Ansarin and Saeeidi Manesh (2017) used a masked paradigm to investigate the semantic priming impact on Persian-English bilinguals. Similarly, there was no evidence of a semantic priming effect.

Priming effects for semantically related word pairs are significant to research for various reasons. To begin with, the approach adopted is widely regarded 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 most of people throughout the world: they know and use many languages to communicate. Third, research in this area has resulted in the creation of research tools that have been used to uncover general language-processing mechanisms that apply to monolingual people as well because cross-language stimuli may aid in the investigation of basic levels of language representation, such as semantics, while others, such as lexicality, are held constant. Fourth, it is commonly assumed that the priming approach may be utilized to investigate the automaticity of language processing. When models of language representation and processing are derived, this technique becomes more revealing. Finally, this type of exploration is practical and relatively simple to implement, implying that further refinement of this method and careful consideration of methodological issues are required to promote this type of work across cultures.

1.1. Statement of the Problem

Traditional techniques for teaching vocabulary were employed until recently. Most teachers haven't given enough thought to how to teach vocabulary growth efficiently. 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. As a result, they prefer to teach language in an indirect manner (Huh, 2009). The employment of methods and techniques for coping with vocabulary items is crucial and beneficial. Semantic priming through vocabulary retention is one of the ways which helps pupils remember words, enhance their vocabulary, and better understand unfamiliar terms.

1.2. 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 and vice versa, 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 among 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 quantitative different L1 and L2 representations.

2. Methodology

The methodology of the research should be detailed very clearly referring to relevant theories.

2.1. Research Questions and Hypothesis

The study was conducted to answer the following questions for which eight hypotheses were formulated:

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

Ho1: Masked semantic priming effect cannot be achieved using L1 (Persian) abstract primes for Iranian EFL learners.

H1: Masked semantic priming effect can be achieved using L1 (Persian) abstract primes for Iranian EFL learners.

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

Ho2: Masked semantic priming effect cannot be achieved using L1 (Persian) concrete for Iranian EFL learners.

H2: Masked semantic priming effect can be achieved using L1 (Persian) concrete for Iranian EFL learners.

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

Ho3: Masked semantic priming effect cannot be achieved using L2 (English) abstract primes for Iranian EFL learners.

H3: Masked semantic priming effect can be achieved using L2 (English) abstract primes for Iranian EFL learners.

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

Ho4: Masked semantic priming effect cannot be achieved using L2 (English) concrete primes for Iranian EFL learners.

H4: Masked semantic priming effect can be achieved using L2 (English) concrete primes for Iranian EFL learners.

2.2. Design of the study

More study into the bilingual lexicon is needed to learn more about alternative theories of bilingual memory. The masked priming paradigm is used in this experiment because it is a well-established and successful strategy for researching bilingual lexicon and lexical retrieval. Two studies were conducted to investigate masked priming utilizing L1 and L2 primes and targets between Persian and English.

Subjects 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 was capable of measuring 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).

2.3. 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 were 18 to 22 years old. They had all completed at least six years of formal English training at school and had learned Persian as the country's official language since childhood. The majority of the participants spoke Azari as their first language. As the results of the proficiency test revealed, their English proficiency level was intermediate. All subjects had normal vision or eyesight that had been corrected to normal vision with glasses.

2.4. Materials

Four groups of prime-target pairs were created: in group one, primes were semantically related words in Persian, and targets were in English using abstract words (*e.g., تهدید - danger*). In group two, primes were semantically related words in Persian, and targets were in English using concrete words (e.g., چتر - *rain*). In group three, primes were semantically related words in English, and targets were in Persian using abstract words (*e.g., risk* - خطر). In group four, primes were semantically related words in English, and targets were in Persian using concrete words (e.g., *umbrella* - *باران*). In all experiments, primes were masked. All the primes and targets were matched on length and number of syllables. 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 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. Table 1 gives examples of the four different kinds of experimental trials as used in the experiments. A complete listing of the items appears in appendices A and B.

