ARTICLES

MASKED SEMANTIC/ASSOCIATIVE AND TRANSLATION PRIMING ACROSS LANGUAGES

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Abstract. The present study was an attempt to investigate bilingual mental lexicon. The main question addressed in the study was whether semantic/associative and translation priming effects could be achieved with Persian-English bilinguals. The masked priming paradigm, as a technique reflecting automatic cognitive processes going on during semantic processing rather than strategic uses of the prime, was deployed to answer the question. Four types of prime-target pairs (translation equivalent, semantically similar, associatively related, and semantically associated pairs) were formed for the purpose of the lexical decision task. A total of 85 Persian-English bilinguals participated in the study. Though the priming effect was not found for the first three groups, the targets in semantically associated pairs (most strongly related words) responded about 29 ms faster. The results suggested that bilinguals share mental representations for associatively semantically related words; consequently, teaching new words of the second language by linking them to associatively related words of the first language may lead to better results.

Keywords: *bilingual memory, semantic priming, cross-language masked priming.*

Ансарін Алі Акбар, Джаваді Шалал. Маскований семантичний/ асоціативний та перекладний праймінг у різних мовах.

Анотація. Статтю присвячено спробі дослідити двомовний ментальний лексикон. Головне питання дослідження – встановити, чи персько-англійські білінгви можуть досягнути ефекту семантичного / асоціативного або перекладацького праймінгу. Для відповіді на це питання було застосовано масковану праймінгову парадигму як техніку, що відображає автоматичні когнітивні процеси, що тривають під час семантичної обробки, а не стратегічного використання прайму. Із метою вирішення лексичного завдання було сформовано чотири типи цільових пар праймінгу (перекладацькі еквіваленти, семантично подібні, асоціативно та семантично пов'язані пари). Загалом у дослідженні взяло участь 85 персько-англійських білінгвів. Хоча ефекту праймінгу не було виявлено для перших трьох груп, респонденти із семантично пов'язаних пар (найміцніше пов'язаних слів) відповіли приблизно на 29 мс швидше. Результати засвідчили, що білінгви мають спільні уявлення для асоціативних семантично пов'язаних слів. Отже, навчання новим словам другої мови, шляхом поєднання їх із асоціативно пов'язаними словами першої мови, може привести до кращих результатів.

Ключові слова: *двомовна пам'ять, семантичний праймінг, крос-мовний маскований праймінг.*

1. Introduction

Bilingual memory has always been a challenging issue for researchers in the field of psycholinguistics. Issues like whether bilinguals store the information for the two languages in a single shared lexicon or two separate lexicons, or whether while accessing a word in a specific language, codes for both languages are activated or only the one for the intended language have been long-standing issues of the field. This study intends to answer the question whether bilinguals share a memory store for the two languages. Priming studies, the idea whether being exposed to a word like *table* facilitates processing a related word like *chair*, have long been an effective and promising technique in studying mental lexicon in general and bilingual mental lexicon in particular. Semantic priming is predicted by all of the following models of bilingual memory proposing a shared conceptual level.

1.1. Models of Bilingual Memory

What most current models of bilingual memory (hierarchical models) agree on is one conceptual store shared by two languages and two lexical representations specific for each language (French & Jacquet, 2004). Among the hierarchical models, the most influential model is the Revised Hierarchical Model (RHM). The RHM (Kroll & Stewart, 1994), as one of the four models that fall under hierarchical models, like all other hierarchical models, distinguishes between two levels in mental lexicon: the shared conceptual level and two lexical levels for each language and the links between them. According to this model, the links between the first (L1) and second (L2) language lexicons do not disappear as the proficiency level in L2 increases; rather, they remain in interaction (French & Jacquet, 2004). The more a bilingual masters L2, the more direct would be the access to semantic levels for L2.

The Bilingual Interactive Activation Plus model (BIA +) proposed by Dijkstra and Heuven (2002), as another influential model, assumes a shared lexicon and favors the semantic priming effect. According to this model, a bilingual uses orthographic and phonological cues of the visual input to differentiate the word. However, at this point, in the parallel access, bilinguals automatically drive the semantic meaning of both L1and L2 (nonselective access); however, of interest in this article, and also as one of the influential models in explaining semantic memory, is a connectionist model called the Spreading Activation Model (Collins & Loftus, 1975).

