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Translation Priming Effect in Spanish-English Bilinguals[1]

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Abstract

This article aims to establish the effects of masked priming by translation equivalents in Spanish-English bilinguals with a high-intermediate level of proficiency in their second language. Its findings serve as evidence to support the hypothesis that semantic representations mediate the mental association among non-cognates from a speaker's first and second languages as proposed by Grainger and Frenck-Mestre (1998) in their article entitled "Masked Priming by Translation Equivalents in Proficient Bilinguals." The present article reports the results obtained from a graduation thesis[3] written as a requirement for the M.A. degree in Linguistics at Universidad Nacional de Colombia. This project was finished in 2009 and was funded by the Unit of Research Administration from the School of Human Sciences at Universidad Nacional de Colombia, Sede Bogotá, through the contest "Convocatoria de Apoyo a Trabajos de Posgrado 2008-II".

Keywords: psycholinguistics, priming, effect, tachistoscopic tasks

Resumen

El presente artículo pretende establecer los efectos de la preparación oculta a través de equivalentes de traducción en personas bilingües en español-inglés con un nivel intermedio-alto de competencia en segunda lengua. Se realizó mediante un diseño pre-experimental de dos tareas taquistoscópicas bajo el paradigma de preparación oculta. Los resultados aquí registrados sirven como evidencia para apoyar la hipótesis que afirma que las representaciones semánticas median la asociación mental entre cognados falsos de la primera y segunda lenguas de un hablante. El presente artículo reporta los resultados obtenidos para una tesis de grado[4] escrita para obtener el título de Magíster en

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Lingüística en la Universidad Nacional de Colombia. Este proyecto finalizó en 2009 y recibió apoyo económico de la Unidad de Gestión de Investigación (UGI) de la Facultad de Ciencias Humanas de la Universidad Nacional de Colombia, Sede Bogotá, mediante la "Convocatoria de Apoyo a Trabajos de Grado 2008-II".

Palabras claves: psicolingüística, priming, efecto, tarea taquistoscópica

Resumo

O presente artigo pretende estabelecer os efeitos da preparação oculta através de equivalentes de tradução em pessoas bilíngues em espanhol-inglês com um nível intermédio-alto de competência em segunda língua. Realizou-se mediante um desenho pré-experimental de duas tarefas taquistoscópicas sob o paradigma de preparação oculta. Os resultados aqui registrados servem como evidência para apoiar a hipótese que afirma que as representações semânticas mediam a associação mental entre cognados falsos da primeira e segunda língua de um falante. O presente artigo reporta os resultados obtidos para uma tese de graduação escrita para obter o título de Mestre em Linguística na Universidade Nacional da Colômbia. Este projeto finalizou em 2009 e recebeu apoio econômico da Unidade de Gestão de Pesquisa (UGI) da Faculdade de Ciências Humanas da Universidade Nacional da Colômbia, Sede Bogotá, mediante a "Convocatória de Apoio a Trabalhos de Graduação 2008-II".

Palavras Chave: psicolinguística, preparação oculta, efeito, tarefa taquistoscópica

Attempting to directly observe visual word recognition in an individual seems difficult since this is by definition a mental (i.e. internal) process. Therefore, researchers interested in exploring this phenomenon have developed indirect methods to obtain data with respect to visual word recognition in a reliable and quantifiable manner. Such methods include tachistoscopic tasks, processes of controlled observation during which an individual must give a physical response to a visual stimulus (Belinchón, Rivière & Igoa, 1992). Examples of these tasks are lexical decision and semantic categorization, which will be explained below.

A lexical decision task (LDT) is a procedure during which an individual must analyze strings of letters that appear in the center of a screen. After reading the letter string, the participant must decide whether it constitutes a word in a previously chosen language or not. For instance, "*fresh*" is a word in English while "*ktmo*" is not. The participant's choice is communicated via a physical response, such as

pressing a key. This task provides two types of results: the amount of time in milliseconds required for each subject to report his/her answer, and the number of errors made by each individual during the task (Belinchón, Rivière & Igoa, 1992).