Table 1
Examples of the Four Different Kinds of Experimental Trials

		Abstract			Concrete		
		Prime Relation			Prime Relation		
Experiments	Direction	Translation	Semantic	Target	Translation	Semantic	Target
1	L*1*–L*2*	خطر	تهدید	danger	باران	چتر	rain
2	L*2*–L*1*	danger	risk	خطر	rain	umbrella	باران

A TOEFL proficiency exam was conducted to ensure that the study participants were balanced bilinguals. Following that, 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 subject 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 plain rainy ones. 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 so 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.

2.5. Data Analysis

At first, incorrect answers were left out of the data analysis. RTs of less than 300 milliseconds and more than 1800 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 performed in order to reduce the impact of outliers. The SPSS statistics package 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 11640 trials. However, 514 trials were erroneous replies among related and unrelated word pairings, so they were deleted. Ten trials out of the remaining 11126 were either below 300 ms or above 1800 ms, they were also eliminated. As a result, 11116 trials were subjected to analysis.

3. Findings

3.1. EXPERIMENT 1: Cross-Language Semantic Priming from L1 to L2d

We used cross-language semantic priming in two trials to learn more about the language imbalance in the masked cross-language priming paradigm. For this model, the evidence for linguistic imbalance is significantly less obvious. Perea et al. (2008) showed priming effects of equal magnitude in both directions. However, Basnight-Brown and Altarriba (2007) found no priming in either direction. Duyck (2005) found asymmetric priming from L1 to L2, but not vice versa, in a comparable cross-language semantic priming paradigm, using pseudohomophones of semantically relevant terms in the prime position. As a result, it's unclear if the cross-language semantic priming effect can be duplicated and, if so, whether the effects are uneven. We looked at cross-language semantic priming from L1 to L2 in Experiment 1. As with the cross-language semantic priming investigations, the primes were semantic associates of the targets. The abstract words made up half of the stimuli, while the concrete words made up the other half.

3.1.1. Abstract Words

Within related and unrelated word pairings in the abstract words group, 230 trials were incorrect, and two trials were outliers, so they were removed from the entire data set of 2910 trials. A total of 2678 trials were included in the study. Table 2 shows a summary of mean RTs for this group.

Table 2
Mean RTs for semantic priming from L1 to L2 for abstract words

	Grouping	N	Mean	Std. Deviation	Std. Error Mean
Reaction Time	Related Condition	855	495.69	1094.11	3.74179
	Unrelated Condition	855	498.57	1209.49	4.13637

Table 3
T-Test result for semantic priming from L1 to L2 for abstract words

T-Test for equality of means			
T	df	Sig. (2-tailed)	Means Difference
-.671	854	.502	4.28839

The T-test for this group revealed an insignificant priming effect (sig..502 >.05), as shown in Table 3, despite the fact that the means differed from the prior groups. The recognition of English targets preceded by a semantically similar Persian word (495 msec) was faster than that of targets preceded by an unrelated Persian word (498 msec).

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

Null Hypothesis 1 (Ho1): Masked semantic priming effect cannot be achieved using L1 (Persian) abstract primes for Iranian EFL learners.

Alternative Hypothesis 1 (H1): Masked semantic priming effect can be achieved using L1 (Persian) abstract primes for Iranian EFL learners.

Therefore, the null hypothesis was confirmed, and the alternative hypothesis was rejected.

3.1.2. Concrete words

Within related and unrelated word pairings in the concrete words group, 142 trials were incorrect, and two trials were outliers, so they were removed from the entire data set of 2910 trials. A total of 2766 trials were examined for this study. For each item, mean latencies for accurate replies were computed. Table 4 shows a summary of the mean RTs for this group.

Table 4
Mean RTs for semantic priming from L1 to L2 for concrete words

	Grouping	N	Mean	Std. Deviation	Std. Error Mean
Reaction Time	Related Condition	899	477.06	1034.46	3.45063
	Unrelated Condition	899	479.82	1024.03	3.41535

Table 5
T-Test result for semantic priming from L1 to L2 for concrete words

T-Test for equality of means			
T	df	Sig. (2-tailed)	Means Difference
-.781	898	.435	3.53149

Since the mean RTs for related and unrelated pairings were varied, a T-test based on participants' RTs was used to examine for significance across two sets of items. The recognition of English targets preceded by a semantically similar Persian word (477 msec) was faster than that of targets preceded by an unrelated Persian word (479 msec). In the translation priming experiment from L1 to L2 for concrete terms, however, the primary impact of priming was minor (sig..435 > .05), as shown in Table 5.
Research Question 2 (RQ2): Can masked semantic priming effect be achieved using L1 (Persian) concrete primes for Iranian EFL learners?