According to the Spreading Activation Model, words are spread through a semantic network with close paths linking the more related words and with long paths linking the more distant words. The nodes in this semantic network are the concepts, and the paths between the nodes represent the associative relationships between these concepts. When a node is activated in this network, the activation spreads through the paths to associative nodes and makes them available for later cognitive processing (Balota & Lorch, 1986, cited in Samani & Sharifian, 1997). In this network, not only are semantic features embedded, but association plays a role in linking the words. In this semantic network, though the links between strongly

associated words are usually agreed upon and believed that the activation spreads for highly related words (those related by category membership and association), the links for nonassociative semantic relations are not clear (Fischeler, 1977, cited in Chiarello et al., 1990).

The fact that the model distinguishes among semantic similarity on one hand and association on the other creates a potentially interesting topic for investigation. Here, the more the prime and target are semantically associated, the higher the possibility of the target to reach the threshold for being activated. This way, a word like *table* is considered to be processed more quickly when it is preceded by a related prime like *chair* (semantically associated with *table*) than when it is preceded by an unrelated item like *car*.

The implications of the model for bilingual semantic networks is the main concern for us in this study. As Costa, Colomè, and Caramazza (2000) argued, if the activation spreads in one semantic network regardless of the language under processing (nonselective access), the lexical nodes for both languages of a bilingual would be activated. This way, it was suggested that if a word like *table* is activated, not only the semantically associated nodes like *chair* in English would be activated, but also this activation would spread to its Persian equivalent, .

1.2. Priming Studies

Evidence in explaining bilingual memory comes from priming experiments, as well as neuropsychological and computational experiments. Experiments of priming drawing upon the theory of subliminal psychology have resulted in the development of techniques like the masked priming technique (Forster & Davis, 1984). The visual subliminal message in masked priming is flashed only for a very brief period of time in front of the eyes of a participant. It has been suggested that the participant is unaware of the existence of the prime, even though the prime goes under cognitive processing. As Kotz (2001) put it, this technique makes sure that the observed priming effect does not result from a conscious perception of the relationship between the prime and the target, but rather from an automatic and pure reflection of the processes at hand; however, participants' being unaware that their bilingualism is under investigation is another advantage that bilingual studies benefit from.

Cross-language semantic priming studies have addressed both cognates (words that besides having the same meanings share orthographical/phonological similarity) and noncognates. Though usually being able to find the effect for cognates (e.g., Sanchez-Casas, Davis, & Garcia-Albea, 1992; Gollan, Forster, & Frost, 1997), the findings are not always consistent in the case of noncognates, especially in case of languages with different scripts (e.g., de Groot & Nas, 1991; Duyck, 2005; Forster & Jiang, 2001; Fotovatnia & Taleb, 2012; Perea, Dunabeitia, & Carreiras, 2008; Samani & Sharifian, 1997; Sanchez-Casas et al., 1992; Williams, 1994).

To elaborate on this, de Groot and Nas (1991) could find a priming effect for translation pairs with Dutch-English bilinguals under unmasked conditions; however, they failed to find such an effect for associates neither under masked, where the target is invisible, nor under unmasked conditions, where the target is

visible. William (1994) could not find the effect for associated pairs in masked conditions, who accounted for the findings, putting forward the idea that semantically similar words and associatively related words behave differently. He argued that the two words that share semantic features may prime one another, but in the case of associates, this is more context-dependent and is linked with individuals' world experience. That is why the same semantic effect achieved with semantically similar words is less likely to be achieved by associates.

In two more recent studies, Perea and Rosa (2002) and Perea et al. (2008) distinguished among semantically similar and associatively related pairs. Perea and Rosa (2002) examined the existence of associative semantic priming under different stimulus onset asynchronies (SOAs) and could obtain the effect at all SOAs. In another study, Perea et al. (2008) investigated bilinguals who have developed their second language at the same time with their first language, in contrast to bilinguals who have adopted the second language later in life. They failed to find any difference between the two groups in terms of the amount of priming observed.

