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Confusions of suffixes in bilingual contexts. Effects of root and suffix substitution

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RESUMEN: Este estudio pretende observar cómo se almacenan las unidades morfológicas de las lenguas de las que dispone un hablante (sufijos, raíces, etc.), así como tratar de averiguar cómo esa organización se ve influida por el contexto lingüístico. Para ello se diseñó una tarea de decisión léxica en la cual se presentaban palabras inglesas como estímulos señal y palabras o pseudopalabras españolas como palabras test. Algunos estímulos españoles se mostraban en su versión intacta (IMPRESIONANTE), otros se modificaban mediante la sustitución de su sufijo habitual por el sufijo equivalente inglés (impressive - IMPRESIVO) mientras que otros sufrían una modificación en su raíz (waiter – GÜAITERO). Los participantes, hispanohablantes inmersos en el sistema educativo americano, debían decidir si estos estímulos eran palabras españolas, o no. Los resultados mostraron un mayor número de errores y unos mayors tiempos de reacción en la condición en la que se intercambiaban los sufijos con respecto a aquella en la que se modificaban las raíces. Estos datos parecen indicar hacia un almacenamiento común de los sufijos en el lexicón bilingüe.

Palabras clave: procesamiento léxico, efecto de inmersión, efecto de facilitación de los cognados, raíces, sufijos.

ABSTRACT: This study aimed to determine how morphological units (e.g., roots, suffixes) are stored in the bilingual mental lexicon and how this organization is influenced by the linguistic context in which a native speaker is immersed. Therefore, a lexical decision task was created in which some Spanish stimuli were presented as targets with English primes. Some of the Spanish stimuli were shown in an intact form (e.g., SEMEJANZA, IMPRESIONANTE), some were modified either at the root level (e.g., waiter-GÜAITERO) or at the suffix level (e.g., impressive-IMPRESIVO) thus creating non-words that looked like cognates. Participants had to decide whether the Spanish stimuli were words or not. The results show a significantly higher error rate and slower response latencies for stimuli that were modified at the suffix level than at the root level, which could be interpreted as evidence for the common storage of suffixes in the bilingual mental lexicon.

Keywords: lexical processing, immersion effect, cognate facilitation effect, roots, suffixes.

0. INTRODUCCIÓN

Current models of lexical access in production propose generally three levels (Caramazza, 1997). The first one is the semantic level, in which concepts are activated. The second one is the lexical level in which the word form with the highest level of activation, according to its correspondence with the meaning activated at the semantic level, is selected. Finally, the last step is the one going from this lexical node that has been selected to its phonological features in order to be pronounced.

Recognition models, on the other hand, show the inverse path (Marslen-Wilson, 1989). After being exposed to a visual or acoustic lexical input we access its formal features (orthographical or phonological). The following step is to extract a meaning from this sum of letters or sounds and,

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eventually, to look for a correspondent lexical entry in the mental lexicon. Summing up, both kinds of models show opposite directions of a similar process in three steps.

Theoretical linguistics, as well as descriptive grammar, proposes another level of lexical analysis. Not only is a word a string of letters or sounds with semantic content, but also a morphological construction. This explains why we can understand a pseudoword as acceptation (Meunier and Longtin, 2005, 2007), as we know the meaning of accept and *-tion*.

Therefore, some authors adapted this idea to psycholinguistics proposing the existence of a morphological level of processing for lexical units (Marslen-Wilson, Tyler, Walksler and Older, 1994; Taft y Forster, 1979; Taft, 1981; Longtin, Segui and Hallé, 2003; Rastle, Davis and New, 2004; Duñabeitia, Perea, Gutiérrez, Mena and Carreiras, 2007), postulating, therefore, a separated storage of stems and affixes. This idea, applied to lexical access models, would suggest the existence of an intermediate step in between the lexical level and the phonological one. Complex words would be decomposed into features, letters and morphemes, previous to the access to their semantic meaning and to the search for their match in the lexicon.