Null Hypothesis 2 (Ho2): Masked semantic priming effect cannot be achieved using L1 (Persian) concrete for Iranian EFL learners.

Alternative Hypothesis 2 (H2): Masked semantic priming effect can be achieved using L1 (Persian) concrete for Iranian EFL learners.

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

3.1.3. Abstract vs. Concrete Words

Mean latencies were measured across items to compare Abstract and Concrete terms. Table 6 shows a summary of mean RTs.

Table 6
Mean RTs for semantic priming from L1 to L2 for abstract vs. concrete words

	Grouping	N	Mean	Std. Deviation	Std. Error Mean
Reaction Time	Abstract words	882	498.12	1166.25	3.92697
	Concrete words	882	478.89	1052.73	3.54474

Table 7
T-Test result for semantic priming from L1 to L2 for abstract vs. concrete words

T-Test for equality of means			
T	df	Sig. (2tailed)	Means Difference
4.950	881	.000	3.88544

The T-test based on participants' RTs was carried over two sets of items since the mean RTs were different. Concrete word answers (478 msec) were quicker than abstract word responses (498 msec). The priming impact of 20 milliseconds was considerable. As a result, the main effect of priming was significant for abstract vs. concrete terms in the semantic priming experiment from L1 to L2 (sig. .000 < .05), as shown in Table 7.
We could not find a significant cross-language semantic priming effect from L1 to L2. Not finding a significant semantic priming effect from L1 to L2 is in line with the findings of Basnight-Brown and Altarriba (2007). Note,

however, that Perea et al. (2008) found significant cross-language semantic priming effects in balanced bilinguals. This finding shows that L1 to L2 semantic priming is possible, provided that the SOA is long enough or that participants are proficient enough.

3.2. EXPERIMENT 2: Cross-Language Semantic Priming from L2 to L1

L2 primes and L1 targets were employed in Experiment 2. We translated the L1 prime (to L2) and the L2 target (to L1) from Experiment 1 to maintain the same association strength from prime to target as in Experiment 1.

3.2.1. Abstract words

64 trials were erroneous replies between related and unrelated word pairings in this group, and two trials were outliers, so they were removed from the entire data set of 2910 trials. A total of 2844 trials were included in the study. Table 8 shows a summary of mean RTs for this group.

Table 8
Mean RTs for semantic priming from L2 to L1 for abstract words

	Grouping	N	Mean	Std. Deviation	Std. Error Mean
Reaction Time	Related Condition	938	450.78	912.56	2.97964
	Unrelated Condition	938	445.06	881.05	2.87675

Table 9
T-Test result for semantic priming from L2 to L1 for abstract words

T-Test for equality of means			
T	df	Sig. (2-tailed)	**Means Difference**
1.620	937	.105	**3.52827**

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 priming effect for abstract objectives did not reach a significant level, according to a T-test. In the semantic priming experiment from L2 to L1 using abstract words, the main impact of priming was insignificant (sig. .105 >.05), as shown in Table 9.

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

Null Hypothesis 3 (Ho3): Masked semantic priming effect cannot be achieved using L2 (English) abstract primes for Iranian EFL learners.

Alternative Hypothesis 3 (H3): Masked semantic priming effect can be achieved using L2 (English) abstract primes for Iranian EFL learners.

As the results show, the null hypothesis was confirmed, and the alternative hypothesis was rejected.

3.2.2. Concrete words

Within related and unrelated word pairings in the concrete words group, 88 trials were incorrect, and four trials were outliers, so they were removed from the entire data set of 2910 trials. A total of 2818 trials were included in the study. For each item, mean latencies for accurate replies were computed. Table 10 shows a summary of mean RTs for this group.