A semantic categorization task (SCT), also called category verification, is a procedure during which a person must analyze words displayed in the center of a screen. After reading a word, the individual must decide whether it belongs to a specific semantic category (i.e. animals, fruits, etc.) or not. For instance, "*orange*" is a fruit while "*chair*" is not. The participant's choice is reported via a physical response, such as pressing a key. In order to make an accurate decision, the participant must evoke the semantic meaning of the word analyzed found in his/her mental lexicon (Balota & Chumbley, 1984). This task provides the same two types of results given by a lexical decision task.

Tachistoscopic tasks can comprise sole letter strings appearing on a screen for the subject to analyze, but they can also provide other types of stimuli that supply additional information about word recognition processes. For example, tasks involving the masked priming paradigm comprise three stimuli: 1) a mask, a string of number signs (####) that usually remains on the screen for 500msec; 2) a prime, a string of letters in lowercase that appears on the screen very briefly (0 to 100msec); and 3) a target, a letter string in uppercase which the participant must analyze in order to make his/her decision. The relevance of the masking priming paradigm lies on the fact that a prime vanishes so rapidly that it is virtually impossible for the participant to consciously see it; instead, it is perceived unconsciously and might, therefore, affect the participant's recognition of the target (Forster, K., 2008).

Literature Review

Numerous studies about bilingual visual word recognition involving tachistoscopic tasks have been conducted. However, only a handful of them have included non-cognates as their stimuli (De Groot & Nas, 1991; Sanchez-Casas, Davis & García-Albea, 1992; Gollan, Forster & Frost, 1997). These studies agree that cognate primes trigger stronger facilitatory effects than non-cognate translation equivalents (Gollan, Forster & Frost, 1997). Furthermore, strong facilitatory effects caused by non-cognate translation primes have been found in cross-script priming (i.e. when the two languages do not share the same script, such as French and Greek) (Voga & Grainger, 2007).

Grainger and Frenck-Mestre (1998) conducted and experiment that comprises the most important precedent for this project. Their

research consisted of evaluating the effects of using French words to prime its non-cognate translation equivalents in English during a lexical decision and a semantic categorization task. The participants were native speakers of English who were highly proficient in French and had lived in France for several years. Their findings establish that at a duration of 43msec, French primes facilitate the category verification of their non-cognate translation equivalents in English during the semantic categorization task (SCT), but no facilitatory effect is observed during the lexical decision task (LDT). This provides evidence that the relationships between non-cognates in a bilingual individual's mental lexicon are semantically mediated (Grainger &Frenck-Mestre, 1998).

Method

Participants

Twenty students from the B.A. degree in English Philology from Universidad Nacional de Colombia participated in this project voluntarily. Ten of them were women and ten were men. They were enrolled in the last semester of their B.A. program (i.e. they had studied English as a foreign language for at least 3 and a half years) and had obtained a passing grade on the FCE (First Certificate in English), a test administered by the British Council, which certifies a high-intermediate level of proficiency in English. The average age of the participants was 23.85 (±2.70) years old. Before the experiment, they were asked to answer the Edinburg Handedness Inventory (Oldfield, 1971) in order to confirm their right-handedness. Additionally, they completed a small survey in which they attested that they had never lived in an English-speaking country and did not have a physical or psychological pathology that could interfere with the experiments.

Design

This project comprises two different experiments: one lexical decision task (LDT) and one semantic categorization task (SCT). Within each task, two different conditions were presented: 1) translation prime (i.e. prime:manzana / target:apple), and 2) unrelated prime (i.e. prime:pereza / target:apple).

Masked priming was used for the present experiments. Hence, each trial included a series of different stimuli, which appeared in black in the middle of a white screen. First, a mask made out of 14 number signs (#) was displayed during 500 msec. Second, after the mask disappeared, the prime in Spanish in lowercase took its place during 3 refresh cycles (49msec). Finally, the target in English appeared in uppercase and only vanished when the participant pressed a key. If the

subject did not answer, the software automatically administered the next trial after 7500msec. The font used for the stimuli was Arial 14pt.