Samani and Sharifian (1997) addressed languages with different scripts, examining the priming effect of a higher node in a semantic network. The study consisted of two translation experiments of L1 to L2 and L2 to L1. The results indicated a priming effect only for L2 to L1. Recently, Fotovatnia and Taleb (2012) deployed a masked priming paradigm with Persian-English bilinguals. They could not find any priming effects for noncognates across Persian and English. They agreed with de Groot and Nas (1991), concluding that only cognates are connected at the conceptual level, though they had not addressed cognates in their study. However, Fotovatnia (2012) included cognates in another study later the same year, and found the priming effect for cognates. Consequently, they suggested two different lexicons for the two languages, arguing that orthography plays a main role in establishing shared lexical entries for cognates. The author justified the results, saying that, since the two languages under investigation lack script similarity, no priming effect had been observed. However, not only the number of studies carried out with languages with different scripts is scarce, but they have also yielded quite contradictory results, which urges the need for more studies done in the area.

2. Methods

Four types of prime-target relationships were formed for the purpose of lexical decision task. The pairs in the first group were translation equivalents, followed by semantically similar pairs in the second, associatively related pairs in the third, and semantically associated pairs in the fourth group. Four blocks of prime-target pairs were created, i.e., translation equivalent pairs (e.g., - *knife*), semantically similar pairs (e.g., - *door*), associates (e.g., - *dog*), and semantically associated pairs (e.g., - *pepper*). By semantically associated, it is meant that not only prime and target were of the same semantic category, but they also tend to co-occur.

The materials used in the first group were selected from the pairs used by Grainger and Frenck-Mestre (1998), and the rest were adapted from Chiarello, Burges, Richards, and Pollock (1990), where the items had been selected from

American English association norms. It should also be noted that the material only included concrete nouns like *book*; adjectives and abstract nouns like *heat* were not addressed by the study.

Neither of the components of the pairs were cognates of English when translated into Persian. Each block consisted of eight related pairs and eight unrelated pairs. An additional set of 64 orthographically legal words were derived from ARC, a non-word database for the purpose of lexical decision tasks (16 pairs in each block). Since the words used in the experiment varied from two to seven letters in length, the non-words were also derived with regard to the same criteria. In other words, words in each block were combined with 16 filters for the *yes* answers to be equal to *no* answers. Each participant received 32 trials per block, a total of 128 trials (32×4). All of the participants received the items in the same order.

2.1. Participants

Eighty-five male and female graduate and undergraduate students studying English Language and Literature and English Language Teaching at the University of Tabriz participated in the study. The participants were given extra course credit for their participation in the study. All of the participants had completed at least seven years of formal instruction in English and had learned Persian from childhood as the official language spoken in the country. Three of the participants were eliminated from the data since their error percentage was above 50. All participants had either normal or corrected-to-normal vision.

2.2. Procedure

In order to make sure that the population was balanced, a proficiency test of TOEFL (2004) was given. What is more, participants were required to fill out a questionnaire about their linguistic background, whether they had problems related to their vision, and whether they had ever lived in an English-speaking country. They were reminded to make sure that they had their glasses with them on the day of the test in case they needed glasses.

Participants were tested individually in a quiet room. Presentation of the stimuli and recording of latencies were controlled by a Sony VIO laptop computer. In each trial, a row of hash marks (#) was presented for 500 ms at the center of a computer screen to indicate where the participants should expect the words, and also to mask the primes. Next, the prime word was presented at the center of the screen for 50 ms. Primes were immediately replaced by the target. 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. They were reminded to answer as quickly and as accurately as possible. All instructions were given in Persian (the participants' mother language), and reaction times were measured from the onset of presentation of the target until the participant pressed the preassigned key on the keyboard.

Each participant received 30 practice trials to master yes/no keys. The whole session lasted approximately 9 to 15 minutes, and none of the participants reported having seen the primes. Presentation of data and measurement of reaction times (RTs) were carried out using DMDX software developed by Forster and Davis

(2003). RTs below 300 ms and above 1800 ms were considered as either late responses to a previous item or no responses in the allowed time. The data were analyzed by SPSS version 20. Four within-group t-tests were carried out on the RTs.

3. Results

The results of t-tests for paired samples were carried out for participants' RTs in primed and unprimed conditions in all four groups. Tables 1 and 2 show the mean latencies and t-test results for translation equivalent groups. A comparison of the means of the reaction times and the results of the t-test indicated that RTs for primed and unprimed conditions did not differ significantly ($p>0.05$).