This proposal could be particularly relevant in the case of the bilingual mental lexicon, as one of the greatest questions in the field is about the common or separate storage of linguistic units in different languages. Are gato and dog stored together? Or, is there a Spanish list of words, independent from the English one? At the conceptual level we could intuitively give a positive answer to such a question, even though there is no absolute unanimity. A cat walking on a street is a cat in Madrid or in New York, and it doesn't make a difference if a speaker call it gato and the other one, cat. This idea is supported by the Revised Hierarchical Model (Kroll and Stewart, 1994) and some subsequent experiments have confirmed that the semantic relation between gato and dog is as strong as the one between cat and dog. Mitchel (2005) ran a mixed language associative list experiment. His results indicated that the false recognition rate for semantically related words was as high for words in the same language as for words from different languages. In a semantic priming paradigm, Schwanenflugel and Rey (1986) also demonstrated that the facilitation observed between semantically related words was not limited to one language and could be extended to words from different languages. We can't forget, anyway, that this general view has some weak points as, for example, the fact that the facilitation effect is stronger for concrete nouns than for abstract ones (Van Hell and de Groot, 1998).

At the lexical level, however, the problem gets harder. The concepts of cat and gato can be stored as one, but does that mean that both words are stored together at the lexical level? At this point, results are various and not always convergent, as it is difficult to separate purely lexical effects from semantic ones. A good example of such a question is Grainger's (1998) paper on translation priming. The author finds a significant priming effect of translation equivalents, but shows how this effect is modulated by the semantic categorization of the concepts.

A fructuous path in this sense is the opposition between translation equivalents and cognates, as the first ones only share semantic information and the latter are similar semantically as well as formally. This distinction allows us to look at translation priming effects from a different perspective. Facilitation for translation equivalents (*cat*/*gato*) could be solely based on semantic relatedness, whereas priming effects observed between cognates (*assistant*/*asistente*) would go beyond semantics and enter the lexical level of representation. As well, some work has been done on priming effects with false cognates (character/carácter; Lalor and Kirsner, 2001) whose main difference towards cognates is the lack of semantic bound. In sum, these three types of cross-linguistically related words could correspond to the monolingual regular lexico-semantic relations: purely semantic (pear/apple), lexical (Grainger and Ferrand, 1996) and lexico-semantic (Duñabeitia et al., 2007).

Although all these three forms of lexico-semantic relations show a priming effect, either intra- or inter-linguistically, cognates show significantly higher effects than translation equivalents. This cognate facilitation effect is particularly remarkable as it shows up in long-lag priming studies (Lalor and Kirsner, 2000) and in masked priming paradigms (deGroot and Nas, 1991; Gollan, Forster and Frost, 1997; Sánchez-Casa et al., 1992).

There are many possible interpretations of such an effect. Costa et al. (2000), for example, suggested that it was due to the retrieval of the phonological features of the target that receives the activation from the lexical nodes selected in both languages. Van Hell and de Groot (1998) gave an explanation based on the semantic similarities of the cognates in order to avoid the postulation of a non-specific language activation of the lexical layer. The third proposition was that this cognate facilitation effect might be due to the influence of morphology. Kirsner, Lalor and Hird (1993) proposed that the facilitation was due to the fact that cognates share the same stem, whereas non-cognates do not. Sánchez-Casas and García-Albea (2005) went further, proposing that the relation between cognates could be considered as the one existing between morphologically related words in a single language. Somehow, cognates would be part of a language non-specific morphological family.

As it happened in the monolingual scheme, where morphological priming showed stronger effects than orthographic priming or purely semantic priming (Duñabeitia et al., 2007, 2008, 2009), cognates show the same trend, pointing to a stronger facilitation when the shared features between prime and target are both semantic and lexical.

However, even the studies that give a morphological interpretation of the cognate facilitation effect consider it as a result of a shared stem, but no work has been done, to our knowledge, on the effects of suffixes. According to some authors, (Marslen-Wilson et al., 1994), stems and suffixes are stored separately and are assembled together according to morphological rules in the mental lexicon. But what happens with these rules and these suffixes in a bilingual lexicon? Are the words from both languages stored together as wholes, or as morphemes? Are both roots and suffixes in the same store? Are the rules used to assemble them common to the different languages available in the bilingual lexicon?