Materials

Due to the methodological differences, the two experiments, lexical decision task (LDT) and semantic categorization task (SCT), will be discussed separately hereafter.

Lexical decision task (LDT).

100 non-cognate translation equivalents in Spanish and English were chosen for this task. Primes were always given in Spanish and targets in English. Both primes and targets were selected from lexical databases that held information about word frequency (i.e. the number of times a word appears per million words): N-Watch was used for English (Davis, 2005) and B-Pal for Spanish (Davis & Perea, 2005). The stimuli were chosen from the medium range of lexical frequency (10 to 100 times per million words). The words finally selected had an average frequency of 61.05 times per million (±30.31). All words had from 3 to 12 letters, on average 6.35 letters (±1.14).

For negative trials, the author of this project created 100 pseudowords in English. Each one of them was formed by changing one or two letters of a real word. These pseudowords were primed by 100 words in Spanish taken from the middle frequency range (10 to 100 times per million words) according to B-Pal (Davis & Perea, 2005). In total, 200 targets with their corresponding primes were used for this task.

Two lists of primes and targets were created: LIST A, in which the first 50 words in English were primed by their non-cognate translation equivalents, and the last 50 held unrelated primes; and LIST B, in which the first 50 words were primed by unrelated words in Spanish, and the last 50 held their non-cognate translation equivalents as their primes. Each participant was only exposed to one list of stimuli (either LIST A or LIST B) in order to counterbalance the experiment. Each list of stimuli was randomized when presented to the participant by using the DMDX software (Forster, J., 2002).

Semantic categorization task (SCT).

60 non-cognate translation equivalents in English and Spanish were selected for this task. Primes were always given in Spanish and targets in English. Both primes and targets were taken from lexical lists that compile the most popular items of several semantic categories, also known as category norms. The lists considered for this task were created in English by Van Overschelde, Rawson and Dunlosky (2004) and in Spanish by Pascual and Musitu (1980). 6 semantic categories

were tested separately: fruits, animals, clothing, insects, furniture and vegetables. The 20 most popular items of each category in English and Spanish were considered, and only 10 non-cognates were selected.

Since this task requires the participant to judge whether a particular word belongs to a semantic category or not, pseudowords were not necessary. Instead, 60 different words from other semantic categories (i.e. guns, flowers, etc.) were chosen for the negative trials. These 60 negative trial targets were primed by unrelated words in Spanish from other categories (i.e. precious stones, reading materials). As a result, each participant was exposed to 120 targets with their corresponding primes.

In order to counterbalance the experiment, each participant was exposed to only one of two different lists of stimuli: LIST A, in which the first 30 positive trial words in English were primed by its non-cognate translation equivalents, and the last 30 held an unrelated prime; and LIST B, in which, the first 30 positive trials were primed by an unrelated word in Spanish, and the last 30 held their non-cognate translation equivalents as their prime. The DMDX software was implemented to randomize each list of stimuli (Forster, J., 2002).

Equipment

One Dell desktop computer controlled the administration of the stimuli. It included a CRT screen with a vertical refresh rate of 60Hz and a screen refresh cycle of 16.66 msec. The software selected to administer the stimuli was DMDX (Forster, J., 2002).

Procedure

Lexical decision task (LDT).

Each participant was instructed to sit before a screen, which showed a white background. In the center of the screen, black words in uppercase appeared. Each time the participant saw a letter string, he/she had to decide whether it was a real word in English or not. If the word existed, the subject had to press "YES"; otherwise, he/she had to press "NO". After pressing one key, the process started again and repeated itself until 200 trials were completed.

Semantic categorization task (SCT).

In this task, the appearance of the screen and the position of the participants were similar to those in the LDT. However, during this task, each time the participant saw a word, he/she had to decide whether it belonged to a specific semantic category or not (i.e. animals). If the word pertained to the category, the subject had to press "YES";

otherwise, he/she had to press "NO". After pressing one key, a new word was administered, with its corresponding mask and prime, until 20 trials were completed. Then, a new category was presented with 20 new trials. 6 categories were tested, for a total of 120 trials.

