Pan-Pacific Association of Applied Linguistics 19(1), 121-132

Reaction Time in Semantic Priming Experiments with Persian (L1) vs. English (L2) Primes

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Ansarin, A. A. & Manesh, S. 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.

Representation of languages in a bilingual mind in general and the way bilinguals restore words from their mental lexicon, and the way they retrieve the words have been explored by many researchers resulting in varied findings. The more information regarding bilingual memory is obtained, the better image would be constructed about this knowledge representation. The present study is an attempt to investigate if bilinguals share semantic features of their L1 and L2 using semantic priming paradigm. In two experiments, semantically related target-prime pairs were examined. In both of the experiments target words were in English, but the primes were in Persian in the first experiment and in English in the second. Reaction time of sixty Persian-English bilinguals for these prompts was measured by DMDX software. Results showed that semantic priming effect was not there in any of the experiments. The findings suggest that bilinguals have shared semantic representation for two languages with different scripts only for the cognate words. Results also suggest that using semantically related words, for non-cognate words, in the process of language teaching is not useful in intermediate proficiency levels.

Key Words: bilingual memory, semantic priming, Lexical decision tasks

1 Introduction

The priming paradigms have been widely used in the last two decades in order to investigate both orthographic and phonological activations during visual word recognition. Priming is an implicit memory effect in which exposure to one stimulus influences the reaction or response time to another stimulus. Meyer and Schvaneveldt (1971) showed that people were faster in making a decision if a string of letters is a word when the word followed an

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associatively or semantically related word. For example, NURSE is recognized more quickly following DOCTOR than following BREAD. Various experiments supported the theory that activation spreading among related ideas was the best explanation for the facilitation observed in the lexical decision task (Schvaneveldt & Meyer, 1973). The priming paradigm provides excellent control over the effects of individual stimulus on cognitive processing and associated behavior because the same target stimulus can be presented with different primes. Thus, differences in performance as a function of differences in priming stimuli must be attributed to the effect of the primes on the processing of the target stimuli. So priming is a term used in lexical decision tasks that accounts for decreased reaction time of related words. Interchangeably, the word activation in many cases, refers to the effect of related words on the reaction time of individuals.

Masked priming has become a very popular technique in psycholinguistics in which a stimulus (the prime) is presented briefly and immediately followed by the target, which causes backward masking of the prime. The combined action of masking stimuli and short presentation of the prime results in a consciously imperceptible stimulus. Unmasked priming, on the other hand, is another technique in which primes are presented with longer durations in order to make them more perceptible for participants. However, in the experiments in which there is no reference to the term masked, unmasked paradigms are intended.

Within-language priming studies (e.g., Chen & Ng, 1989; Fischler, 1977; Scarborough, Gerard, & Cortese, 1984) and cross-language priming studies (e.g., Keatley & de Gelder 1992; Kotz, 2001; Kotz & Guttler, 2004) have been carried out with various languages.

The representation of languages in bilingual minds has been explored by many researchers, using different priming paradigms, which has led to different results. Chen and Ng (1989) was one of the studies that addressed both within and across languages priming effects. They reported existence of semantic priming effect for Chinese-English bilinguals in lexical decision task. However, translation equivalent primes were reported to have greater effect than semantically similar ones. Since translation equivalent pairs were activated from one single node, unlike semantically related words which were activated from more than one.

Similarly, Keatley, Spinks, and de Gelder (1994) conducted three experiments to examine cross-language priming in bilinguals. The first was a cross-language primed lexical decision task experiment with Chinese-English bilinguals. Subjects made lexical decisions about primary associate targets in the two languages at the same rate, but priming occurred only when the prime was in their first language (L1), Chinese, and the target was in their second language (L2), English. Their second experiment produced the same pattern of asymmetrical priming with two alphabetic languages, French and Dutch. Finally, in the third experiment, the crucial stimuli were translation

equivalents. In contrast to the results of experiments 1 and 2, priming occurred across languages in both the Ll-L2 and L2-L1 conditions. However, this priming was also asymmetrical, with more priming occurring in the L1-L2 condition.

However, there are reports of studies that failed to find semantic priming effect across languages. For example, Scarborough, Gerard, and Charles (1984) found within language semantic priming with Spanish-English bilinguals, but they could not find the same effect for translation equivalents. Chen and Ng (1989) attributed the difference in findings to procedural differences among the studies. They believed that the time interval between the prime and the target in Scarborough et al. (1984) was too long, so the effect of the prime disappeared; they proposed that the interval must be long enough in order for the prime to be processed, but not too long, because the effect would disappear, (as cited in Javadi, 2014).