The goal of the experiment reported here was to determine whether the suffixes and roots of both languages are stored together or separately, but also to determine if the selection of the suffixes is language-dependent or not. Therefore, a lexical decision task was designed during which native Spanish speakers were shown an English prime (undeniable, impressive, etc.) and a Spanish target. Some of the targets were modified at the root level (real word: *innegable* – pseudoword: *indeniable*), creating a non-word that would appear similar to a cognate. Some targets were modified at the suffix level (impressive-real word: *impresionante* – pseudoword: *impresivo*) in order to create more nonword artificial cognates. Regular cognates (*human*/*humano*) as well as translation equivalents (*apple*/*manzana*) were also included as control conditions.

The main idea was that, if results showed a higher error rate (responding "word" to these nonword targets) when the modification was at the root level, the storage of the roots might not be language specific. The same assumption was made for suffixes. Also, if participants tended to commit errors when the modification was at the suffix level, it might mean that the selection of suffixes that match with the activated stem is not language specific.

It is especially relevant to mention that, for this experiment, we didn't test balanced bilinguals (Gass and Selinker, 2001). Our subjects were all proficient L2 English speakers who were immersed in an American educational context. Therefore, the assumptions we could make are not absolutely structural, but highly contextual. We can not predict what would happen for other types of bilinguals, or even for these same students, once they are back home, where they would be surroun-

ded again by speakers of their mother tongues. If an effect is found, it might be due to the immersion context (Lynck, Kroll and Sunderman, 2009; Levy, McVeigh, Marful and Anderson, 2007) and not to a deep bilingual structure of the lexicon.

1. METHOD

1.1. Participants. Twelve native Spanish speakers, students and faculty from Colby College (Maine-USA), were recruited. They received 10$ compensation for their participation.

1.2. Materials. A list of 120 English-Spanish pairs of stimuli was developed. The English stimuli were all real English words and were all used as primes for the lexical decision task. For the Spanish targets, we created five different groups of stimuli, thirty translation equivalents (*computer-ordenador*), thirty cognates (*lion–león*), thirty Spanish words that share their root with their English translation, but have a different suffix (*impressive–impresionante*), thirty words that share a suffix with their English translation but have a different root (*undeniable–innegable*) and thirty nonword fillers that did not share either root or suffix with the prime.

All the Spanish words that shared a root with their English translation, but had a different suffix (*impressive–impresionante*) had a modified version, where the suffix was modified in order to create a Spanish non-word that would look like an artificial cognate (e.g., *impressive–impresivo*). The Spanish words with the same suffix and different root as its English translations (*undeniable–innegable*) also had a modified version where their root was altered in order to create a Spanish nonword which would act as a cognate (*undeniable–indeniable*).

CONDITION	PRIME	TARGET INTACT	TARGET MODIFIED
1 cognate	secret	SECRETO	////
2 = root / ≠ suffix	acceptance	ACEPTACIÓN	* ACEPTANCIA
3 = suffix / ≠ suffix	attainable	ALCANZABLE	* ATAÑABLE
4 Tanslation equivalent	dog	PERRO	////

Figure 1: Description of the experimental stimuli

The intact and modified versions were counterbalanced across two scripts. Each script was made of thirty fillers, fifteen translation equivalents, fifteen cognates, thirty English-Spanish pairs that shared a suffix, half of them modified and the rest intact, thirty English-Spanish pairs with a shared root, half of them modified, half intact.

1.3. Procedure. Participants first completed a consent form. Afterwards, they were given instructions for the lexical decision task. They were shown a list of pairs of words: the first one was an English word in lower case, and the second one, a Spanish word in upper case. In order to avoid strategic translations from the prime to the target, we used a stimulus onset asynchrony (SOA) of 250 ms. As soon as the target appeared, they had to decide whether the Spanish stimulus was a word or not. If they considered the stimulus as a word, they had to press the L key on the keyboard. If they considered the stimulus as a nonword they had to press the A key.

Finally they were thanked and debriefed.

2. RESULTS

Looking at the error rates, the results show that participants made more errors on nonwords modified at the suffix level (*impresivo*) than at the root level (*güaitero*) and that re-

sponse times for nonwords with suffix modifications were higher than for nonwords with root modifications.