Table 1

Mean Latencies for Translation Equivalent Pairs

	Grouping	N	Mean	SD	Std. Error Mean
RT	Translation Equivalent Related	255	502.36	151.88	9.51
	Translation Equivalent Unrelated	271	509.90	111.30	6.76

Table 2

T-test Results for Translation Equivalent Pairs

	Grouping	t	df	Sig. (2-tailed)	Mean Difference
RT	Translation Equivalent Related	–0.652	524	0.51	–7.53
	Translation Equivalent Unrelated	–0.646	464.09	0.51	–7.53

As Tables 3 and 4 indicate, in the second group (semantically similar pairs), although priming reduced response latencies for primed conditions as compared to unprimed conditions, the mean difference did not amount to any significant difference ($p>0.05$).

Table 3

Mean Latencies for Semantically Similar Pairs

	Grouping	N	Mean	Std. Deviation	Std. Error Mean
RT	Semantically Related	257	488.11	131.15	8.18
	Semantically Unrelated	259	488.76	158.41	9.84

Table 4

T-test Results for Semantically Similar Pairs

	Grouping	t	Df	Sig. (2-tailed)	Mean Difference
RT	Semantically related	–0.051	514	0.95	–0.65
	Semantically Unrelated	–0.051	498.04	0.95	–0.65

The results of t-tests (Tables 5 and 6) indicate that the effect was insignificant for associatively related pairs (0.33>0.05).

Table 5

Mean Latencies for Associatively Related Pairs

	Grouping	N	Mean	Std. Deviation	Std. Error Mean
RT	Associatively Related	262	500.35	112.03	6.92
	Associatively Unrelated	264	491.50	97.51	6.00

Table 6

T-test Results for Associatively Related Pairs

	Grouping	T	df	Sig.(2-tailed)	Mean Difference
RT	Associatively Related	.96	524	.33	8.85
	Associatively Unrelated	.96	513.12	.33	8.85

As Tables 7 and 8 indicate, though the effect was insignificant for all three previous groups, in the last group, RT analysis showed a high priming effect in reducing the overall response latencies as compared to the unprimed cases (0.006, at a 0.05 significance level).

Table 7

Mean Latencies for Semantically Associated Pairs

	Grouping	N	Mean	Std. Deviation	Std. Error Mean
RT	Translation Equivalent Related	264	510.70	118.09	7.26
	Translation Equivalent Unrelated	250	540.13	125.19	7.91

Table 8

T-test Results for Semantically Associated Pairs

	Grouping	t	df	Sig. (2-tailed)	Mean Difference
RT	Semantically Associated	2.74	512	0.006	29.42
	Semantically unassociated pairs	2.73	505.57	0.006	29.42

4. Discussion

The main question addressed in the present study was whether bilinguals develop a separate lexicon for storing the words of their second language or they store them in a shared lexicon with the L1 words. It was hypothesized that if words are stored in a shared lexicon, then related words (in terms of meaning and

association) should be able to prime each other. A masked cross-language semantic priming technique was deployed in a lexical decision task to answer the question. Four types of prime-target pairs were formed. The pairs in the first group were translations, followed by semantically similar words in the second, associatively related pairs in the third, and semantically associated pairs in the last group. The direction of priming was L1 to L2 in all four groups. Semantic priming was only found for the last group; i.e., semantically associated pairs (mostly related pairs). The findings of the study are in accordance with the predictions made by the Spreading Activation Model. It is suggested that, in the case of a shared lexicon, the activation of a node in one language would spread to a semantically associated node in another language; thus, the presentation of an L1 prime would facilitate accessing the semantically associated L2 target word.

Considering translation equivalent pairs, the findings of the study are in line with those of Fotovatnia and Taleb (2012) and Samani and Sharifian (1997), who could not find a translation priming effect with Persian-English bilinguals, and contrary to the findings of de Groot and Nas (1991) and Forster and Jiang (2001), who found the effect for Chinese-English bilinguals, just to name a few. However, on the other hand, considering the case for semantically/associatively related pairs, the results are consistent with the findings of Perea et al. (2008), who found a semantically associative priming effect with Basque-English bilinguals. It has to be noted that Perea et al. (2008) found the effect for associative related and semantic related pairs, contrary to the findings of the present study. However, the question why such an effect could not be found with translation equivalent pairs remains open. The results might have been affected not only by language-specific factors, but also by the way bilinguals learn a second language.

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