The direction of prime i.e., whether the prime is in L1 or L2, is another factor beside the SOA factor (Stimulus-Onset Asynchrony), which changes the results in a significant way. Perea et al (2008) found same magnitude of priming effect for both L1 to L2, and L2 to L1 directions. But other studies have reported different result when the direction is changed. For example, Kiran and Lebel (2007) examined lexical representation in early Spanish-English bilinguals using an unmasked semantic and translation priming paradigm. In the latter study, results revealed that all groups were more accurate in making a decision by English targets (L1-L2 direction) than Spanish targets (L2-L1 direction).

Cross-language semantic priming experiments with different groups of bilinguals also have yielded contradictory results. Kotz (2001) and Kotz and Guttler (2004) investigated semantic priming with two groups of words i.e., semantically related words and associates. Kotz (2001) noticed semantic priming in both types of relations, but Kotz and Elston-Gultter (2004) only obtained semantic priming with associatively related words. The only difference between these two studies was that participants in Kotz (2001) were proficient bilinguals. In another study, Guasch et al. (2011) carried out cross-language semantic priming experiment with proficient Catalan-Spanish bilinguals in order to provide further evidence to confirm or reject Kotz's (2001) findings. The authors believed that the inconsistency in the results was partly due to the fact that the participants in the studies were not balanced. The authors distinguished among associatively related words on one hand and semantically related words on the other. In their study, the proficiency level of participants as one of the important factors which was controlled. Also, both directions of priming effect were tested i.e., L1 to L2 and L2 to L1. They criticized previous studies for failing to distinguish semantically related pairs from associatively related pairs. They manipulated the degree of similarity among the primes and targets to see whether different amount of priming effect could be achieved with pairs of different degrees of semantic

similarity. They reported a significant semantic priming effect for highly semantically similar pairs in both L1 to L2 and L2 to L1 directions on one hand and lexical decision and semantic categorization task on the other.

2 Statement of the Problem

One line of psycholinguistic research explores how people represent the two languages i.e., whether they have a separate representation for each language, or a single conceptual representation shared by two languages. Priming experiments have long been considered as a reliable evidence for separate or shared semantic representations. Therefore, the purpose of the present study was to resolve the conflicting reports on these language representation types and explore whether within-language and cross-language priming effect could be achieved using L1 and L2 primes with Persian-English bilinguals.

3 Research Questions and Hypotheses

RQ1: Can semantic priming effect be achieved using L2 primes for Iranian EFL learners?
Null Hypothesis 1 (H_{o1}): Semantic priming effect cannot be achieved using L2 primes for Iranian EFL learners.

RQ2: Can semantic priming effect be achieved using L1 primes for Iranian EFL learners?
Null Hypothesis 2 (H_{o2}): Semantic priming effect cannot be achieved using L1 primes for Iranian EFL learners.

4 Method

4.1 Design of the Study

The present experimental study draws upon priming paradigm as one of the established and effective techniques for studying bilingual lexicon and lexical access. A priming study using L1 and L2 primes between the two languages of Persian and English was carried out in a series of experiments.

Participants were tested individually in a quiet room. Presentation of the stimuli and recording of reaction times were made by two laptop computers. In each test, the prime was presented in the center of the screen for 102ms which was considered to be minimum time for primes to be seen by participants. Primes were immediately replaced by the target words. Participants were instructed to press one of the two assigned 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. Participants were told that each word would flash on the screen, and they were instructed to respond as quickly and as accurately as possible. It should be noted that the instructions were given in Persian, and reaction times were measured from target onset till participants' responses.

4.2 Participants

Sixty male and female undergraduate students studying English Language and Literature at undergraduate level participated in this study. All had at least completed 6 years of formal instruction in English and had learned Persian from childhood as the official language spoken in the country. Most of the participants spoke Azari as their mother tongue. All of the participants had either normal vision or corrected to normal vision, using glasses.