Table 10
Mean RTs for semantic priming from L2 to L1 for concrete 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 11
T-Test result for semantic priming from L2 to L1 for concrete words

T-Test for equality of means			
T	df	Sig. (2-tailed)	Means Difference
-.693	925	.498	3.49014

The mean RTs for related and unrelated pairings were different; a T-test based on participants' RTs was used to see if the difference was significant across two groups of items. Persian targets followed by an English translation (444 msec) were identified faster than unrelated English words (446 msec). This 2-msec priming effect, however, was insignificant. As a result, in the translation priming experiment from L2 to L1 for concrete words, the main effect of priming was insignificant (sig. .489 > .05), as shown in Table 11.

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

Null Hypothesis 4 (Ho4): Masked semantic priming effect cannot be achieved using L2 (English) concrete primes for Iranian EFL learners.

Alternative Hypothesis 4 (H4): Masked semantic priming effect can 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

Comparing Abstract and Concrete words, mean latencies were calculated across items. A summary of mean RTs appears in Table 12.

Table 12
Mean RTs for semantic priming from L2 to L1 for abstract vs. concrete words

	Grouping	N	Mean	Std. Deviation	Std. Error Mean
Reaction Time	Abstract words	935	450.24	912.35	2.98372
	Concrete words	935	444.20	885.16	2.89480

Table 13
T-Test result for semantic priming from L2 to L1 for abstract vs. concrete words

T-Test for equality of means			
T	df	Sig. (2-tailed)	Means Difference
1.738	934	.082	3.47408

The mean RTs differed; a T-test based on participants' RTs was conducted across two sets of items to see whether the difference was significant. In the semantic priming experiment from L2 to L1, the main effect of priming was insignificant for abstract vs. concrete words (sig..082 > .05), as shown in Table 13.

3.3. Combined analysis for Experiments 1 and 2

We evaluated the data from Experiments 1 and 2 to see whether there were any changes in cross-language semantic priming in both directions. In general, L2 targets elicited slower reactions than L1 targets. The average latencies of abstract and concrete items were determined. Tables 14 and 15 show a summary of mean RTs for abstract and concrete words, respectively.

Table 14
Mean RTs for semantic priming for abstract words in L1 - L2 vs. L2 - L1

	Grouping	N	Mean	Std. Deviation	Std. Error Mean
Reaction Time	L1 - L2 Condition	901	500.44	1191.56	3.96969
	L2 - L1 Condition	901	449.75	920.64	3.06712

Table 15
Mean RTs for semantic priming for concrete words in L1 - L2 vs. L2 - L1

	Grouping	N	Mean	Std. Deviation	Std. Error Mean
Reaction Time	L1 - L2 Condition	909	481.16	1115.99	3.70154
	L2 - L1 Condition	909	443.73	886.56	2.94056

Because the mean RTs differed, a T-test based on the participants' RTs was used to determine if the difference was significant across four sets of items. In the semantic priming experiment for abstract terms in L1- L2 vs. L2- L1, the main effect of priming was significant (sig. .000 < .05), as indicated in Table 16. In the semantic priming experiment for concrete terms in L1-L2 vs. L2-L1, the main effect of priming was likewise significant (sig. .000 < .05), as shown in Table 17.

Table 16
T-Test result for semantic priming for abstract words in L1- L2 vs. L2- L1

T-Test for equality of means			
T	df	Sig. (2-tailed)	Means Difference
11.891	900	.000	4.26231

Table 17
T-Test result for semantic priming for concrete words in L1- L2 vs. L2- L1

T-Test for equality of means			
T	df	Sig. (2-tailed)	Means Difference
9.436	908	.000	3.96727

Experiment 1 showed an insignificant translation priming effect from L2 to L1 for abstract and concrete words. Concerning L1 targets in Experiment 2, differences in mean RTs for abstract and concrete words were also insignificant. In both groups, responses to L2 targets were generally slower than L1 targets. Differences in responding to abstract and concrete words were not significant. However, in comparing abstract and concrete words in

two different directions, semantic priming asymmetry was significant for both abstract and concrete words. In general, the expected semantic priming asymmetry in the lexical decision task was observed. Therefore, the combined analysis for Experiments 1 and 2 showed that the overall cross-language priming effect interacted with the priming direction (from L1 to L2, or vice versa).