This finding is supported by the results of an analysis of variance (ANOVA) of the response times in which target type (word/non-word) and change type (suffix/root) were the two within-subjects factors.

Target type showed a significant effect, $F(1,11)=29.3$, $p<.001$, which reflects that response times for nonwords were significantly higher (M=1664.39) than response times for words (M=1254.83). There was also a marginally significant effect of change type, $F(1,11)=3.95$, $p<.072$, which shows that response times were higher for suffix modifications (M=1506.18) than root modifications (M=1413.04). The interaction between both factors was not significant, but nonwords showed an observable difference in response times between modifications at the suffix level (M=1730.93) and at the root level (M=1597.85).

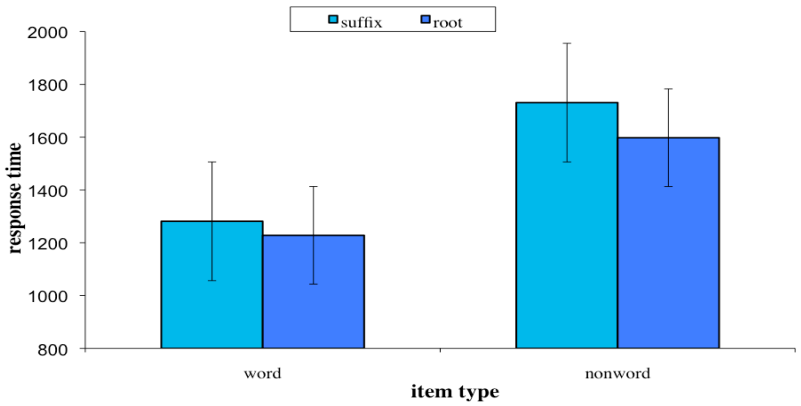

Figure 2: Response Time as a function of Item Type

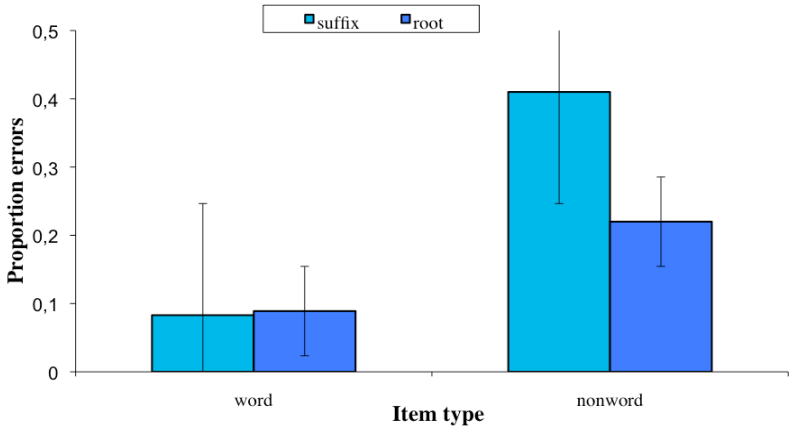

Figure 3: Proportion of Errors as a funtion of Item Type

In order to compare error rates, another analysis of variance was conducted, with the same within-subjects factors as for response times.

Target type yielded a significant effect, $F(1,11)=24.69$, $p<.001$, showing that the error rate for nonwords (M=.31) was significantly higher than for words (M=.09). The effect of change type was significant, $F(1,11)=13.67$, $p<.004$, which points that suffix modifications (M=.24) brought to a higher error rate than root modifications (M=.16). The interaction was also significant, $F(1,11)=5.96$, $p<.03$, which means that suffix modified nonwords (M=.41) had a higher error rate

than words which shared the same root but had a different suffix (M=.08) and that root modified nonwords had a higher error rate (M=.22) than words that shared the same suffix but had a different root (M=.09).

3. DISCUSSION

The so-called cognate facilitation effect has been interpreted in many ways. If cognates are processed faster than translation equivalents, it might be due to phonological similarities or to semantic similarities. However, another possibility was the one pointed out by Sánchez Casas and García Albea (2005), proposing that the effect could be explained as a convergence of both formal and semantic resemblances. In sum, cognates would be part of a language non-specific morphological family in which both *acceptance* and *aceptación* would be part of a common store, together with *accept*, *accepted* or *aceptaba*.