4.3 Materials

Two groups of prime-target pairs were created; in group one, primes and targets were in English (e.g., *table-chair*) and in group two, primes were in Persian but targets were in English (*e.g., میز-chair*). The materials used in this study were adapted from Chiarello, Burgess, Richards, and Pollock (1990). It should be noted that the materials only included concrete nouns like *book*, and adjectives and abstract nouns like *heat* were not addressed by the study. In dealing with the two languages of Persian and English, the components of the pairs were non-cognates.

Each group consisted of 10 related pairs *(e.g., مرد - woman & man - woman)*, and 10 unrelated pairs *(e.g., مبل - cow & sofa - cow)*. In each group there were 20 pairs of nonwords *(e.g., باران - ompts & rain - ompts)* derived from ARC nonword data base (Rastle, Harrington & Coltheart, 2002) for the purpose of lexical decision task. Since the words used in the experiment varied from 2 to 7 letters in length, the nonwords were also derived with regard to the same criterion.

In other words, each data set consisted of 20 words and 20 nonwords, as for the *yes* answers to be equal to *no* answers. Each participant received 40 trials per set, a total of 80 trials in 2 set. All of the participants received the items in the same order. The whole session lasted approximately 10 minutes. Reaction times (RTs) were measured using DMDX software developed by Forster and Davis (1984).

In order to make sure that the participants in the study are balanced bilinguals a proficiency test of TOEFL (2004) was given. Afterwards, the students participated in the experiment individually.

4.4 Data Analysis

In preparing the data for analysis, first incorrect responses were excluded from data analysis. That is RTs below 300ms and above 1800ms were excluded from data analysis since they were either late responses to a previous item or no responses in the allowed time. It was done in order to moderate the influence of outliers. The data were analyzed by SPSS version 20. Two within group t-test were carried out on the data in order to compare the RTs of related vs. unrelated pairs.

5 Results

5.1 Experiment with L2 Primes

In this set, within related and unrelated word pairs, 94 trials were wrong answers and 7 trials were outliners, so they were excluded from the total data which was 2400 trials. The analysis was carried out on 2299 trials. Mean latencies for correct responses were calculated across items. The mean reaction time in related condition was 554.1157. However, in unrelated condition it was 552.3848. A summary of mean RTs for this group appears in Table 1.

Table 1. Mean RTs for Experiment with L2 Primes

Priming conditions	N	Mean	Std. Deviation	Std. Error Mean
Related condition	534	554.1154	139.85965	6.05232
Unrelated condition	565	552.3848	129.87311	5.46380

Since the mean RTs for related and unrelated pairs were different, a T-test based on participants' RTs was carried out on two sets to show if this difference is significant or not. As illustrated in Table 2, T-test for this group indicated an insignificant priming effect (sig.886>.05).

Table 2. T-Test Results for Experiment with L2 Primes

Priming conditions	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Related condition	.143	533	.886	.86535	-11.0240	12.7547
Unrelated condition	-.158	564	.874	-.86530	-11.5972	9.8666

Therefore, the first null hypothesis was confirmed and the alternative hypothesis was rejected. Semantic priming effect cannot be achieved using L2 primes for Iranian EFL learners.

5.2 Experiment with L1 Primes

In this condition, i.e., within related and unrelated word pairs, 76 trials were wrong answers and 8 trials were outliners, so they were excluded from the total data and the analysis was carried out on 2316 remaining trials. The mean reaction time in the related condition was 571.3832 and in the unrelated condition 564.5302. A summary of mean RTs for this group appears in Table 3. Comparison of the mean values shows that there is a slight difference between these two conditions.

Table 3. Mean RTs for Experiment with L1 Primes

Priming conditions	N	Mean	Std. Deviation	Std. Error Mean
Related condition	562	571.3832	139.92521	8.187195
Unrelated condition	554	564.5302	143.20213	5.851802

However, a T-test was carried out to check if this slight difference of means is significant or not. The main effect of priming was insignificant in experiment using L1 primes (sig. .562>.05) as illustrated in Table 4.

Table 4. T-Test Results for Experiment with L1 Primes

Priming conditions	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Related condition	.581	561	.562	3.42650	-8.1670	15.0200
Unrelated condition	-.563	553	.574	-3.42648	-15.3772	8.5242

As the results show, the null hypothesis was confirmed and the alternative hypothesis was rejected. Semantic priming effect cannot be achieved using L1 primes for Iranian EFL learners.

6 Discussion

The description of representation of languages in a bilingual mind has always been one of the challenging issues for psychologists. Questions like whether information for two languages is stored in one single lexicon or two separate lexicons, and the way it is accessed has been addressed by researchers interested in language processing research.