Results

Lexical Decision Task (LDT)

Mean reaction times (RT) in milliseconds (msec) per experimental condition per participant were calculated after excluding outliners (RTs> 1500 msec, 0.7% of the data). These data are given in Table 1. Table 2 presents the percentage of errors per subject per condition. An ANOVA was performed on the data in order to establish whether significant statistical differences could be found between the two conditions: translation prime (i.e. manzana/ apple), and unrelated prime (i.e. pereza/ apple).

Table 1

Mean Reaction Times (msec) per Experimental Condition and Participant During the Lexical Decision Task

Participant	Translation	Unrelated
01	678	793
02	631	672
03	833	834
04	701	755
05	670	649
06	602	633
07	678	664
08	649	698
09	777	758
10	852	659
11	1071	918
12	927	860
13	662	677
14	574	548
15	554	558
16	571	589
17	612	604
18	836	849
19	812	925
20	565	608
Mean	713	713
Standard Deviation	±138	±117

Table 2

Percentage of Errors per Experimental Condition and Participant During the Lexical Decision Task

Participant	Translation	Unrelated
01	0.00%	4.08%
02	0.00%	2.04%
03	10.20%	6.12%
04	4.08%	6.12%
05	2.04%	2.04%
06	2.04%	0.00%
07	0.00%	2.04%
08	4.08%	4.08%
09	2.04%	0.00%
0	0.00%	4.08%
1	14.29%	18.37%
12	4.08%	4.08%
13	0.00%	0.00%
14	2.04%	0.00%
15	2.04%	2.04%
16	2.04%	2.04%
17	0.00%	4.08%
18	2.04%	0.00%
19	6.12%	2.04%
20	6.12%	0.00%
Mean	3.16%	3.16%
Standard Deviation	±3.71%	±4.11%

Reaction times during the lexical decision task show no significant differences between translation and unrelated prime conditions [$F(1.19) < 0.001$, $p<0.991$]. Percentages of errors do not differ significantly either within the two conditions [$F(1.19) < 0.001$, $p<0.999$].

Semantic Categorization Task (SCT)

Mean reaction times (RT) in milliseconds (msec) per experimental condition per participant were calculated after excluding outliers (RTs> 1500 msec, 0.6% of the data). These data are presented in table 3. Table 4 holds the percentage of errors per subject per condition. The data were submitted to an analysis of variance (ANOVA) in order to determine whether significant statistical differences could be found between the two conditions: translation prime (i.e. manzana/ apple), and unrelated prime (i.e. pereza/ apple).

Table 3
Mean Reaction Times (msec) per Experimental Condition and Participant During the Semantic Categorization Task

Participant	Translation	Unrelated
01	679	772
02	639	690
03	864	930
04	786	857
05	750	727
06	644	621
07	800	817
08	571	629
09	764	902
10	732	827
11	857	1074
12	700	1033
13	717	763
14	821	889
15	581	734
16	606	662
17	653	678
18	912	1092
19	787	1080
20	591	658
Mean	723	822
Standard Deviation	±101	±156

Table 4
Percentage of Errors per Experimental Condition and Participant During the Semantic Categorization Task

Participant	Translation	Unrelated
01	3.45%	6.90%
02	0.00%	0.00%
03	3.45%	10.34%
04	0.00%	6.90%
05	0.00%	13.79%
06	0.00%	0.00%
07	0.00%	0.00%
08	10.34%	6.90%

09	6.90%	6.90%
10	3.45%	17.24%
11	3.45%	17.24%
12	0.00%	6.90%
13	10.34%	6.90%
14	3.45%	0.00%
15	0.00%	3.45%
16	0.00%	3.45%
17	0.00%	6.90%
18	10.34%	3.45%
19	3.45%	0.00%
20	0.00%	3.45%
Mean	2.93%	6.03%
Standard Deviation	±3.76%	±5.35%

Reaction times during the semantic categorization task (SCT) show priming effects in the experimental condition, which means that the presence of non-cognate translation equivalents in Spanish as primes facilitate the categorization of its English counterparts. This facilitatory effect accelerates categorization processes about 99 msec on average. This effect is statistically significant [$F(1.19) = 21.703$, $p<0.001$]. Likewise, fewer errors were observed under the translation prime condition. This effect is also statistically significant [$F(1.19) = 5.147$, $p<0.035$].