From a theoretical viewpoint, this idea could be a transposition of the monolingual effect of a stronger facilitation for semantically as well as lexically related words as opposed to solely semantically or lexically related ones.

The experiment presented here was designed as to answer two questions. First, is this cognate facilitation effect a whole-word effect or a morphological one? And second, is it based on a morphological relation at the root level, or/and at the suffix level?

Our results suggest that the phenomenon of the higher facilitation for root-related cognates than for suffix related ones, when these are nonwords and they don't have a memory trace of their own, might be due to the presence in both stimuli of a common root. This is particularly obvious as suffix related nonwords showed a particularly low proportion of errors, as compared to root-related ones. Our interpretation of these data is that the facilitation observed for cognates is based on the common stem, as the transposition of the correct suffix doesn't break the effect, whereas changes at the root level do.

However, we can think of a methodological problem. The stimuli used in our design were presented visually, which might be an alternative explanation for our results. The formal similarity between *acceptance* and *aceptancia* is transparent to anyone who sees both stimuli, whereas the relation between *waiter* and *güaitero* might be phonological, but not specifically visual. Therefore, the whole-word similarity explanation can not be definitely rejected and an auditory version of the experiment should be run. This argument might be even stronger if we reckon that the difference between root and suffix related stimuli in their word version is not even marginally significant either for reaction times or errors.

What could be argued here, however, is that if the effect is the same for words as *recognition-reconocimiento* than for *journalist-periodista*, it might mean that the facilitation is definitely morpheme-based and not word-based. This has been observed for monolingual experiments as Duñabeitia et al. (2008) who demonstrated that morphological priming is independent of the position of the common morphemes. There is as much priming for *darkness* on *happiness* as for *accepted* on *acceptance*, which confirms once again that facilitation effects between complex words occurs on a morphological basis and not as whole words representations. The experiment presented here shows the same effect, but applied, this time, to a bilingual paradigm.

Therefore, even though much more research has to be done on this question, we conclude as to confirm Sánchez Casas and García Albea's (2005) idea of a language non-specific morphological family where the common roots would be the center of it and the suffixes of both languages would be stored around it as to being assembled at any time it is needed. In sum, this comes to confirm the idea of a common morpho-lexical store in the bilingual lexicon.

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APPENDIX A: COMPLETE LIST OF STIMULI

COGNATES

bank	BANCO
lion	LEÓN
circle	CÍRCULO
coast	COSTA
information	INFORMACIÓN
park	PARQUE
chimney	CHIMENEA
double	DOBLE
minute	MINUTO
alarm	ALARMA
announce	ANUNCIAR
appetite	APETITO
meter	METRO
adult	ADULTO
cable	CABLE
animal	ANIMAL
color	COLOR
different	DIFERENTE
favorite	FAVORITO
active	ACTIVO
special	ESPECIAL
guide	GUÍA
complete	COMPLETO
adventure	AVENTURA
captain	CAPITÁN
secret	SECRETO
class	CLASE
distribute	DISTRIBUIR
center	CENTRO
contract	CONTRATO

TRANSLATION EQUIVALENTS

lover	AMANTE
trousers	PANTALONES
computer	ORDENADOR
water	AGUA
tale	CUENTO
blue	AZUL
song	CANCIÓN
window	VENTANA
friend	AMIGO
pen	BOLÍGRAFO
nail	UÑA
strawberry	FRESA
sheep	OVEJA
cloud	NUBE
dog	PERRO
shop	TIENDA
table	MESA
book	LIBRO
cat	GATO
wall	PARED
eye	OJO
apple	MANZANA
letter	CARTA

office	DESPACHO
house	CASA
yellow	AMARILLO
car	COCHE
hair	PELO
glass	VASO
smile	SONRISA