Particular interest has been shown by psycholinguists by exploring bilingual lexicons, using priming effect. Although there are various studies addressing the issue, cross-language researches on languages with different scripts are needed. Since Persian and English make use of completely

different scripts, the two languages seemed to be good candidates for exploring priming paradigm. The present study was an attempt to investigate bilingual mental lexicon and mental access.

The hypothesis was that whether semantic priming effect would be achieved with L1 and L2 primes. However, the results indicated that responses for unrelated pairs were faster than responses for related pairs. And the priming effect was found to be insignificant in both conditions.

A look in previous findings indicates that cross-language semantic priming studies have yielded rather varied results. There are reports of significant priming effect and also reports of null effect in different studies. For example, in the case of Persian and English languages, Fotovatnia and Taleb (2011) investigated semantic priming effect with Persian-English bilinguals under masked paradigm with cognates and noncognates. However, authors could not find a significant priming effect for noncognates. They attributed the lack of noncognate priming to lower proficiency of their participants. They also suggested that noncognates do not share representations at the conceptual level according to De Groot and Nas (1991).

In a recent study, Javadi (2014) investigated priming effect with Persian-English bilinguals under masked paradigm within four types of pairs. These four pairs were translation equivalent pairs, semantically similar pairs, associatively related pairs, and associatively/semantically related pairs. The author failed to show priming effect for translation equivalent pairs, semantically similar pairs, and associatively related pairs. She could find priming effect only for associatively/semantically related pairs.

The present study also failed to find priming effect with Persian-English bilinguals using L1 and L2 primes. As for this, one may suggest that since different scripts activate different lexical levels i.e., nonselective access, as predicted by Revised Hierarchical Model (RHM), words from L1 may fail to prime L2 words. Another factor which leads to lack of priming might be participants' age, i.e., when the participants are late bilinguals the link between the lexical and conceptual level is not so strong to allow semantic priming. Also lack of priming could be interpreted in terms of lower levels of proficiency in the L2.

Revised Hierarchical Model (RHM) assumes the same conceptual level for the two languages in a bilingual memory (French & Jacquet, 2004), and the strength is varied for different bilinguals and different languages. As the findings of the present study suggest the link between languages with different scripts, which allows direct access to the conceptual level and consequently leads to activation of shared semantic features, needs to be strengthened by either higher proficiency level or early bilingualism. What's more, according to negative priming idea, which was first proposed by Bijeljac-babic, Biardeau, and Grainger (1997), being exposed to different words activates lexical representations from both languages and it makes the processing more time taking.

Furthermore, in this study, all words were non-cognates in Persian and English. According to De Groot and Nas (1991), cognate words share representations at the conceptual level, whereas noncognates do not share representations at the conceptual level. Other studies also confirmed lack of significant noncognate priming (García-Albea, Sánchez-Casas, Bradley, & Forster, 1985; García-Albea, Sánchez-Casas, & Igoa, 1998; Grainger & Frenck-Mestre, 1998). As a conclusion, the results of this study may be related to L1-L2 cross-linguistic influences, students' level, types of target words, etc.

7 Implications of the Study

The present study explored the mental representation of words in the mind of Persian/English bilinguals to improve our understanding of lexical acquisition and processing in L1 and L2. Such understanding contributes to the models that explore the structure of mental cognitive structure that is responsible for the storage and processing of information at the theoretical level and the effective design and implementation of instructional materials at the pedagogical level. As Brunning, Schraw, and Ronning (1999) put it, "there are very few educational decisions to which the cognitive issues of memory, thinking, and problem-solving are not relevant" (as cited in Fotovaynia & Taleb, 2010). The findings of the present study suggest that using related words between languages in the process of vocabulary teaching is not useful in intermediate proficiency levels.

8 Conclusion

This study investigated the idea whether semantic priming effect could be obtained for semantically related pairs, using L1 and L2 primes, under unmasked paradigm. Semantic priming effect was not achieved in the different conditions of the study. So we could conclude that semantic priming effect cannot be achieved using L2 or L1 primes for Iranian EFL learners. At least in languages with different scripts, higher proficiency level would be needed to access conceptual level in the mind and activate shared semantic features between languages and achieve priming effects.

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Received: April 23, 2015
Revised: June 1, 2015
Accepted: July 1, 2015