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 problem is much more problematic when it comes to multilingual memory. Scientists from many professions have long debated whether information for two languages should be kept in a single lexicon or two distinct lexicons, as well as how they should be accessible. Psycholinguistics is one of the domains that uses priming experiments to address multilingual lexicon. Despite the fact that several studies have been conducted on the subject, cross-language research on languages with different scripts needs additional investigation. Because Persian and English employ entirely different 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 distinct 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 apparent priming is thought to provide more pure results.

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 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., Chen & Ng, 1989; Williams, 1994; Kotz, 2001; Kotz & Guttler, 2004; Kiran & Le (e.g., Keatley & de gelder, 1992; Keatley et al., 1994; Basnight- Brown & Altarriba, 2007). However, there have been reports of a null effect (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 (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 noncognates to examine the semantic priming effect with Persian-English bilinguals. Noncognates, 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 noncognate priming. De Groot and Nas (1991) also proposed that noncognates 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. Translation equivalent pairings, semantically comparable pairs, associatively related pairs, and associatively/semantically related pairs were the four pairs studied. For translation equivalent pairs, semantically similar pairs, and associatively related pairs, the author could not observe a priming effect. She was only able to discover a priming effect for pairings that were associatively/semantically associated.

Using the semantic priming paradigm, Ansarin and Saeeidi Manesh (2015) studied whether bilinguals share semantic aspects of their L1 and L2. Target-prime pairings that were semantically linked were investigated in two trials. The target words were in English in both experiments, while the primes were in Persian in the first and English in the second. For these stimuli, the reaction time of sixty Persian-English bilinguals was tested. The semantic priming effect was not present in any of the studies, according to the findings. Bilinguals have shared semantic representation for two languages with different scripts only for cognate terms, according to the research. The authors concluded that, at least at intermediate competency levels, utilizing semantically similar terms 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.

In the present study, we failed to find semantic priming effects with Persian-English bilinguals for abstract words and concrete words. 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.

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 initially include only a portion of this information, modified by the L2 store's different linguistic network and the student's diverse experiences in L2 contexts, the L2 representation would initially include only a portion of this information, including rich connections both internally and across memory systems. 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 more remarkable, 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. A 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. It agrees with the findings of the current study, which demonstrated no significant priming in semantically related pairings.

According to the interactive activation model, word recognition is coordinated by a combination of bottom-up and top-down processes. Visual features drive the bottom-up process, demonstrating that if the letter string of a particular word is recognized, each of the visual elements in that letter string will assist in identification. The BIA model takes into account the same structure as the interactive activation model, but assumes that the bottom-up process includes non-selective linguistic activation. This suggests that the bilingual languages are active at the same time during the first stages of word recognition. If access is language selective, the fact that words are cognates or have numerous neighbors in another language should have no influence on reaction times, according to Szubko-Sitarek (2015). If access is not selective, candidates from both languages will offer themselves, resulting in longer reaction times once again. Despite the fact that the words in our experiments were not cognates, the priming asymmetry observed is consistent with language selective access.

The Revised Hierarchical Model (RHM) assumes direct access to concepts after L2 proficiency and stronger access from L2 to concepts via the L1 lexical representation in the early stages of acquisition. In bilingual memory, it considers the same conceptual level for the two languages. The connection strength varies depending on the bilingual and the language. This connection strength in languages with different scripts, which provides direct access to the conceptual level and hence leads to activation of similar semantic characteristics, has to be enhanced by either greater proficiency levels or early bilingualism, as the current study's findings suggest.

4.1. Limitations of the Study

The main limitation in the research process was the number of participants in the study. To obtain more reliable results, including more participants would be more favorable; however, since achieving balanced proficient bilinguals was a complicated process, the study was carried out with 97 participants at the University of Tabriz.

4.2. Implications of the Study

The goal of this study was to learn more about bilinguals' mental representations of words in order to better understand lexical acquisition and processing in L1 and L2. 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. According to the findings of this study, utilizing related terms from other languages in the process of vocabulary training is more recommended at higher levels of competence. Clearly, further field-based experimental research is required to confirm the conclusions of this study.

4.3. Suggestions for Further Research

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 be used to 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.