FILLERS

abject	ABJECTIANO
absoluteness	ABSOLUTANESIA
academically	ACADEMICALIA
according	ACUERDINGO
desk	DESCO
mix	MIXAMIENTO
delete	DELETIDO
account	ACUENTAMISIÓN
achieve	AQUIEVANAR
acknowledge	ANOLEGEVAR
lord	LORDO
yesterday	YESTREDÍA
pillow	PILORO
witness	VITENESO
woman	VOMA
voice	VOYECEO
voucher	VOCHECERO
waitress	VAITERESA
awaken	AVACONADO
usefulness	USAFULANESIA
luckily	LOCLIO
married	MARIDIANA
unpack	ONPACOLAR
upside	UPASIDIA
rehearsal	REJARSELANO
reminding	REMANDINGO
refusal	REFIUSALIA
pull	PULAR
push	PUCHEAR
payment	PAYAMIENTO

PAIRS WITH A SHARED ROOT IN BOTH ALTERED AND INTACT VERSION

	INTACT	**MODIFIED**
academician	ACADÉMICO	ACADEMICIO
acceptance	ACEPTACIÓN	ACEPTANCIA
trafficker	TRAFICANTE	TRAFICADOR
abandonment	ABANDONO	ABANDONAMIENTO
subconscious	SUBCONSCIENTE	SUBCONSCIOSO
disturbance	DISTURBIO	DISTURBANCIA
barbarian	BÁRBARO	BARBARIO
commander	COMANDANTE	COMANDADOR
voter	VOTANTE	VOTADOR
similarity	SIMILITUD	SIMILARIDAD
pictorial	PICTÓRICO	PICTORIAL
atributable	ATRIBUIBLE	ATRIBUABLE
technician	TÉCNICO	TECNICIANO
pensioner	PENSIONISTA	PENSIONADOR

enthusiastic	ENTUSIASTA	ENTUSIÁSTICO
surrealistic	SURREALISTA	SURREALÍSTICO
laxative	LAXANTE	LAXATIVO
admiral	ALMIRANTE	ALMIRAL
scientist	CIENTÍFICO	CIENTISTA
assignment	ASIGNACIÓN	ASIGNAMENTO
criticism	CRÍTICA	CRITICISMO
egotism	EGOÍSMO	EGOTISMO
brilliance	BRILLANTEZ	BRILLANCIA
sustenance	SUSTENTO	SUSTENANCIA
impressive	IMPRESIONANTE	IMPRESIVO
adornment	ADORNO	ADORNAMENTO
juror	JURADO	JURADOR
conservative	CONSERVADOR	CONSERVATIVO
augmentation	AUMENTO	AUMENTACIÓN
accordance	ACUERDO	ACORDANCIA

PAIRS WITH A SHARED SUFFIX IN BOTH ALTERED AND INTACT VERSION

	INTACT	**MODIFIED**
baker	PANADERO	BACADERO
journalist	PERIODISTA	JORNALISTA
amusement	DIVERTIMENTO	AMUSAMENTO
inhabitant	HABITANTE	INHABITANTE
indeniable	INNEGABLE	INDENEGABLE
waiter	CAMARERO	GÜAITERO
tanker	PETROLERO	TANQUERO
ressemblance	SEMEJANZA	RESEMBLANZA
advantageous	VENTAJOSO	AVENTAJOSO
juncture	COYUNTURA	JUNTURA
attainable	ALCANZABLE	ATAÑABLE
budgetary	PRESUPUESTARIO	BUDGETARIO
arguable	DISCUTIBLE	ARGÜIBLE
reliable	FIABLE	RELAÍBLE
believable	CREÍBLE	BELIBLE
surgeon	CIRUJANO	SURJANO
butcher	CARNICERO	BUCHERO
lighter	ENCENDEDOR	LITADOR
messenger	MENSAJERO	MESENJERO
benediction	BENDICIÓN	BENEDICCIÓN
smoker	FUMADOR	ESMOQUEADOR
desperation	DESESPERACIÓN	DESPERACIÓN
suspicious	SOSPECHOSO	SUSPICIOSO
assumption	SUPOSICIÓN	ASUMICIÓN
seasonal	ESTACIONAL	SESONAL
desirable	DESEABLE	DESAIRABLE
miraculous	MILAGROSO	MIRACULOSO
bilingualism	BILINGÜISMO	BILINGUALISMO
location	UBICACIÓN	LOCACIÓN
logger	LEÑADOR	LOGADOR