Comparison of the Two Experiments

A summary of the mean reaction times (RT) in milliseconds (msec) obtained in both tasks is presented in Table 5. The same information appears graphically in Figure 1.

Table 5

Numeric Comparison of the Mean Reaction Times (msec) Observed During the Lexical Decision and the Semantic Categorization Tasks

Prime/ RTs (msec)	Lexical Decision Task	Semantic Categ. Task
Translation	713	723
Unrelated	713	822
Priming effect observed	0	99

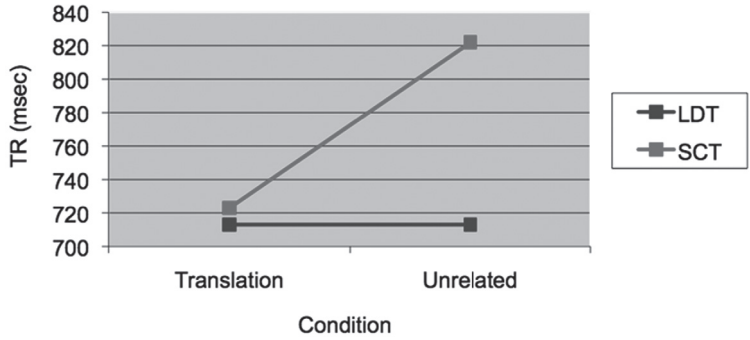

Figure 1. Graphic Comparison of the Mean Reaction Times (msec) Observed During the Lexical Decision and the Semantic Categorization Tasks

The previous data evidence the differences in reaction times obtained during the lexical decision task (LDT) and the semantic categorization task (SCT), as well as the priming effect absent in the LDT and observed in the SCT. Reaction time differences between tasks are statistically significant [$F(1.19) = 27.99$, $p<0.001$].

Discussion

The two experiments carried out in this project provide strong evidence that non-cognate translation equivalents in Spanish facilitate the visual word recognition of words in English during a semantic categorization task (SCT) carried out by Spanish-English bilinguals with a high-intermediate level of proficiency in their second language. However, the same type of priming stimuli used during a lexical decision task (LDT) elicit no significant priming effects.

These findings converge with those presented by Grainger and Frenck-Mestre (1998), who discovered that masked priming by non-cognate translation equivalents in French caused facilitation during semantic categorization tasks (SCT) in English performed by highly skilled English-French bilinguals. On the one hand, this implies that the priming effects obtained during their SCT can be extrapolated to other pairs of languages as the one studied in this project (Spanish-English). On the other hand, these findings demonstrate that cross-linguistic masked priming effects do not occur exclusively in highly proficient bilinguals since this project's participants were only high-intermediate level learners.

However, it should be noted that this experiment used primes in the participants' first language and targets in their second language, which is the opposite directionality to the experiment conducted by Grainger and Frenck-Mestre (1998). The L1-L2 directionality tested in this project might be accounted for the strong effect of facilitation during the SCT, which surpassed the one found by previous researchers.

This project's findings serve to corroborate the hypothesis that semantic representations mediate the associations between the words of the first and the second language in a bilingual mind (Grainger & Frenck-Mestre, 1998). This implies that the independent mental lexicons of each language are connected through meanings and not through form; in other words, bilinguals associate equivalent non-cognate words in their second language with the meanings of the words of their first language and not with their forms. For that reason, when participants are asked to make lexical decisions in a second language, their first language knowledge seems not to collaborate. In contrast, when subjects need to categorize items in semantic groups, they must refer to meaning; hence, their first language knowledge facilitates their choices.

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