5. Conclusions

It was intended to investigate whether the semantic priming effect could be obtained for semantically related pairs, using L1 and L2 primes in two different directions for abstract and concrete words. Experiment 1 and Experiment 2 showed that such priming could not be observed either from L1 to L2 or from L2 to L1. The differences between abstract and concrete words were significant only in Experiment 1. The priming asymmetry was found for both abstract and concrete words. There was a trend for larger priming effects with concrete words than abstract words. It should be noted that priming effects interacted significantly with concreteness only from L1 to L2 in the semantic priming Experiments. Based on the results obtained from four experiments, it was suggested that at least in languages with different scripts higher proficiency level is needed in order to access conceptual level in mind and activate shared semantic features between languages, and achieve priming effects specifically for abstract words with L2 targets.

RHM (Kroll & Stewart, 1994), 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 and the RHM models. 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 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.

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.

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.

Bhatia, T. K., & Ritchie, W. C. (2004). Bilingualism in South Asia. In T. K. Bhatia & W. C. Ritchie (Eds.), *The handbook of bilingualism* (pp. 780-807). Malden, MA: Blackwell.

Bleasdale, F. A. (1987). Concreteness-dependent associative priming: Separate lexical organization for concrete and abstract words. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, 13, 582-594.

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.

Brown, A & Gullberg, M. (2010). Bidirectional crosslinguistic influence in L1-L2 encoding of Manner in speech and gesture: A study of Japanese speakers of English. *Studies in Second Language Acquisition,* 30(2), 225-251.

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., & Nas, G. L. J. (1991). Lexical representation of cognates and noncognates in compound bilinguals. *Journal of Memory & Language*, 30, 90-123.

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.

Edwards, J. V. (2004). Foundations of bilingualism. In T. K. Bhatia & W. C. Ritchie (Eds.), *The handbook of bilingualism* (pp. 7-31). Malden, MA: Blackwell.

Ferré, P., Guasch, M., García-Chico, T., & Sánchez-Casas, R. (2015). Are There Qualitative Differences in the Representation of Abstract and Concrete Words? Within-Language and Cross-Language Evidence from the Semantic Priming Paradigm. *Quarterly Journal of Experimental Psychology, 68*(12), 2402–2418.

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.

Fotovatnia, Z., & Taleb, F. (2012). Masked noncognate 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 noncognates 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.

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.

Hoshino, N., & Kroll, J. F. (2008). Cognate effects in picture naming: Does cross-language activation survive a change of script? *Cognition*, *106*, 501–511.

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.

Kolers, P. A., & Roediger, H. L. (1984). Procedures of mind. *Journal of Verbal Learning & Verbal Behavior*, 23, 425-449.

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., & De Groot, A. M. B. (Eds.). (2006). *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.

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.

Meyer, D. E., & Schvaneveldt, R. W. (1971). Facilitation in recognizing pairs of words: Evidence of a dependence between retrieval operations. *Journal of Experimental Psychology*, 90, 227-234.

Morford, J. P., Wilkinson, E., Villwock, A., Pinar, P., & Kroll, J. F. (2011). When deaf signers read English: Do written words activate their sign translations? *Cognition*, 118, 286-292.

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.

Perea, M., & Rosa, E. (2002a). The effects of associative and semantic priming in the lexical decision task. *Psychological Research*, 66, 180-194.

Perea, M., & Rosa, E. (2002b). Does the proportion of associatively related pairs modulate the associative priming effect at very brief stimulus-onset asynchronies? *Acta Psychologica*, 110, 103-124.

Perea, M., & Rosa, E. (2002c). Does "whole word shape" play a role in visual word recognition? *Perception & Psychophysics*, 64, 785–794.

Posner, M., & Snyder, C.R.R. (1975 a). Attention and cognitive control. In R. Solso (Ed.). *Information Processing and Cognition: The Loyola Symposium*. Hillsdale. New Jersey: Erlbaum.

Posner, M., & Snyder, C. (1975 b). Facilitation and inhibition in the processing of signals. In P. rabbitt & S. Dome (Eds.), *Attention and performance V* (pp. 669-683). New York Academic Press.

Ratcliff, R., & McKoon, G (1988). A retrieval theory of priming in memory. *Psychological Review*, 95, 385-408.

Sánchez-Casas, R. M., Davis, C. D., & García-Albea, J. E. (1992). Bilingual lexical processing: Exploring the cognate/noncognate 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.

Schwanenflugel, P. J., & Rey, M. (1986). Interlingual semantic facilitation: Evidence for a common representational system in the bilingual lexicon. *Journal of Memory & Language*, 25, 605-618.

Schwartz, A. I., & Van Hell, J. G. (2012). Bilingual visual word recognition in sentence context. In J. Adelman (Ed.), *Visual word recognition* (pp. 129–148). London, UK: Psychology Press.

Tabouret-Keller, A. (2004). Bilingualism in Europe. In T. K. Bhatia & W. C. Ritchie (Eds.), *The handbook of bilingualism* (pp. 662-688). Malden, MA: Blackwell.

Thierry, G., & Wu, Y. J. (2004). Electrophysiological evidence for language interference in late bilinguals. *NeuroReport*, *15*, 1555–1558.

Thierry, G., & Wu, Y. J. (2007). Brain potential reveals unconscious translation during foreign-language comprehension. *Proceedings of the National Academy of Sciences*, *104*, 12530–12535.

van Beijsterveldt, L. M., & van Hell, J. G. (2009). Structural priming of adjective–noun structures in hearing and deaf children. *Journal of Experimental Child Psychology,* 104(2), 179-196.

Wen, Y., & van Heuven, W. J. B. (2017). Non-cognate translation priming in masked priming lexical decision experiments: A meta-analysis. *Psychonomic Bulletin & Review, 24*(3), 879–886.

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., 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.

Appendices

Apendix A				
word targets and corresponding primes in experiment 1				
Abstract words				
English (L2) target	Persian (L1) translation	control	Persian (L1) semantically-related	control
truth	حقیقت	امنیت	دروغ	آشپزی
future	آینده	شرایط	گذشته	تکرار
feeling	احساس	کل	روحیه	ادعا
peace	صلح	واقعیت	جنگ	دقیقه
question	سوال	سرود	پاسخ	بتن
story	داستان	دور	افسانه	کمرو
danger	خطر	ژست	تهدید	شادی
crime	جرم	سرگرمی	شاهد	عملکرد
law	قانون	پاک	قاعده	شخص
choice	انتخاب	شوم	گزینه	مفهوم

Apendix B				
word targets and corresponding primes in experiment 1				
Concrete words				
English (L2) target	Persian (L1) translation	control	Persian (L1) semantically-related	control
color	رنگ	تاول	قرمز	درشت
rain	باران	رمان	چتر	جسم
curtain	پرده	پارک	پنجره	بدهی
father	پدر	اتاق	مادر	بیشتر
queen	ملکه	کاپیتان	پادشاه	ناظر
mountain	کوه	کلیسا	تپه	قاشق
girl	دختر	قهوه	پسر	آهن
castle	قلعه	پیشنهاد	قصر	رقص
key	کلید	تصادف	قفل	کاغذ
plane	هواپیما	موج	پرواز	قفل

Apendix C				
word targets and corresponding primes in experiment 2				
Abstract words				
Persian (L1) target	English (L2) translation	control	English (L2) semantically-related	control
حقیقت	truth	north	lie	pie
آینده	future	little	past	cast

احساس	feeling	reality	mood	whom
صلح	peace	sense	war	far
سوال	question	business	answer	appear
داستان	story	yours	tale	rational
خطر	danger	basic	risk	reach
جرم	crime	visit	witness	vicious
قانون	law	how	rule	hide
انتخاب	choice	anyone	option	hardly

Apendix D				
word targets and corresponding primes in experiment 2				
Concrete words				
Persian (L1) target	English (L2) translation	control	English (L2) semantically-related	control
رنگ	color	solar	paint	month
باران	rain	ruin	umbrella	clock
پرده	curtain	surgeon	window	supper
پدر	father	material	mother	number
ملکه	queen	flower	king	sing
کوه	mountain	position	hill	hall
دختر	girl	high	boy	day
قلعه	castle	woman	palace	eyes
کلید	key	neck	lock	loan
هواپیما	plane	close	flight	lips